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University of Edinburgh (Great Britain)

THE BURN ILLNESS — THE SO-CALLED "STAGE OF TOXEMIA"

A. B. WALLACE

Symposia are invaluable in bringing together workers of several disciplines to attack a particular problem and recent advances should be submitted. At the same time I believe work of previous generations of investigators should be recalled since many observations were astute and fundamental. Speaking personally, I myself am often sustained, refreshed and stimulated by perusal of the older literature, and it is history that I shall stress. For many years the greatest dangers from burning were considered to be from shock, toxaemia from infection, and from wasting or inanition. First, consider the sequelae resultant from thermal damage.

Following a burn injury, water associated with serum protein (especially albumin) and electrocyte accumulates in the area and oedema results. Potassium is released from injured erythrocytes and from cells in the affected area while sodium enters the injured cells.

The local changes lead to an extensive shift of body water and substances in solution with reduction of water, sodium and serum proteins in other parts of the body.

Early work on burn physiology demonstrated that in the plasma-loss the smaller albumin molecules migrated more easily than the globulin and that this could lead to reversal of the albumin-globulin ratio. This decrease in the albumin-globulin ratio could, however also be due in part to an outpouring of new additional globulin into the circulation. Between the fifth and sixth days the albumin levels reach a minimum but the total serum proteins starts to increase about the sixth day by the increase of globulin components, especially gamma and alpha-2 globulins. So far no relationship has been determined between gamma globulin level and septicaemia though in some cases the level is abnormally low.

Arzt and Reiss (1958) divide the first thirty days after burning into three phases.

In the first two or three days there is a considerable loss of potassium and seems excessive. The concept, however, of potassium as a burn toxin is not well supported.

In extensive deep burns there is considerable red cell destruction with increase of haemoglobin pigment in the plasma. In normal circumstances the

kidneys can deal with such an increase but when associated with a posterior pituitary antidiuretic stimulus and the poor renal blood flow of severe burns, damage to the renal tubules is a distinct possibility.

Following prolonged hypotension, intestinal bacteria may invade the body and their toxins may be absorbed. There is no doubt that in shock the resistance of the patient to infection is lowered. In summary, the first phase in the burn illness is characterised by burn shock. In severe cases there may be severe pulmonary oedema and hypoalbuminaemia with a steadily decreasing blood pressure and increasing oliguria. In this phase autopsy specimens show intravascular red cell aggregation, stasis, oedema and haemorrhage in may organs.

In the second phase of the burn illness, from the second to the eighth day after the burn, further changes in the body fluids may occur, but one must always recall that normal protective mechanisms are so disturbed or at times destroyed that infection is a great danger. Autopsy findings may, however, be completely negative, indicating a possible biochemical death, but on the other hand there may be seen degeneration in certain organs, e.g. liver cell damage and haemoglobinuric nephrosis. In other words, in this second phase an intoxication is, on occasion, indicated by degeneration of the cells of parenchymatous organs.

As a student interested in surgical paediatrics I often read the texbook "Surgery of Childhood", written by John Fraser (1926).

In the chapter on burns and scalds he remarked that usually on or about the fourth day the alarming features of toxaemia became apparent and that experimental and clinical evidence supported the view that absorption of toxic products from burnt tissue was the causative factor. Fraser quoted Bodilean's experiments where rabbit limbs were burnt to varying degrees and the stage of toxaemia developed as in humans but he was able to prevent the occurrence if he either excised the area of the burn or ligatured the blood vessels which supplied the damaged part. Fraser also stated that a destruction of red cells had been described and paid tribute to Robertson's work in Toronto with the method of exsanguination and blood transfusion following, where possible, an excision of the burnt area and skin grafting. It seems strange that this outstanding pioneer's experimental and clinical work of 1923 still remains somewhat experimental and it is, I think, not inappropriate to quote from the preface of James Syme's "Principles of Surgery", published in 1846 — "A surgeon who practises according to rule and without the guidance of sound principles, is like the mariner of old who, devoid of compass and quadrant, crept along the shore, afraid to lose sight of land, and in constant dread of being driven upon the rocks, or blown out to sea". Today we still seek points of guidance. Even one hundred and ten years later the burns problem is confused, mainly from failure to appreciate the nature of a burn wound, both its three dimensions and that it is a dynamic continuing lesion with a continuing local and general response (Moore 1959).

TOXAEMIA OF BURNS

The concept of acute toxaemia probably arose from the work of Ardakoff who found in 1876 that the blood of a burnt animal was toxic to other animals.

As described by Sewitt (1957) there are four groups of evidence:

1. Injection of blood or serum of burnt animals produces, in normal animals, severe illness or death.

2. Injection of extracts of burnt skin or the injection of burnt exudate or vesicle fluid into normal animals, produces toxic or lethal effects.

3. In cross circulation experiments when one animal is burnt the unburnt animal also develop a severe illness.

4. Exclusion of the burnt part from the general circulation or early excision of the area prevents a fatal outcome.

Recent work of Foederov and Skurkovich (1955) indicates that the body is flooded with antigens from the burnt area and that these may be responsible for the burn illness.

Serum and blood from convalescent dogs had clear beneficial influences on burnt dogs, the peripheral circulation improved, the blood volume returned towards normal, renal output increased, the survival time was prolonged and mortality rate decreased.

This approach is promising and has been followed by very detailed and illuminating studies in your school in Prague.

To return however to the historical approach to burn toxaemia, Wilson, Macgregor and Stewart (1938) divided the course of burns into five stages.

1. Initial shock (0—2 hours after burn)
2. Secondary shock (2—48 hours after burn)
3. Acute toxaemia (6—100 hours after burn)
4. Septic toxaemia (after about 100 hours following burn)
5. Healing

It is to this so-called toxaemic phase that attention will be directed. Function tests of parenchymatous organs and autopsy studies indicate the remote effects of a burn injury and support the concept of a specific burn toxin.

Wilson's third stage included cases of severe febrile or other untoward conditions that occur either (a) before forty-eight hours in patients in whom there is not enough fluid loss or other evidences to account for them; or (b) after forty-eight hours and hence too late for them to be due to secondary shock. Wilson favoured the view that acute toxaemia was caused by the action of a specific toxin of non-bacterial origin which had been absorbed from the burnt area, and believed that infection did not exert much influence until the second week. Aldrich (1933), however, considered the stage of sepsis could begin as early as twenty-four hours after the burn. Wilson (1938) found the characteristic pathological lesion to be severe degeneration and necrosis of liver cells. Buis and Hartmann (1941) suggested that these findings might in part be caused by the anoxaemia from shock, plasma loss, haemoconcentration and acute congestion.

Clinicians in the 1925—1935 period (a period in which I was a student) described the picture of acute toxaemia as that of a very ill patient often with normal blood pressure. Vomiting was often present. Mental symptoms included both restlessness and drowsiness, while jerking movements of the limbs and trunk sometimes occurred. The restlessness on occasion merged into delirium,

stupor and, finally, coma. Epileptiform convulsions have been described. It is possible that some cases of tetanus reported are nothing but such convulsions. The mental disturbances usually appeared before any serious failure of the circulation. In severe cases, hyperpyrexia was a characteristic feature during this phase and sometimes was persistent and progressive. The fact that the elevation was steady rather than septic in type supported a metabolic or toxic cause rather than a bacterial one.

Circulatory failure sometimes occurred in this stage unaccompanied by haemoconcentration and after too long a time interval to be due to shock. The pulse became progressively more rapid and feeble, the skin of the trunk and limbs became pale or mottled and cold. The cold skin contrasted strikingly with the high rectal temperature.

The toxic theory has been in the forefront as an explanation for the cause of shock and resultant death for many years. A myriad of substances have in turn been advanced as the toxic factor in burns with varying degrees of supporting experimental and clinical evidence.

Cumin (1823) believed death to be due to internal inflammation and Dupuytren (1832) attributed death to excess of pain. Ardakoff (1876) first reported that the blood of a burnt animal was toxic to healthy animals. Wilms (1901) concluded from clinical observations that the action of heat on the skin gives rise to split protein products that are partly exuded from the surface and partly absorbed. Parascandolo (1904), in early experimental work on rabbits, held that death was due to a circulating poison which acted on the liver and on the kidneys and that blood of burnt animals was toxic when injected into other animals. Pfeiffer (1905), in animal experimentation, reported that deaths after six hours were caused by decomposition products of burnt protein. Robertson and Boyd (1923) reported that blood from burnt animals injected into other animals produced toxic symptoms identical to those in burnt animals, and that autopsy findings were similar. Their findings, however, were not confirmed by Underhill and Kapsinow (1931), who challenged the adequacy of controls done. Many Japanese investigators have favoured the toxic theory. Willis (1925) found that experimentally burnt animals showed characteristic changes in the intestines, adrenals and kidneys and that when the injured area was excised these changes did not occur. Ravdin and Ferguson (1925) supported the toxic theory while Davidson (1925—1927) introduced tannic acid to precipitate toxins. The experiments of Rosenthal (1937) supported the toxic theory. Lewis (1927) has suggested that injured tissue liberates histamine or histamine-like substances. Barsonin and Gaddum (1936) reported a rise in blood histamine in burnt patients reaching a peak of five times normal seven days after the burn. Kisima (1938) also supported the histamine theory. Aldrich (1938) considered bacterial infection to be the main cause of burn illness. Harkins (1942) stated that the question of production of burn toxins was probably bound up with the problems of tissue autolysis in general. Beloff and Peters (1944) showed that a proteinase may be liberated from rat's skin by burning and suggest that such an enzyme might be in some way responsible for blister formation. It is possible too that liberated enzymes may act as "burn toxins" when absorbed and cause a general toxaemia.

Although estimations of extent of burnt areas are now more accurate there is still a failure of appreciation of burn in depth; in other words three-dimensional damage. As pointed out by Peters (1945) there are at least two different zones: zone I, that of complete heat-coagulation; and zone II of partial heat damage. In respect to possible burn toxins zone II is the potentially dangerous area because undamaged cellular elements (e.g. enzymes), can pass into the circulation. Skin proteins may well act as toxins in the circulation. In zone I, the temperature of the causal agent coagulates and fixes the protein and can destroy enzymes. In zone II, however, active enzymes can leave the cells. Haemoconcentration from fluid loss into the burnt tissue is accompanied by a hyperglycaemia and lactic acidaemia, while the liver loses the power to synthesize glycogen from glucose.

As Moyer (1962) so aptly says, the primary aim in all therapeutic measures is to do no further harm to burnt tissues. Yet over the years the clinical progress of the burnt patient following treatment is often the picture of intoxication from absorption of local applications to the injured surface. Consideration of the response to various medicaments over the years is revealing. In other words, the form of treatment given was often the basic cause of the burn illness and this must be considered even today. With this in view Moyer suggests that the treatment of burns can best be studied over two periods, one before 1868, that is before Listerism and the other after. Though this in some ways seems convenient, one must be clear in the first place as to what Listerism is. In his own words, Lister defined his principles as — "the systematic employment of some antiseptic substance so as to prevent the occurrence of putrefaction as distinguished from the mere use of such as an agent or dressing."

However, even before the discovery of bacteria by Pasteur attempts were made to control putrefaction. For instance in 1835 aqua phagoedemical (a mixture of mercuric chloride and lime water) was applied to burnt surfaces. About 1830 attempts were made to exclude air by the application of tr. benz. co. and, later, in 1858, the employment of a mixture of castor oil and collodion.

A different approach, the employment of wet dressings, was recommended in 1835 by Lisfranc. He used a solution of sodium and calcium chlorides. In 1850, in Falkirk (Scotland) with the famous iron works, linimentium aquae calcis, or carron oil (a saturated solution of calcium hydroxide in linseed oil) was introduced and remains in use in some quarters.

In 1845 the theory was advanced that heat must be drawn out of the burn and for this immersion in cold baths was introduced. About 1829 the concept arose that the burnt area must be fed and so food stuffs, e.g. flour, was applied.

An entirely different approach to limit putrefaction of the burn illness was the introduction to Britain between 1827 and 1831 from America of the dry cotton wool dressing. James Syme, of Edinburgh, popularised the method and later Gamgee of Birmingham. Gamgee combined the dressing with pressure.

In the post-Lister period the dry dressing were discarded and cotton dressings impregnated with antiseptics took their place with grievous results. Looking back, the clinical course of the patient was often the picture of local damage and general intoxication from wet applications to the injured surfaces.

Around 1867 a 14 per cent solution of phenol in olive oil was recommended and in 1876 soaks of saturated boracic acid. In both procedures local damage was increased and toxic absorption common. Iodoform was tried in 1887 and picric acid in 1901 and, in more recent years, the sulphonamides. In all procedures cases of poisoning were reported.

Tannic acid was reintroduced in 1925 and was widely employed but in 1942 was discovered to have considerable toxic effects from impurities especially on the liver.

Since the Second World War the fear of mass burn casualties from an atomic war has led to many suggestions for an efficient quick dressing of an occlusive nature but again there is danger. Moyer wisely recalls Edenbuizen's (1863) experiments which demonstrated that mammals cannot be covered over more than 30 per cent of the body's surface with materials impervious to fluid, such as gum arabic or linseed oil, without endangering life. Skin plays an important part in the maintenance of body temperature and must be given freedom of action. But it also confers life-saving protection from invading microorganisms and from excessive loss of fluid-containing electrolyte and colloid. The burn illness can arise from the many facets of disturbances of the normal protective properties of skin.

Many surgeons are aware of a dramatic clinical improvement in a patient following early excision of eschar. Whether this is due to removal of sources of fluid imbalance and of autolytic or bacterial intoxication has to be proved.

Nevertheless, there is still a promising field in early excision and in extensive burns for the employment of synthetic skin provided this skin is elaborated to conform to the natural properties of skin. Not only will it complete wound closure but it will limit infection and loss of fluid with sodium and nitrogen and at the same time aid in temperature control.

The cause of the phase of toxaemia is still complex. Since skin is complex in origin, in structure and in properties, the burn toxaemia problem is of necessity difficult to solve.

The solution lies still in (a) removing sources of poison in the wound; (b) in immediate or early wound closure and (c) the possible elaboration of an antitoxin.

SUMMARY

Symposia are invaluable in bringing together workers of several disciplines to attack a particular problem. Recent advances are submitted but at the same time work of previous generations of surgeons should be recalled. Many of their observations were astute and fundamental and I myself am often refreshed and stimulated by perusal of the older literature.

The term toxaemia has been used rather loosely in relation to the chronological course of burns. The chronological course is described and the theories on the toxaemia of burns elaborated. Consideration is given to the response over the years to various treatments, paying particular attention to the pre-Listerian and post-Listerian periods.

Undoubtedly the phase of toxaemia is still by no means simple. Since skin is complex in origin, in structure and in properties, the burn problem is of necessity difficult to solve.

RÉSUMÉ

La maladie des brûlures — la période toxique

A. B. Wallace

La valeur inestimable des symposia consiste dans le fait qu'ils réunissent les spécialistes des disciplines différentes pour résoudre ensemble certains problèmes. Ce temps dernier, des succès importants ont été obtenus, mais il ne faut pas oublier le travail des générations de chirurgiciens qui nous ont précédés. Beaucoup de leurs observations ont été très pénétrantes et d'une importance fondamentale. L'auteur avoue que la lecture de la littérature ancienne l'inspire souvent à des travaux nouveaux.

Le terme «toxémie» a été employé de façon différente par rapport au développement chronologique de la maladie des brûlures. L'ordre chronologique des théories diverses, relatives à la toxémie des brûlés est décrit.

On attire l'attention sur la réponse de l'organisme sur des traitements différents, au cours des années, en insistant spécialement sur les dites époques pré-Listerienne et post-Listerienne. La période de la toxémie est sans aucun doute extrêmement compliquée. Si l'on tient compte du fait que le derme lui-même représente un ensemble très complexe quant à ses origines, sa composition et ses qualités, il en résulte que la solution du problème de brûlures doit nécéssairement présenter beaucoup de difficultés.

ZUSAMMENFASSUNG

Das toxische Stadium der Verbrennungskrankheit

A. B. Wallace

Die ausserordentliche Bedeutung von Symposien besteht darin, dass sie Fachleute der verschiedensten Gebiete bei der Lösung bestimmter Probleme vereinigen. In der letzten Zeit waren viele Erfolge zu verzeichnen, es ist hier jedoch auch der Arbeit früherer chirurgischer Generationen zu gedenken. Viele ihrer Beobachtungen waren äusserst scharfsinnig und besassen grundsätzliche Bedeutung. Der Verfasser gesteht gern ein, dass er gerade bei der Lektüre der alten Literatur oft Erholung und Anregungen für neue Arbeit findet.

Der Termin „Toxämie" wurde bisher in verschiedenem Zusammenhang mit dem chronologischen Verlauf der Verbrennungskrankheit benützt. Es wird die chronologische Entwicklung verschiedener Theorien über die Toxämie bei Patienten mit Verbrennungen geschildert.

Der Verfasser berichtet ferner über die Reaktion des Organismus auf die im Verlaufe der Jahre verwendeten verschiedenen Behandlungsarten, wobei eine vor-Listersche und eine nach-Listersche Periode unterschieden werden. Das Stadium der Toxämie ist zweifellos äusserst kompliziert. Mit Rücksicht darauf, dass die Haut an und für sich inbezug auf Herkunft, Zusammensetzung und Eigenschaften komplex ist, muss die Lösung des Problems der Verbrennungen notgedrungen sehr schwierig sein.

RESUMEN

Quemaduras — período de toxicidad

A. B. Wallace

El gran papel de los congresos científicos consiste en el hecho de que éstos asocian a los especialistas de varios ramos para resolver ciertos problemas. En los últimos tiempos se han alcanzado muchos éxitos pero hay que recordar de las generaciones

quirúrgicas anteriores. Un gran número de sus observaciones han sido muy perspicaces y del significado esencial. El autor confiesa y admite que con frecuencia la literatura vieja estimula su iniciativa a empezar nuevo trabajo.

El término „toxemia" se usaba en varias relaciones con el transcurso cronológico de la enfermedad causada por las quemaduras. En este trabajo se describe el transcurso cronológico de varias teorías acerca de la toxaemia en los quemados.

Se dedica atención a la reacción del organismo en el transcurso de los años hacia varios tipos del tratamiento tomando en consideración especial el llamado período de pre-Lister y post-Lister. El período de la toxemia, sin luego, es muy complicado. En vista del hecho de que la piel de por sí es compleja en su origen, composición y propiedades, la solución de la cuestión de las quemaduras es indudablemente muy difícil.

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(A. B. Wallace, M. Sc.): 23 Mortonhall Road, Edinburgh 9, Great Britain

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Pathology Department, Birmingham Accident Hospital, Birmingham (England)

BACTERIAL INVASION AFTER EXTENSIVE BURNS

S. SEVITT

Toxaemia of burns, that is clinical and pathological effects due to toxic substances entering the body from the burned skin, is an old concept dating back to about 1870 (see Sevitt 1957). After a prolonged period of popularity the concept lost ground mainly because developments in knowledge helped to explain various clinical and pathological phenomena and rendered the theory unnecessary. Thus, for example, the leading role of burn exudation in causing oligaemia and the circulatory disorder of shock became clarified and led to fluid therapy; various biochemical and metabolic disturbances after burning involving electrolytes, nitrogen and carbohydrate do not require a toxin for their understanding; renal failure, lymphoid degeneration, changes in the adrenal glands and so on are better understood. Further, bacteriological studies have shown that the burned skin frequently and rapidly becomes heavily contaminated with a variety of bacteria including *Staphylococcus aureus,* haemolytic streptococci, *Pseudomonas pyocyanea, Bacterium coli,* other coliform bacilli and other pathogenic or facultatively pathogenic bacteria as well as various saprophytes.

The act of burning sterilizes the skin; its antibacterial properties are lost whilst burn exudate and slough are good if rather selective culture media (Colebrook, Lowbury and Hurst 1960). Thus bacteria contaminating the burn either from the patient himself or from his environment, grow quickly on the skin surface to form large numbers of *micro-colonies* each containing vast numbers of organisms. Self or cross-contamination may begin within a few hours of burning and within a few days or even 24 hours numerous bacteria are often present. Contamination can only be demonstrated by bacterial culture but colonization can be demonstrated histologically in skin sections using a modification of the Gram-stain (Twort-Gram stain modified) to distinguish between Gram positive and Gram negative organisms. Fig. 1 shows colonization by Gram positive cocci *(Staph. aureus)* of part of a burn in a patient who died 2 to 3 days after injury.

Local invasion of the upper dermis has begun. In Fig. 2 the groups of lighter staining organisms are Gram negative bacilli (coliform bacilli on culture) which have begun to invade the upper dermis. Fig. 3a shows colonization and invasion of the burned dermis by Gram positive cocci (dark stained) and Gram negative bacilli (lighter stained) in a patient who died from septicaemia and bronchopneumonia (Fig. 3b) 3 weeks after burning. Entry to the blood stream,

that is bacteraemia, is probably quite frequent and repeatedly occurring through lymphatic spread or by entry into small venules. Fig. 4 illustrates how this may happen: the wall of a small blood vessel in burned skin contains a group of Gram negative bacilli which had spread to the vessel through dermal invasion.

The purpose of this paper is to show that the results of bacterial invasion have become the main causes of death of burned patients receiving modern fluid therapy; and to illustrate some of the pathological and bacteriological processes. In the past, deaths from infection were less common than they are today but this is because many patients who previously would have died early from the complications of oligaemia (burn shock) now survive 1 to 2 weeks or longer only to succumb to infection. If non-bacterial toxaemia does exist (and it is not certainly proven) it is overshadowed by the frequent and dangerous consequences of bacterial infection and invasion.

PRESENT STUDY

This report is based on a clinico-pathological (including bacteriological) analysis of the causes of death of burned patients who died in the Burns Unit of the Birmingham Accident Hospital over a 5½ year period (1958—1963) and who reached necropsy, a total of 121 patients. The necropsy rate was over 70%. Tab. 1 shows that the majority of the subjects (61%) had burns involving more than 30% of the body area and that in about one-third more than 50% of the body area was burned. Most of the burned area was fullthickness skin loss in the great majority of subjects. Most of those (60%) with burns of less than 30% body area were elderly.

Causes of Death

The various factors found causing or contributing to death are outlined in Tab. 2. These are divided into pre-existing natural disease (in 17 patients, mainly elderly), non-bacterial complications (72) and various bacterial complications (108). The non-bacterial complications are relatively numerous but do not concern us here except that they are not infrequent in those who also develop septicaemia or bronchopneumonia. A total of 197 known factors or complications caused or contributed to the death of the 121 subjects, an average of 1.56 per

Tab. 1. Burns necropsies 1958—1963. Birmingham Accident Hospital

Age in years	% body area burned					Total
	< 15%	15%—30%	31%—50%	51%—70%	> 70%	
< 10	0	5	14	10	6	35
10—20	0	1	3	6	2	12
21—60	5	8	8	6	1	28
> 60	15	13	11	4	3	46
All ages	20	27	36	26	12	121

Male 40 — Female 81

Tab. 2. Natural disease and post-burn complications causing or contributing to death of 121 burned patients

		Totals
Natural disease		17 patients
	Carcinoma (2), coronary occlusion (5), Cerebral infarction (5), hypertension (3), Cerebral tumour (1), other (1)	
Non-bacterial complications		72 complications
	Early shock and/or cardiac failure 12	
	Respiratory 19	
	(carbon-monoxide 1, inhalation of smoke 2, glottic oedema 1, obstructive tracheo-bronchitis 2, blast injury to the lung 1, congestive atelectasis 8, pulmonary oedema 2, inhalation of vomit 2)	
	Cardiac	
	(Toxic myocarditis 1, cardiac arrest 4) . . 5	
	Renal failure 24	
	Hypokalaemia 4	
	Pulmonary embolism 4	
	Hepatic jaundice 2	
	Acute dilatation of the stomach 2	
Bacterial complications		108 complications
	Septicaemia 45	
	Bronchopneumonia 45	
	Pyelonephritis 12	
	Peritonitis 2	
	Meningitis 1	
	Gas-gangrene 1	
	Entero-colitis 2	
		197
	Average per fatal case	1.56

death. This is probably an underestimate and death is not infrequently a complex of 2 or more causes. In 43 cases (35.5%) the causes of death seemed unrelated to bacterial infection but in 78 subjects (64.5%) the cause was mainly or entirely bacterial (Tab. 3). Among them septicaemia and/or bronchopneumonia were dominant.

Even among those dying with septicaemia or bronchopneumonia other factors or complications are often contributory (Tab. 4). Among the 45 subjects with septicaemia there were 43 other causes, the most frequent of which were bronchopneumonia (15 subjects), renal failure (7 subjects) and acute pyelonephritis (5 subjects). Some of the complications listed were probably manifestations of septicaemia, like cardiac arrest, paralytic ileus and meningitis. Moreover *some* of the cases of renal failure may be due to bacterial infection (septicaemia) since extensive necrosis of proximal tubules is not uncommon in septicaemic patients. Among 30 subjects dying with bronchopneumonia without

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septicaemia there were 12 other causes including 4 with serious pre-existing disease and 4 with renal failure.

The frequency of septicaemia or bronchopneumonia is related to survival period and increases considerably during the first week of survival (Tab. 5). None of the 13 subjects succumbing within a day of burning died of these causes; the combined frequency between 1 and 3 days after burning was as high as 37.5%; it rose to 65% among those dying between 4 and 7 days, to 73% among

Tab. 3. Frequency of bacterial and non-bacterial causes of death among 121 fatal cases of burns

Cause(s) of death	Number (%) of cases
Non-bacterial	43 (35.5%)
Bacterial	78 (64.5%)
Septicaemia	45
Bronchopneumonia	30
Other	3

those dying during the second week, and to 81% among those surviving more than 2 weeks. The progressive increases in the incidence of septicaemia and bronchopneumonia during the first 2 weeks after burning are separately shown; it is noteworthy that the rising frequencies are more or less parallel from 19% after the first day to about 50% at the and of 2 weeks or thereafter. Deaths from these infections occurred in spite of the use of various antibiotics locally or systemically. (A minority of patients with septicaemia recovered and did not reach the present analysis). Antibiotics are regularly used in Birmingham: those employed in different cases were penicillin, chloramphenicol, tetracyclines, erythromycin, kannamycin, polymyxin, colomycin, methicillin, claxocillin and fucidin often in special combinations according to the bacterial flora of the burn and the results of blood culture.

Bacteriology

The bacteria causing the fatal septicaemia are shown in Tab. 6 and 7. The results are based on cultures of blood, skin exudate or slough and urine during life, on cultures of the splenic pulp at necropsy supplemented by Gram-staining of skin and tissue. Bacterial data were sufficient in 39 of the septicaemic cases. *Pseudomonas pyocyanea, Staphylococcus aureus* and various coliform bacilli were the most frequent body invaders but strains of *Proteus* and faecal streptococci were occasionally present. In one unusual case, aspergillus invasion of the lung was diagnosed histologically and was associated with heavy colonization of the burned skin by fungi (Fig. 16, 17). The absence of haemolytic streptococci, formerly a common and dangerous invader in burned patients is striking; and this is attributed to the use of antibiotics powerful against these species and their relative inability to develop resistance. All the strains of staphylococci were resistant to penicillin and often to other antibiotics and were undoubtedly

Tab. 4. Fatal septicaemia and bronchopneumonia after burning. The frequency of other complications and pre-existing disease contributing to death

Pre-existing disease or other complications contributing to death	Main causes of death	
	Septicaemia (45 cases)	Bronchopneumonia (30 cases)
Pre-existing disease	0	4
Bronchopneumonia	15	—
Lung abscess	0	2
Renal failure	7	4
Pyelonephritis	5	2
Meningitis	1	0
Cardiac arrest	2	0
Paralytic ileus	1	0
Pulmonary atelectasis	3	0
Hypokalaemia	2	0
Pulmonary embolism	2	0
Other complications	5	0
Total other causes	43	12

acquired in hospital through cross-infection. Cross-infection rather than self-infection is the dominant means of infection of extensive burns treated in hospital and is a major problem.

Pseudomonas pyocyaneus has emerged as the most important invader in the Burns Unit in Birmingham and elsewhere having replaced haemolytic streptococci. This is in spite of the use of polymixin and latterly colomycin prophylactically or therapeutically.

A single bacterial species was found responsible in 18 septicaemia cases whilst 2 or more species were cultured either on the one occasion or at successive times in 20 others (Tab. 7). In 11 of the former *Ps. pyocyanea* was (or seemed to be) the only invader and in 16 of the latter this organism was associated with or was preceded by invasion by *Staph. aureus,* coliform bacilli or both. Pyocyanea invasion is often the later phase of a septicameia in which other organisms, especially staphylococci, have previously been cultured and which have then been suppressed by effective antibiotics (methicillin, claxocillin, kannamycin). In this sense many of the pyocyanea-invasions are superinfections.

Septicaemia

The diagnosis of septicaemia from the macroscopic appearance at necropsy is not easy in many cases but this is also often true for septicaemia not due to burns. Gross lesions like pyaemic abscesses or septic infarction of the lungs, kidney and spleen are commonly absent whilst the splenic pulp may be firm and uniformly dark red, not showing the classical pale diffluent appearance. The

diagnosis must then be arrived at by a combined assessment of the clinical symptoms and signs (general illness, pyrexia, possibly hyperpyrexial attacks, tachycardia), leucocytosis, bacteriological findings during life especially positive bloodcultures, bacteriology of the spleen and other organs at necropsy (taking precautions to sterilize the surface by searing with a hot spatula) and histological evidence of internal bacterial invasion. The latter has not been sufficiently emphasized. The findings are influenced by the species of invading bacteria. Leucopenia and hypothermia may occur in pseudomonad-septicaemia especially in the terminal phase. Septicaemia by *staphylococcus aureus* often produces a diffluent splenic pulp whilst this is generally absent when invasion is by Gram negative bacilli including *Bacterium coli* and *Ps. pyocyanea.* This is because a considerable polymorphonuclear leucocytosis is produced by invading staphylococci whilst this is less prominent, less frequent and occasionally absent with pyocyaneus invasion. In some cases with *Ps. pyocyanea* infection of the burn, red nodular foci develop in the unburned skin and break down to form circumscribed ulcers (ecthymatous lesions) (Fig. 10): these are probably a manifestation of septicaemia although skin implantation of bacteria is also a possibility.

In a minority of cases the internal bacterial spread is manifest by small septic infarcts in the lungs, by multiple renal abscesses and rarely by acute bacterial endocarditis or meningitis.

Fig 5a and 5b show a septic thrombus in the centre of a lung infarct in a man of 47 years who died 9 days after 55% burns; the cause of death was septicaemia (*staph. aureus* + *Ps. pyocyanea*) and renal failure. Parts of the burns were green from pyocyanin. The thrombus (possibly an embolus) is densely infiltrated with polymorphs (Fig. 5a) and the Gram preparation shows the presence of colonies of Gram positive cocci (Fig. 5b).

Acute bacterial endocarditis is rare. Fig. 6a to c illustrate a case. A girl of 15 years died 12 days after burns involving 60% of the body area. Blood cultures during life grew *staphylococcus aureus* and *Ps. pyocyanea* but necropsy showed gross evidence of pyaemia and bacterial endocarditis from staphylococci. The vegetations on the mitral valve showed very numerous Gram positive cocci

Tab. 5. Frequency of septicaemia and bronchopneumonia in fatal burned patients related to survival period

Survival period	All cases	No. cases with septicaemia (%)	No. cases with pneumonia (%)	No. with septicaemia and/or pneumonia (%)
< 1 day	13	0 (0%)	0 (0%)	0 (0%)
1—3 days	16	3 (19%)	3 (19%)	6 (37.5%)
4—7 days	23	6 (26%)	11 (48%)	15 (65%)
8—14 days	26	14 (54%)	12 (46%)	19 (73%)
> 14 days	43	22 (51%)	19 (44%)	35 (81%)
Totals	121	45 (37%)	45 (37%)	75 (62%)

(Fig. 6a) and similar organisms were seen histologically in myocardial abscesses (Fig. 6b) and in renal abscesses (Fig. 6c).

Cases are more numerous in which the evidence of septicaemia is less obvious, particularly when the septicaemic invasion has been with Gram negative bacilli. Gram-staining of routine sections of internal organs especially the lungs, kidneys and spleen, can be rewarding. Fig. 7a to c illustrate findings in a girl of 22 years who died 2 days after 58% burns. Renal failure had occurred and at

Tab. 6. Bacteriology of fatal septicaemia after burning among 39 cases (1958—1963)

	No. of cases (%)
Pseudomonas pyocyanea	27 (69%)
Staphylococcus aureus	15 (38%)
Coliform Bacilli	19 (48%)
Proteus	2+
Faecal streptococci	3+
Aspergillus	1
Total	67+

necropsy spleen culture gave a moderately heavy growth of *Bacterium coli.* Gram negative bacilli had already colonized the burned skin (Fig. 7a); occasional glomeruli were densely colonized by similar organisms (Fig. 7b) and discrete microcolonies of Gram negative bacilli were seen in the splenic pulp (Fig. 7e) and elsewhere. Postmortem growth probably increased their number but there is little doubt of the antemortem invasion of the body. In other subjects microcolonies of Gram negative bacilli are found in alveolar exudate in the lungs even in the absence of pneumonic exudate (Fig. 8) or in the interstitial tissue of the kidneys as part of a pyelonephritic process (Fig. 9).

Pseudomonas pyocyanea invasion

This organism though only a facultative-pathogen, can cause dangerous disease especially in patients with impaired resistance and is especially liable to attack those with extensive burns. Like haemolytic streptococci, it interferes with the taking of skin grafts and delays the healing of burns; and through invasion it can cause septicaemia, bronchopneumonia, cystitis and pyelonephritis in burned patients (Jackson, Lowbury and Topley 1951, Leidberg et al 1954, Korloff 1956, Artz and Teschan 1957, Sevitt 1957, Markley et al 1957, Chinese workers 1959, Cason and Lowbury 1960, Rabin, Graber et al 1961). The danger of pseudomonad invasion of large burns is worldwide and is indicated by these reports from Britain, the U.S.A., Canada, Scandinavia, China and Peru. Septicaemia by staphylococci or other organisms may first occur and then be succeeded by pyocyanea-invasion especially when antibiotic therapy against the Gram positive cocci has been effective. The burn sometimes develops patches of black necrosis and occasionally ecthymatous lesions develop in unburned skin (Fig. 10). Necropsy sometimes reveals infarct-like nodules in the lungs or

kidneys and occasionally elsewhere including the heart or intestine. Histologically, these are essentially necrotic foci, often haemorrhagic and generally infiltrated with myriads of Gram negative bacilli. The blood vessels are of special interest: their walls are often teeming with bacteria and are generally necrotic; vascular thrombosis may or may not be present. The association of these lesions with *Ps. pyocyanea* was described years ago by Fraenkel (1906, 1917) and have been noted in burns by Rabin et al. (1961). Similar changes may be found in the

Tab. 7. Bacteriology of fatal septicaemia after burning. Single and mixed invasion among 39 cases (1959—1963)

Bacterial invasion by one species	18 cases
Pseudomonas pyocyanea	11
Staphylococcus aureus	2
Coliform Bacilli	5
Mixed bacterial invasion	20 cases
Ps. pyocyanea + staph. aureus	6
Ps. pyocyanea + staph. aureus + coliform	4
Ps. pyocyanea + coliform	6
Staph. aureus + coliform	3
Coliform + Proteus	1
Fungal infections (aspergillus)	1 case

blood vessels of burned skin colonized by *Ps. pyocyanea* and in the dermal vessels of the lesions in unburned skin. Leucocytes are few or absent in the affected blood vessel wall.

Some of these changes are illustrated in Fig. 11 to 15. Fig. 11a shows heavy invasion with Gram negative bacilli of the burned skin a child of 3 years who died 22 days after 80% burns from septicaemia (*Ps. pyocyanea, Klebsiella* and an other coliform bacillus isolated by blood culture); and the blood vessels of the dermis were extensively invaded by similar organisms which formed a bacterial ring around the contained blood (Fig. 11b). Unburned skin showed an ecthymatous lesion and the spleen culture produced a scanty growth of *Ps. pyocyanea.* This child had been intensively treated by a combination of claxocillin (orbenin), kannamycin and colomycin given systemically. In another child with pyocyanea-septicaemia (4½ years, 38% burns, surviving 25 days) the burned dermis and subdermal fat also showed necrotic vessels (Fig. 12a) which were outlined by large numbers of Gram negative bacilli (Fig. 12b). The ecthymatous lesion of unburned skin (Fig. 13a, b) shows vesiculation and necrosis of the epidermis which was free of bacteria, necrosis of the dermis and deep dermal vessels with necrotic walls containing myriads of Gram negative bacilli (Fig. 13b).

Examples of vascular changes in internal lesions in other cases of pyocyanea-septicaemia are shown in Fig. 14 and 15. Fig. 14 is from an infarct-like nodule in the lung of a child of 2 years who died of septicaemia 16 days after

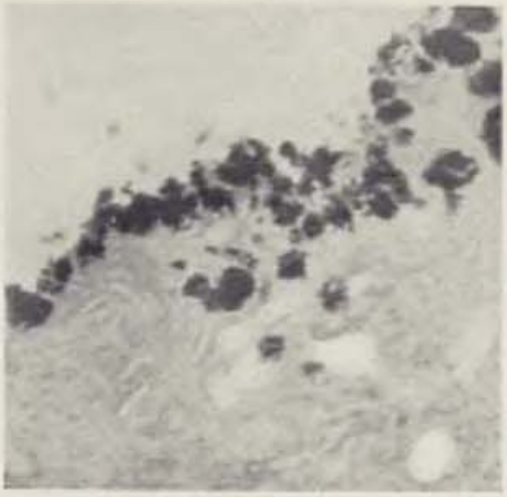

Fig. 1.

Fig. 2.

Fig. 1. Burned skin surface colonized by Gram positive cocci which are invading upper dermis. (Gram-Twort × 400.) — Fig. 2. Burned skin colonized by Gram negative bacilli invading upper dermis. (Gram-Twort × 400.)

Fig. 3a.

Fig. 3b.

Fig. 3a. Burned skin colonized by Gram positive cocci (darker staining) and Gram negative bacilli (lighter stained). (Gram-Twort × 100.) — Fig. 3b. Lung, bronchopneumonia. (Haematoxylin and Eosin × 100.)

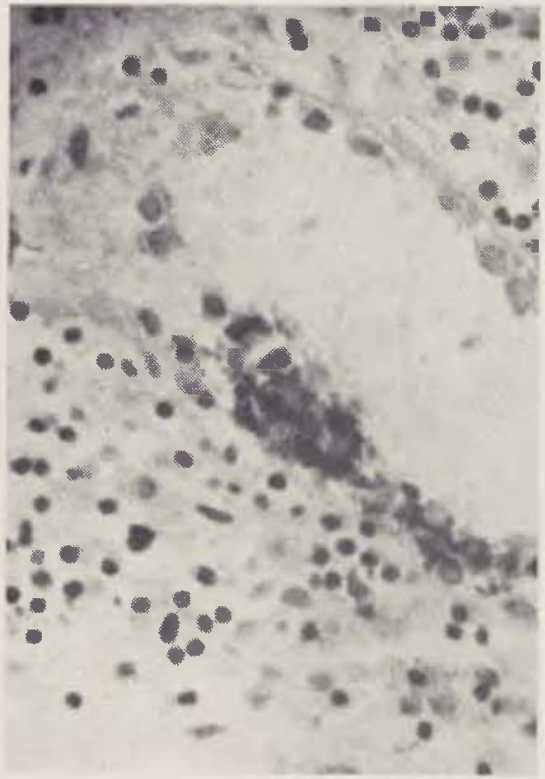

Fig. 4.

Fig. 4. Blood vessel in burned skin showing numbers of Gram negative bacilli in part of its wall. (Gram-Twort × × 400.)

Fig. 5a, b. Septic thrombus in a lung infarct. Showing numerous polymorphs (5a) and groups of Gram positive cocci (5b). (5a, H and E × 100; 5b, Gram-Twort × 100.)

Fig. 5a.

Fig. 5b.

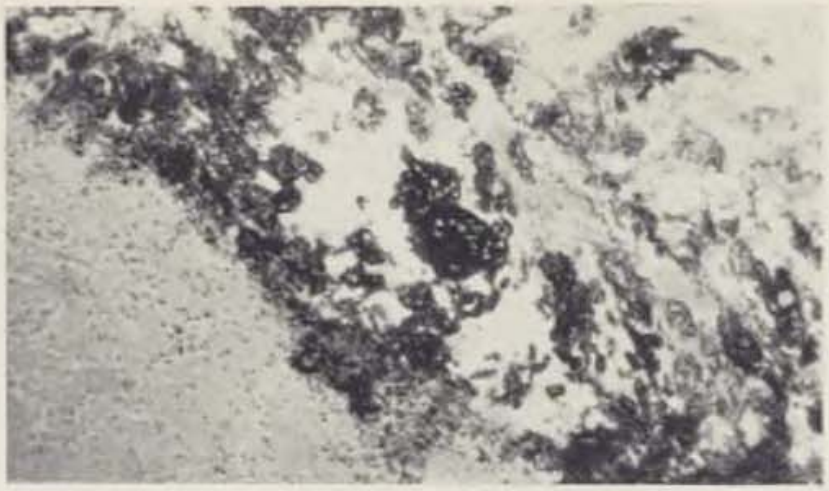

Fig. 6a.

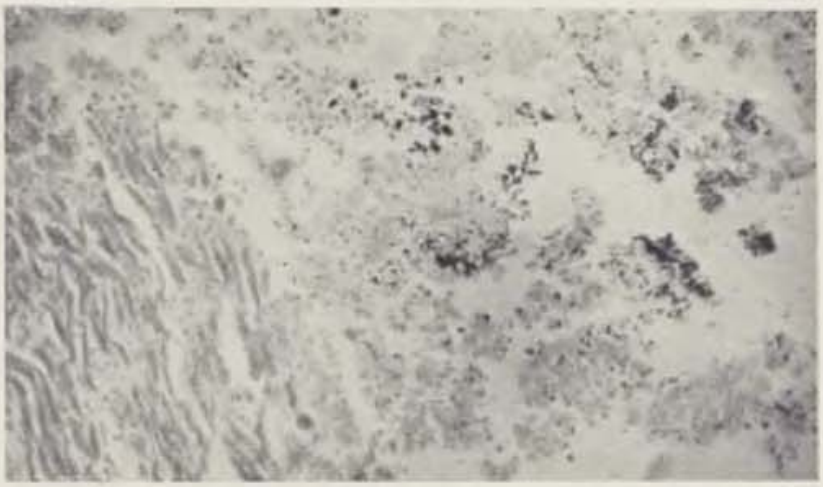

Fig. 6b.

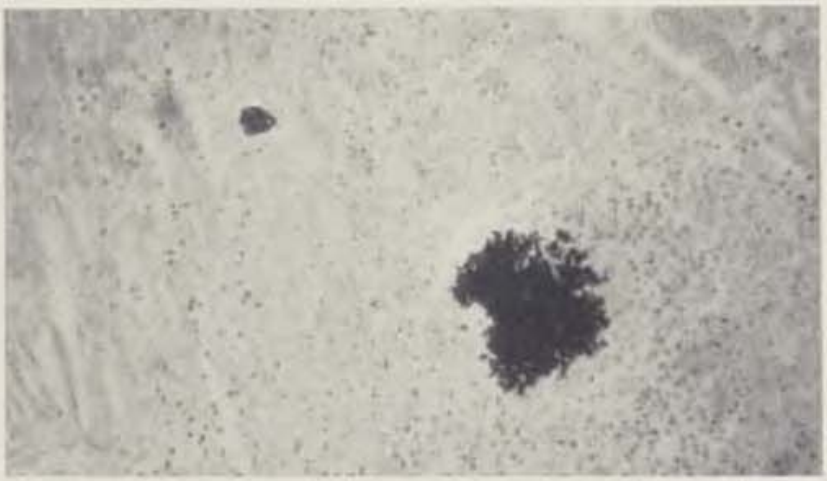

Fig. 6c.

Fig. 6a to c. Acute bacterial endocarditis *(staphylococcus aureus)*. Enormous numbers of Gram positive cocci in the mitral valve vegetation (6a). Gram positive cocci in abscess of myocardium (6b) and kidney (6c). (Gram-Twort × 100.)

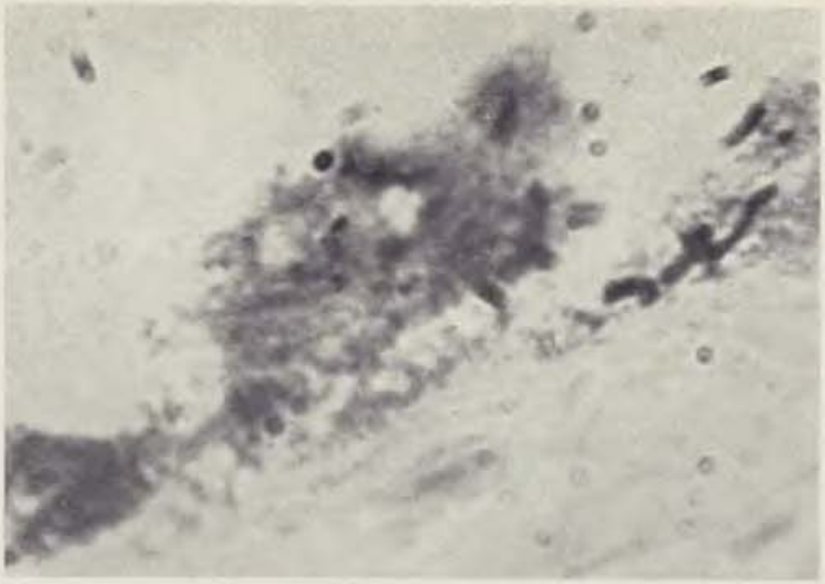

Fig. 7a.

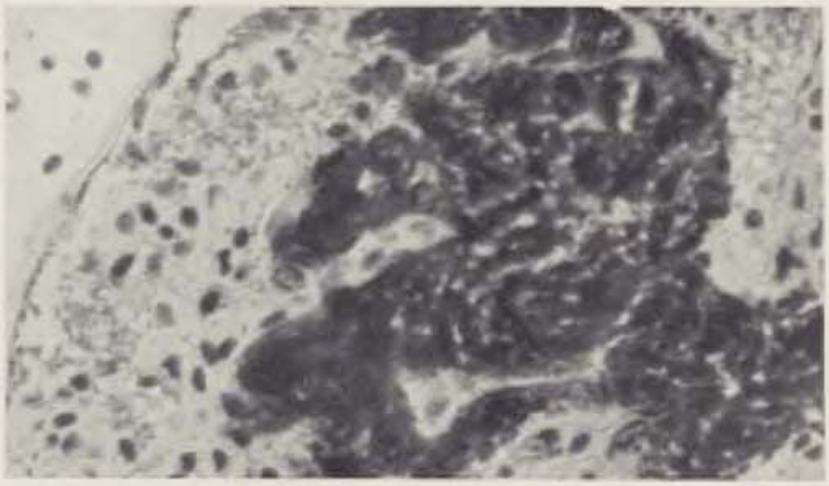

Fig. 7b.

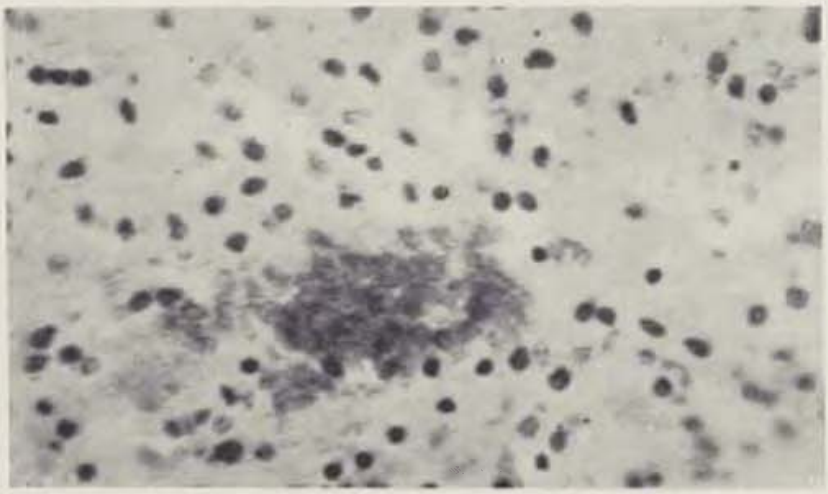

Fig. 7c.

Fig. 7a to c. *Bact. coli* septicaemia. 7a, Gram negative bacilli colonizing the burned skin. 7b, colonization of a glomerular tuft. 7c, colony of bacilli in the splenic pulp. (Gram-Twort 7a × 900; 7b and c × 400.)

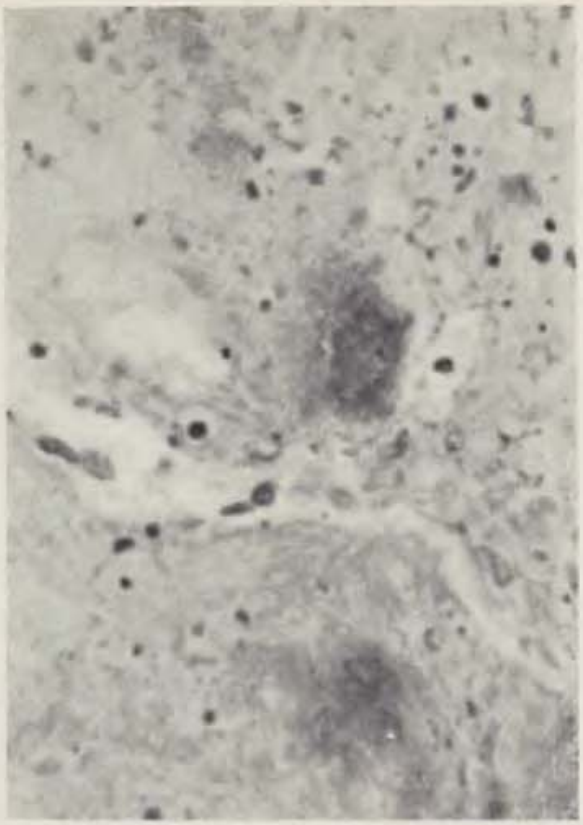

Fig. 8. Lung. Micro-colonies of Gram negative bacilli in alveolar exudate. (Gram-Twort × 400.)

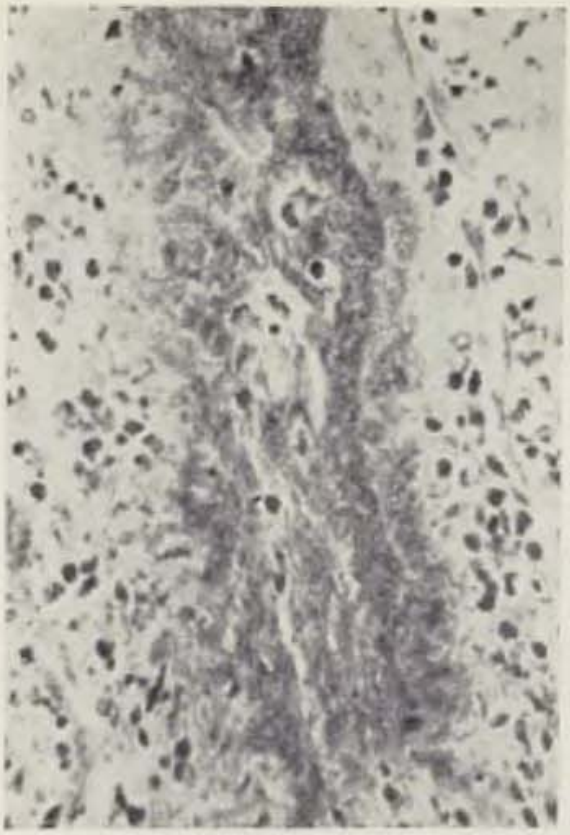

Fig. 9. Kidney. Growth of Gram negative bacilli in interstitial tissue and tubular exudate. (Gram-Twort × 400.)

Fig. 10. Early ecthymatous lesion in unburned skin due *Ps. pyocyanea* (see Fig. 13a, 13b).

Fig. 11a.

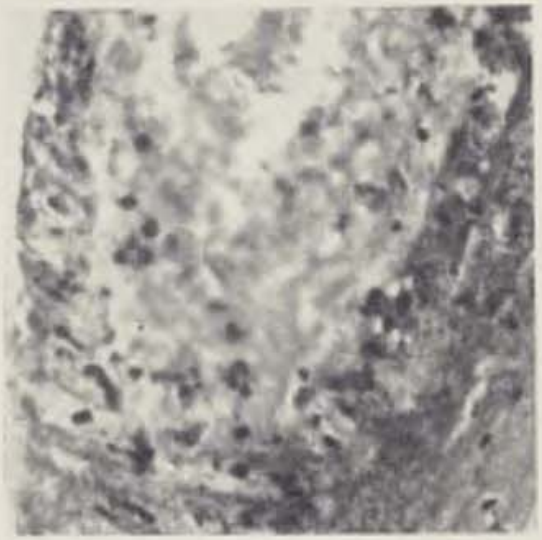

Fig. 11b.

Fig. 11a, b. Burned skin infected with *Ps. pyocyanea*. Numerous Gram negative bacilli in the upper dermis (11a) and in the wall of a dermal blood vessel (11b). (Gram-Twort 11a × 900; 11b × 400.)

Fig. 12a.

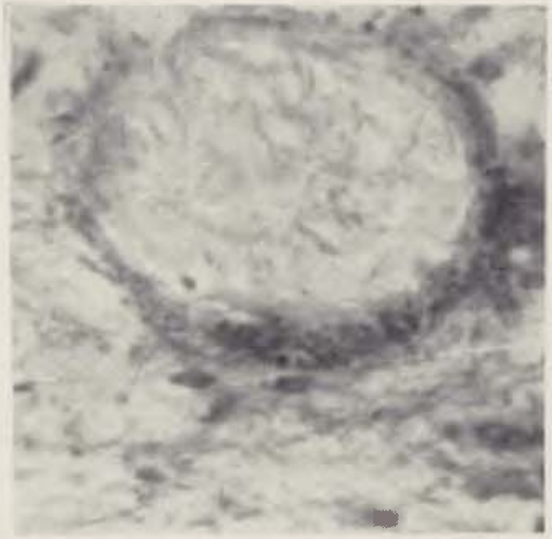

Fig. 12b.

Fig. 12a, b. Burned skin infected with *Ps. pyocyanea*. Subdermis showing necrosis of small vessels (12a). Small vessel with numerous Gram negative bacilli in the wall (12b). (12a, H and E × 40; 12b, Gram-Twort × 900.)

Fig. 13a.

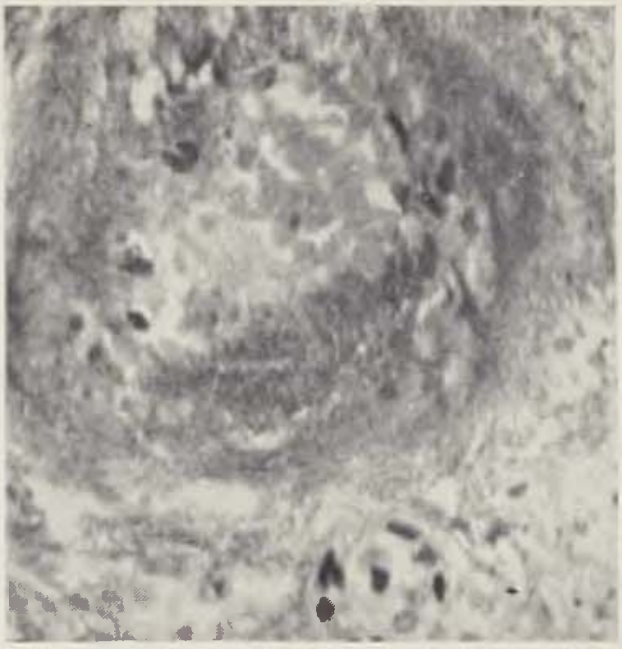

Fig. 13b.

Fig. 13a, b. Pseudomonad-ecthymatous lesion in unburned skin. 13a shows vesiculated epidermis and necrotic dermis with a necrotic blood vessel (lower third). 13b is a higher view of that vessel showing its wall densely infiltrated by bacilli. (13a, H and E × 40; 13b, H and E × 400.)

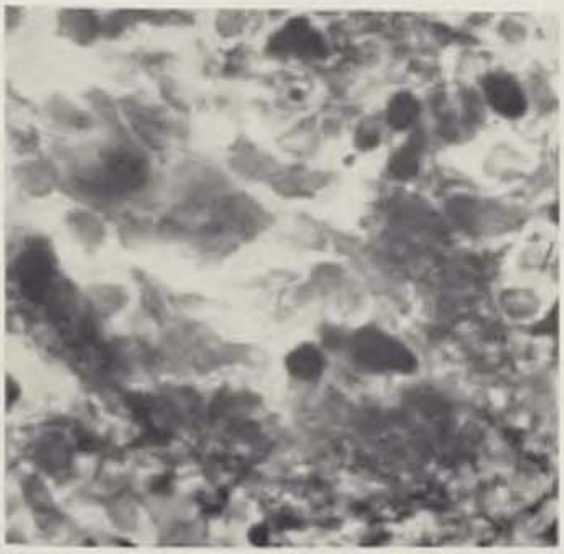

Fig. 14. Lung, pseudomonad infarct-like nodule. Small vessel densely infiltrated with Gram negative bacilli. (Gram-Twort × 900.)

Fig. 15. Kidney, pseudomonad infarction. Vessel wall densely outlined by Gram negative rods. (Gram-Twort × 100.)

Fig. 16.

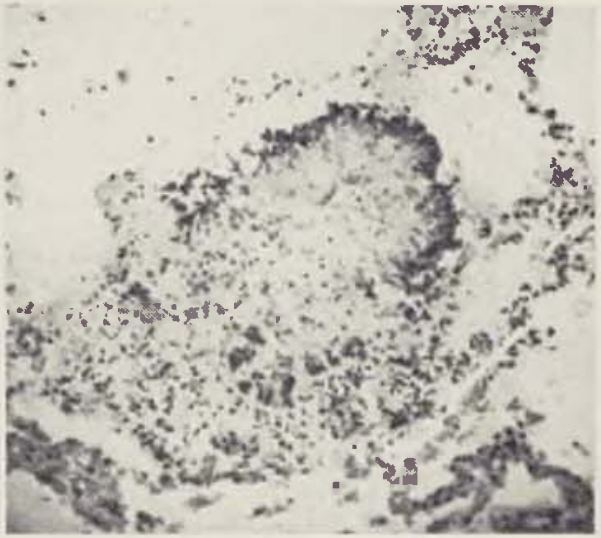

Fig. 17.

Fig. 16. Burned skin heavily colonized by a felted mass of fungal mycelium (Periodic acid — Schiff X 100).

Fig. 17. Lung nodule with colony of aspergillus (H and E X 100).

Fig. 18.

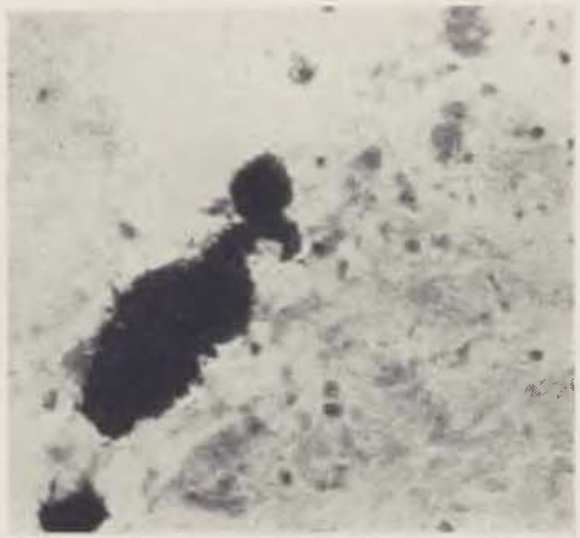

Fig. 19.

Fig. 18. Acute duodenal ulcer after burning. Floor of ulcer invaded by yeast mycelium (lighter stained), and spores (darker stained (Gram-Twort X 400).

Fig. 19. Acute duodenal ulcer after burning. Floor of ulcer with colonies of Gram positive cocci (dark) and Gram negative bacilli (lighter stained). (Gram-Twort X 400.)

burns involving 25% of the body area: vessels in the haemorrhagic-necrotic focus were teeming with Gram negative bacilli. Fig. 15 shows a vessel in a septic infarct of the kidney: the vessel wall in the Gram preparation stands out prominently because of its invasion with Gram negative bacilli. This was from a child of 3 years who died 10 days after 50% burns. Blood culture had grown *Ps. pyocyanea* but acute hypokalaemia (serum potassium 2.8 mEq. per litre) also contributed to death.

Tab. 8. Acute duodenal ulcers after burning. Colonization by micro-organisms seen histologically

No. of ulcers examined	14
No. colonized	8 (57%)
Yeast-forms (monilia) . . .	4
Gram-negative bacilli . . .	5
Gram positive cocci . . .	2

(In 2 ulcers a mixed flora seen; Gram positive cocci and Gram negative bacilli in 1; yeasts, Gram positive cocci and Gram negative bacilli in other).

The vascular lesions associated with *Ps. pyocyanea*-infection are of considerable interest. The selective invasion of the wall and subsequent growth of organism within it, are not accompanied by a cellular response. Thrombosis is not essential and is probably a secondary event. Direct invasion of the vessel wall from without or from the blood stream must occur; but the possibility that the blood vessels are first "sensitized" by a product of the organism or selectively absorb antibody to the organism and that wall-invasion by bacteria is a later response, has to be considered. Indirect evidence of this is suggested by a study in progress of ecthymatous lesions since few if any vessels are involved in early foci. Whatever the mechanism of vascular invasion it is clear that the result enhances the possibility of bacteraemia and septicaemia by *Ps. pyocyanea.*

How does pseudomonas produce its ill effects. The blue-green pigment pyocyanin, frequently stains the exudate from burns colonized by this species. Pyocyanin has been found to produce toxic effects when applied to skin in culture in concentrations estimated to be of the order of those found in a stained dressing (Cruickshank and Lowbury 1953). Release of bacterial endotoxins may be important particularly for circulatory collapse and there is some evidence that the slime fraction of the bacillus rather than the bacterial cell is the toxic factor (Liu, Abe and Bates 1961). It is even possible that massive destruction of bacteria by selective antibiotics may hasten collapse and death through a sudden release of bacterial endotoxin. That *Ps. pyocyanea* produces cyanide *in vitro* has been known for many years and this *in vivo* possibility also needs to be explored.

Fungi and yeasts

Like other patients treated with broad spectrum antibiotics some burned patients (particularly children) develop moniliasis of the mouth, pharynx and alimentary tract and the latter may occasionally cause or contribute to death.

Infection of the burned tissues by yeasts and fungi seems to be uncommon or at least rarely reported but 2 cases of fatal *cancrum oris* due to mucormycosis in burned patients have been reported by Rabin, Lundberg and Mitchell (1961). The present series revealed 1 case of disseminated aspergillus infection of the lungs associated with fungal colonization of the skin (Fig. 16 and 17). The patient was a man of 68 years who died 20 days after 35% burns. Clinically the cause of death was thought to be septicaemia; fungal infection was not suspected and was only revealed by histological examination. The fungus in the miliary necrotic foci in the lung is thought to be aspergillus because of its septation and pattern of branching, although it is probably not *A. fumigatus,* the usual human pathogen. In the skin section, the heavy mat of mycelium and bacteria makes identification difficult: a strain of candida, (monilia) is present as well as a phycomycete such as Mucor and an aspergillus. The mycelial invasion of the dermis suggests it is the source of the lung infection.

Colonization of acute duodenal ulcers

Acute ulceration of the duodenum is a well known complication of burning: usually it is a silent event and is found in about 10% of those reaching necropsy (Sevitt 1957). Gram preparations of sections of 14 ulcers from patients who died after burning were studied and in 8 of them (57%) the floor of the ulcer was colonized by yeasts and/or bacteria (Tab. 8). Fig. 18 shows candida invasion in one ulcer and Fig. 19 shows colonies of Gram positive cocci and Gram negative bacilli in another. Yeast-forms (candida) were found in 4 ulcers, Gram negative bacilli in 5 and Gram positive cocci in 2. Invasion of the ulcer floor is presumably from the bowel and may well prevent early healing.

DISCUSSION AND CONCLUSION

Bacterial infection of burns is very common despite all the antibiotics; for although infection with the once dreaded Group A haemolytic streptococcus *(Strep. pyogenes)* can usually be prevented or eliminated by chemotherapeutic agents, other organisms especially *Ps. pyocyanea, Staphylococcus aureus* and various coliform bacilli are still a danger and a challenge. Most patients with extensive burns can now be brought safely through the shock phase by fluid therapy but septicaemia or pneumonia still quite often develop from bacteria which have colonized the burn, and many of these patients die. Indeed 61% of the deaths in the present series were due to bacterial invasion and 80% of those who survived 2 weeks or longer was traceable to this cause.

The recent introduction of new agents active against penicillin-resistant strains of *staph. aureus,* especially the new penicillins (claxocillin and methicillin) and fucidin, — promises to control infection by this species; but so far the control of infection by *Ps. pyocyanea* has been disappointing. Polymixin and colistin (colomycin) act *in vitro* against pyocyaneus strains but the results of therapy are poor. Recurrent invasion of the bloodstream from the burned skin is no doubt contributory to all forms of septicaemia, but in the case of pseudomonas infection, the teeming of blood vessel walls with organisms is of additional importance.

The main cause of death in patients reaching hospital with large burns is bacterial infection manifest usually as septicaemia or bronchopneumonia or both complications. The role of bacterial toxaemia from skin colonization (without septicaemia) is incompletely understood but may be important with some bacteria, more important perhaps than is generally considered. Indeed early endotoxaemia from coliform bacilli may contribute to burn shock in some cases and cause death during the first 2 or 3 days. The role, if any, of non-bacterial toxaemia is difficult to estimate; and if it is a genuine entity it is overshadowed by and difficult to separate from the results of bacterial infection.

SUMMARY

Bacterial endo-toxaemia and invasion of the body are the main causes of toxaemic symptoms in extensively burned patients and are the most frequent causes of death after the shock-phase. If non-bacterial toxaemia is an entity, it is usually overshadowed by the more important effects of bacterial infection and invasion. Contamination of the burned skin may occur soon after burning and the affected skin surface often becomes covered by microcolonies of various organisms. Haemolytic streptococci, *Staphylococcus aureus, Pseudomonas pyocyanea* and various coliform are the most important and dangerous. This continuously threatens septicaemic and other types of bacterial invasion. The present report is especially concerned with observations at necropsy concerning the forms which this bacterial invasion and infection may take. Bronchopneumonia, pyelonephritis and cystitis are common; occasionally pyaemia, bacterial endocarditis and even meningitis may develop. Recent observations are presented concerning ecthymatous lesions in unburned skin due to *Pseudomonas pyocyanea* and histological evidence concerning invasion of acute gastro-intestinal ulcers by various organisms (Gram positive cocci, Gram negative bacilli and monilia). These lesions are evidence of the variety of pathological forms which bacterial invasion in extensively burned patients may take and which are difficult to diagnose clinically.

RÉSUMÉ

De l'invasion bactérienne à la suite des brûlures de grande étendue

S. Sevitt

L'endotoxémie bactérienne et l'invasion de l'organisme représentent les causes principales des symptômes de la toxémie, au cas des brûlures de grande étendue et le plus souvent, elles sont également responsables de l'issue fatale après la phase de choc. Si la toxémie non-bactérienne constitue une manifestation indépendante, elle est très souvent cachée par les séquelles bien plus graves de l'infection bactérienne et de l'invasion. La contamination de la peau brûlée peut se produire immédiatement après l'accident et la surface atteinte est souvent couverte de microcolonies d'organismes les plus divers.

Les plus importants et les plus dangéreux parmi eux sont les streptocoques hémolytiques, les staphylocoques dorés, pseudomonas pyocyaneum et certaines bactéries coliformes. La communication présentée examine les résultats d'une série d'autopsies,

par rapport au genre des infections qui s'étaient produites. On rencontre souvent des bronchopneumonies, des pyélo-néphrites et des cystites, occasionnellement des pyémies ou des endocardites bactériennes; en certains cas, on a même pu assister au développement d'une méningite.

On présente des observations faites récemment, englobant des lésions ecthymateuses de la peau non-brûlée, causées par le genre Pseudomonas pyocyaneum, puis des observations histologiques au sujet d'une invasion des ulcères gastro-intestinaux récents, par les organismes les plus divers (coques à Gram-positifs, bacilles à Gram-négatives et moniliformes).

Ces lésions témoignent de la diversité des formes pathologiques qui pénètrent dans l'organisme des brûlés et dont le diagnostic clinique est tellement difficile.

ZUSAMMENFASSUNG

Der bakteriellen Invasion nach ausgedehnter Verbrennung

S. Sevitt

Überschwemmung des Organismus mit bakteriellen Endotoxinen und Invasion von Bakterien in den Organismus sind die hauptsächlichsten Ursachen der Toxämie bei ausgedehnten Verbrennungen und die häufigste Todesursache nach dem Schock. Wenn eine nicht-bakterielle Toxämie als selbständiges Phänomen auftritt, wird sie oft durch die weitaus schwerwiegenderen Folgen der bakteriellen Infektion und Invasion in den Schatten gestellt. Die Kontamination der verbrannten Haut kann bald nach dem Unfall erfolgen und die betroffene Hautfläche ist oft von Mikrokolonien verschiedener Organismen bedeckt.

Am gefährlichsten und folgenschwersten ist die Infektion mit hämolytischen Streptokokken, Staphylococcus aureus, Pseudomonas pyocyanaea und den verschiedenen Coli-Bakterien. Die vorliegende Arbeit befasst sich mit autoptischen Befunden unter Berücksichtigung der Art der erfolgten Infektion. Brochopneumonie, Pyelonephritis und Cystitis treten häufig auf, gelegentlich auch Pyämie, bakterielle Endocarditis; vereinzelt wurde sogar Meningitis beobachtet.

Es werden Beobachtungen aus der letzten Zeit angeführt, die ekthymatöse Schädigung der nichtverbrannten Haut betreffen, bewirkt durch Pseudomonas pyocyanaea, ferner histologische Beobachtungen der Invasion verschiedener Mikroorganismen (Gram-positive Kokken, Gram-negative Bazillen sowie Monilien) in frische gastrointestinale Ulzerationen.

Diese Schädigungen stellen einen Beweis für die Mannigfaltigkeit der pathogenen Mikroorganismem dar, die den von ausgedehnten Verbrennungen betroffenen Organismus befallen und die klinisch nur sehr schwierig zu diagnostizieren sind.

RESUMEN

De la invasión bacteriológica después de extensas quemaduras

S. Sevitt

La endotoxemia bacteriológica y la invasión del organismo representan las causas principales de los síntomas de toxemia durante quemaduras extensas y son con más frecuencia el motivo de la muerte después de la fase del choque. Si la toxemia no bacteriológica es un fenómeno independiente, con frecuencia está obscurecida por consecuencias considerablemente más graves de la infección y invasión bacteriológicas. La

contaminación de la piel quemada puede suceder muy temprano después del accidente y la superficie afectada está cubierta muy a menudo por microcolonias de varios organismos.

El peligro más grave lo representan estreptococos hemolíticos, estafilococos áureos, Pseudomonas pyocyaneum y varias bacterias coliformes. La conferencia se ocupa de la investigación de autopsia teniendo en cuenta el tipo de la infección. Broncopulmonía, pielonefritis y cistitis son frecuentes, de vez en cuando, piemia y endocarditis bacteriológica; algunas veces pudo desarrollarse también meningitis.

Se presentan observationes llevadas a cabo en los últimos tiempos que comprendren perjuicios ectimatosos de la piel no quemada causados por Pseudomonas pyocyaneum, luego, observaciones histológicas de la invasión dirigida a los tumores gastrointestinales recientes por diferentes organismos (cocos gram-positivos, bacilos gram-negativos y monilias).

Estos perjuicios atestiguan diferencias de las formas patológicas que penetran en el organismo quemado extensivamente sobre las cuales uno puede presentar diagnosis clínica con gran dificultad.

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(S. Sevitt, M. D.): Birmingham Accident Hospital, Bath Row, Birmingham, 15, England

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Université de Paris (France)

PHÉNOMÈNES ENZYMATIQUES LOCAUX AU NIVEAU DES ZONES BRÛLÉES

C. NICOLÉTIS

Ancien Interne des Hôpitaux de Paris Chef de Clinique Chirurgicale Prosecteur à la Faculté

Nous laisserons de côté les phénomènes généraux liés à la protéolyse. Ils ont déjà été étudiés par certains auteurs qui voient dans ce processus la cause principale des phénomènes généraux de la phase toxique. Nous avons pensé qu'il s'agissait d'un processus physiologique, qui pouvait prendre dans les grandes brûlures une importance telle qu'il devenait l'élément majeur.

Ce processus physiologique, est celui qui préside à l'élimination des escharres, à la délimitation des lésions nécrotiques (sillon d'élimination au cours de la gangrène sèche), ou à la détersion des plaies. Quel est-il? Premier stade précédant la réparation d'une perte de substance, son étude est pleine d'intérêt: tant que le nettoyage n'est pas obtenu la réparation ne se fait pas, car elle est inhibée par le processus de détersion qui obligatoirement la précède. Si l'on tient compte du fait que la détersion spontanée peut durer plusieurs semaines, que pendant ces semaines évolue localement un processus inflammatoire dont le terme est la fibrose, on conçoit l'intérêt d'abréger cette évolution: obtenir une détersion accélérée, suivie d'une réparation rapide, pour une cicatrice meilleure.

Les tissus dévitalisés subissent un processus de digestion locale qui va aboutir à leur liquéfaction et à leur élimination exactement identique à la digestion des aliments protidiques dans le tube digestif précédant leur assimilation.

RAPPEL DE LA DIGESTION DES PROTIDES

Les enzymes responsables de cette digestion sont bien connues dans le tube digestif. Ce sont des enzymes gastriques, pancréatiques et intestinales.

Les enzymes gastriques

C'est essentiellement la Pepsine. Celle-ci est une protéinase (endopeptidase). Son PH optimum d'action est 2. Elle scinde les protéines en polypeptides groupant des acides aminés avec 7 radicaux. Surtout, elle est spécifique des liaisons peptidiques dans lesquelles sont impliqués des groupements NH 2 appartenant à des acides aminés aromatiques (Tyrosine, Phénylalanine). Le Pepsine provient de l'activation du pepsinogène, l'activateur étant représenté par l'acidité du milieu.

Tab. 1. Enzymes proteolytiques

I. *Enzymes digestives*

	Nom	pH. optim.	Action
GASTRIQUES	PEPSINE	2—3	Scission Protéines (Acides Aminés Aromatiques)
	LAB FERMENT	2—3	Protéinase
	CATHEPSINE	2—3	Protéinase
PANCREATIQUES	TRYPSINE	6—8	Scission Protéines (Ac. Aminés basiques)
	CHYMO-TRYPSINE	8	Moins specifique
	CARBOXY-PEPTIDASE	8	Peptidase
	PROTAMI-NASE	8	Peptidase
	ELASTASE	?	Specifique de l'Elastine des tissus
INTESTINALES	AMINOPEP-TIDASE	8—9	Peptidase
	NUCLEASE NUCLEOTI-DASE NUCLEOSI-DASE Phosphatases	8—9	NUCLEOPROTEINES

II. *Enzymes tissulaires*

CATHEPSINES (A, B, C) 6 ! id. Pepsine, Trypsine, Chymo

PEPTIDASES: Carboxy et Aminopeptidase

III. *Enzymes bacteriennes*

NON SPECIFIQUES: Proteases, Peptidases, Amidases, Transaminases
Désaminases et Décarboxylases

SPECIFIQUES: Hyaluronidase, Collagénase, Streptokinase, Streptodornase

IV. *Enzymes vegetales*

PAIKINASE: Action très large

Les autres enzymes gastriques sont le Lab-ferment ou présure, la Cathepsine, qui sont également des protéinases.

Les enzymes pancréatiques

Elles sont au nombre de quatre. Deux d'entre elles sont des protéinases, ou endopeptidases. Ce sont la Trypsine et la Chymotrypsine. Deux autres sont des peptidases ou exopeptidases. Ce sont la carboxypeptidase et la protaminase.

1. La Trypsine

C'est une protéinase. Son PH d'action optimum est de 8, mais elle est active dans une zone de PH assez large (jusqu'à 6). Elle hydrolyse les liaisons peptidiques dans lesquelles les groupements carboxyles (COOH) d'acides aminés basiques sont engagés (arginine, lysine). Donc la scission des protéines provoqués par la Trypsine aboutit à la formation de polypeptides dont la longueur de chaîne est extrêmement variable, le facteur commun étant que tous sont terminés par un acide aminé basique. Il faut noter enfin que les protéines dénaturées sont plus sensibles à la Trypsine que les protéines natives. La Trypsine active résulte de l'activation du trypsinogène par l'entérokinase, protéinase elle-même qui détache un hexapeptide inactivant, selon la formule:

Trypsinogène + enterokinase = Trypsine + hexapeptide.

Inversement de nombreux corps se combinent à la Trypsine et l'inactivent. C'est ainsi que certains colorants extraits du bleu de Soja, le di-iso-propyl-fluoro phosphate, sont des inactivants de la Trypsine.

2. La Chymotrypsine, dont le nom vient de la propriété qu'elle possède de coaguler le lait.

Elle hydrolyse les liaisons de type: Tyrosyl-CO-NH, Phenylalanine, Tryptophane, Methionine, Leucine. Donc sa spécificité est moins grande que celle de la Trypsine. La Chymotrypsine nait de l'activation du Chymotrypsinogène; l'activateur est la Trypsine elle-même.

3. L'Elastase est spécifique de l'Elastine et est présente dans le suc pancréatique.

4. Enfin, il existe encore une carboxypeptidase, spécifique de la liaison COOH.

Les enzymes intestinales

A l'inverse des précédentes qui n'agissent que sur les substrats ne comportant pas d'acides nucléiques, les enzymes intestinales, l'aminopolypeptidase agissent sur les acides nucléiques par un complexe enzymatique qui comporte: la Nucléase qui transforme l'acide nucléique en nucléotides, la Nucléotidase qui transforme les nucléotides en nucléosides, la Nucléosidase achève la dégradation des nucléosides en Pentose d'un côté (d-ribose ou d-ribodesose) et Base purique ou pyrimidique.

Au terme de l'action de ces différents groupes d'enzymes, les protéines ont été transformées progressivement d'abord en polypeptides puis en acides aminés, composés solubles et assimilables par les muqueuses digestives. Il nous paraît intéressant de souligner que leur mise en action successive et respective témoigne de leur rigoureuse spécificité d'action: chacune de ces enzymes agit dans des conditions physico-chimiques précises (de PH en particulier), et sur un substrat précis qui nécessite l'action de ces enzymes dans un ordre précis, celui que la nature nous a donné. Ainsi si nous assimilons la détersion d'une plaie à la digestion d'un morceau de viande, nous sommes amenés à penser qu'elle met en oeuvre un processus aussi complexe que celle-ci.

l'activité protéolytique relève de l'action de deux ordres d'enzymes, les unes sont d'origine tissulaire, les autres d'origine bactérienne.

1. Les enzymes protéolytiques des tissus

Les tissus contiennent des enzymes identiques à celles du tube digestif. Les protéinases tissulaires sont appelées Cathepsines. Il en existe trois types: a, b, c, dont les actions correspondent respectivement à celles de la Pepsine, de la Trypsine, de la Chymotrypsine. Le PH maximum d'action est de 6. Ces enzymes sont inactivées par les composés sulfhydrylés.

Tab. 2. Detersion accelerée

Ier JOUR:

Excision chirurgicale
Poudre de Pepsine
Pansement acide (Acide Lactique, Sol à pH 2,2)

IIe JOUR:

Nettoyage *avec un liquide Alcalin (Dakin)*
Poudre de «Pancrinase» (mélange de — Trypsine
— Chymotrypsine
(Labo. CHOAY) — Elastase
— Elastomucoproteinase)
Pansement simple (le pH spontané des plaies est à 8—9)

IIIe JOUR:

Pansement au Serum Salé Hypertonique à 20 %

Les cellules contiennent également des peptidases (carboxypeptidase aminopeptidase) dont certaines ont été isolées. C'est l'ensemble de ces ferments qui préside à l'autolyse.

Il faut probablement ajouter à ces enzymes connues depuis un certain temps d'autres plus récemment déceouvertes, (l'Elastase, l'Elastomucoprotéinase). La liste n'en est probablement pas close.

2. Les enzymes protéolytiques d'origine bactérienne, sont également à considérer. Elles s'ajoutent aux précédentes en rendant leur action plus efficace.

L'équipement enzymatique des germes que l'on trouve au niveau des plaies en voie de détersion montre une extrême richesse de celles-ci comme une extrême variabilité.

Il existe en effet des enzymes très diverses: oxydases, peroxydases, cytochromoxydase, catalase, deshydrogenase, hyaluronidase, collagénase, (chez certaines bactéries douées d'un pouvoir histolytique), streptokinase, streptodornase, ces deux derniers ferments étant l'un fibrinolytique, l'autre étant une desoxyribonucléase.

Ces quelques considérations nous ont amenés à penser que ces processus pouvaient nous donner une compréhension plus uniciste de l'ensemble des phé-

nomènes de la phase toxique. Cette protéolyse physiologique visant à l'élimination des tissus nécrotiques serait à la fois le fait de l'organisme lui-même et des germes que l'on trouve inévitablement au niveau de toute perte de substance cutanée. Dès lors les phénomènes toxiques peuvent être considérés comme la conséquence de cette protéolyse massive, à la fois cellulaire et microbienne, qui s'ajoute à l'action des toxines propres à certains germes (Staphylocoque, Streptocoque, Entérocoque).

CONSEQUENCES THERAPEUTIQUES

Cette conception d'ensemble nous a conduit à repenser plusieurs problèmes thérapeutiques quotidiens liés à la détersion et à la réparation des pertes de substance cutanées.

1. Dans les grandes brûlures étendues, l'intensité des phénomènes de protéolyse a pu être combattue par l'utilisation des anti-enzymes. Dans ce cas le processus de protéolyse prend une telle ampleur qu'il mérite d'être freiné pour éviter une trop importante toxinogenèse. Des succès ont été mis sur le compte de cette thérapeutique qui s'opposerait à l'élaboration des toxines, au lieu de les combattre comme pourrait le faire le sérum antitoxique ou le sérum de convalescent du Professeur Fedorov.

2. Sur le plan local, nous avons cherché à distinguer le cas où (dans les pertes de substance de petite dimension), il fallait inhiber le processus protéolytique (parce que son excès entraînait une aggravation de la profondeur ou de l'étendue de la lésion, ou encore se montrait capable de digérer une ou plusieurs greffes), des cas où le processus enzymatique devait être au contraire assisté (parce qu'il se montrait insuffisant pour déterger la plaie dans les délais souhaitables).

Nous pensons que ce délai doit être le plus court possible, car le temps pendant lequel le tissu conjonctif reste «exposé» tient sous sa dépendance l'intensité de la réaction inflammatoire, et par conséquent de la fibrose qui en est l'aboutissement.

Pour faire cette distinction l'examen clinique suffit mais ou doit aussi mé surer l'activité protéolytique des sécrétions de la plaie, pour avoir une notion quantitative de ce phénomène, ce que nous essayons de mettre au point.

La freination du processus protéolytique peut être tentée par l'utilisation des inhibiteurs dont on connaît actuellement deux types différents (extrait du pancréas de boeuf, ou de la parotide du mouton). L'indication de ce freinage, sur le plan local, est donc la brûlure du deuxième degré qui paraît s'approfondir ou la perte de substance couverte par une greffe que l'on voit se lyser de jour en jour. Il ne faut pas se dissimuler que cette freination n'intéresse en réalité qu'un nombre très réduit d'enzymes (essentiellement Fibrinolysine et Trypsine). Cela explique que les tentatives de thérapeutique protectrice par ces inhibiteurs d'enzymes n'aient été jusqu'ici couronnées que de succès relatifs. La découverte d'autres substances capables d'inhiber l'ensemble du système enzymatique et protéolytique permet d'espérer un blocage plus efficace de ce processus.

Quant à l'assistance du processus de protéolyse, elle n'a jusqu'ici été réalisée que par l'utilisation de poudre de Trypsine. Nous considérons, pour notre part, que l'action de la Trypsine est très problématique et en tous cas très incomplète. Une détersion correcte ne saurait être réalisée que par un apport local de tous les enzymes protéolytiques mis dans les conditions optima de PH, pour que leur action soit complète.

En pratique, voici comment nous procédons:

Le premier jour, nous procédons à l'excision mécanique des débris nécrotiques trop volumineux pour être attaqués efficacement par les enzymes. Le premier pansement a lieu; il comporte la protection des bords de la perte de substance par un pansement gras, suivant rigoureusement les contours de la plaie. La plaie, ainsi présentée, est saupoudrée de poudre de Pepsine, et recouverte d'un pansement humide à l'acide lactique à PH 2.

Le deuxième jour, est fait le deuxième pansement. La plaie est nettoyée avec un liquide alcalin (Dakin). Une poudre d'enzymes pancréatique et intestinale est appliquée. Nous n'employons plus la Trypsine isolément, mais un complexe qui nous est fourni par le Laboratoire Choay, sous le nom de Pancrinase et qui comporte: Trypsine, Chymotrypsine, Elastase et Elastomucoprotéinase.

Le Ph optimum de ces enzymes est, on le sait, alcalin, comme le PH spontané de la plupart des plaies. Aussi laissons-nous ici faire la nature qui réalise le PH nécessaire, sans apport médicamenteux.

Le troisième jour, sera fait un pansement humide au sérum salé hypertonique à 20 % qui par la chasse hydrique d'origine osmotique qu'il réalise va entraîner un certain nombre de débris.

Il nous paraît important à ce stade d'ailleurs de ne pas chercher à trop modifier les conditions biologiques. Il va s'établir en effet une flore microbienne contre laquelle il ne convient pas toujours de lutter. Il nous paraît évident qu'il faut lutter contre une infection patente, ou menaçante. Par contre, certaines infections atténuées ne sont pas sans jouer un certain rôle dans la détersion de la plaie. Nous la qualifions volontiers de «flore symbiotique», et comme toutes les leçons que la Nature nous donne, il faut les méditer, nous pensons, pour notre part, que les Antibiotiques ne doivent pas être employés d'une matière systématique, sous peine de retarder ou d'entraver le processus normal de la protéolyse qui fait appel à des éléments microbiens dont l'équilibre doit être respecté, tout comme doit être respectée la flore intestinale dont l'action vient dans le tube digestif, compléter celle des ferments digestifs. Nous savons que les protides insuffisamment dégradés par ceux-ci, lorsque la digestion est incomplète, entrainent le développement d'une flore de putréfaction qui vient à la fois prendre le relais de ces enzymes et refléter leur insuffisance.

Nous avons cherché à déterminer quelle était la flore bactérienne moyenne des plaies sans infection patente. Les germes le plus souvent retrouvés sont le protéus, le pyocyanique, l'entérocoque et quelques autres germes: streptocoque, staphylocoque, colibacille.

Il se trouve justement qu'il s'agit là de germes doués d'un pouvoir protéolytique certain (protéus, pyocyanique en particulier), mais atténués. Il existe

des germes à pouvoir protéolytique élevé, maix ceux-ci sont très pathogènes, et la pullulation doit être combattue. Le même germe peut par ailleurs, dans certaines circonstances, présenter une variabilité de son pouvoir protéolytique. C'est ainsi que J. Monod a pu introduire la notion d'«enzymes constitutives» et d'«enzymes adaptatives». De plus certains enzymes ne sont présents qu'au cours de la phase de croissance de la colonie microbienne, phase dite exponentielle. C'est dire la variabilité de cette protéolyse microbienne, son caractère quelquefois dangereux ou insuffisant, et la nécessité, là encore, de la freiner ou de l'assister, suivant les mêmes critères que ceux de la protéolyse d'origine cellulaire. Mais alors qu'il est relativement facile de freiner l'action microbienne grâce à l'utilisation d'Antibiotiques choisis en fonction de la sensibilité du germe, il n'est possible de suppléer à une protéolyse microbienne insuffisante que par un apport d'enzymes non microbiennes.

Nous avons voulu attirer l'attention sur l'intérêt d'une «détersion accélérée» pour raccourcir au maximum la durée de la réaction inflammatoire, génératrice de fibrose.

La «détersion assistée» que nous proposons tient compte du déroulement physiologique normal du processus protéolytique. Nous l'obtenons actuellement en trois jours, avec trois pansements qui réalisent successivement les conditions de la digestion gastrique, puis pancréatico-intestinale.

Nous respectons, enfin, éventuellement, une «certaine flore microbienne» que l'on peut qualifier de symbiotique: les deux critères qui la définissent sont: une virulence atténuée et un certain pouvoir protéolytique.

RÉSUMÉ

Laissant de côté les phénomènes généraux toxiques liés à la protéolyse massive au cours des brûlures, déja étudiés par d'autres, l'Auteur se livre à l'étude des processus biologiques locaux qui président à la détersion des plaies. Ceux ci sont de nature enzymatique, d'origine cellulaire, mais aussi bactérienne; ils peuvent être comparés à ceux qui se déroulent à l'intérieur du tube digestif lors de la digestion des protides: l'aliment protidique doit subir l'action particulière et successive de tous les enzymes protéolytiques dont aucun ne peut prendre la place d'un autre, du fait de la spécificité très rigoureuse de leur point d'attaque sur les chaînes protidiques. L'analogie est assez féconde.

Cette protéolyse locale, dans la plupart des cas, doit être simplement respectée dans son déroulement naturel, en particulier en ne cherchant pas à détruire systèmatiquement une flore microbienne locale par l'utilisation inconsidérée des antibiotiques. Il faut, bien entendu, lutter contre les infections virulentes, mais savoir respecter une flore véritablement symbiotique dont l'action protéolytique peut être bénéfique et contribuer à la détersion locale dans des délais plus courts.

Dans certains cas, le processus protéolytique est excessif, il aboutit à aggraver la profondeur ou l'étendue d'une brûlure, il peut même digérer une greffe. Il faut alors le freiner. L'utilisation des inhibiteurs, actuellement à ses débuts, paraît avoir, à cet égard un avenir plein de promesses.

Dans certain cas, enfin, la protéolyse est insuffisante. La détersion s'arrête. Il faut alors l'assister. L'auteur propose une méthode personnelle qui reproduit les phases successives de la digestion protidique.

L' intérêt de réduire au maximum la phase de détersion est évident puisque elle précède obligatoirement la phase de dé reparation et que pendant tout son temps se déroulent des phénomènes inflammatoires dont les aboutissants sont la sclérose et la retraction. En «conduisant» ainsi la détersion, de manière physiologique, on gagne un temps précieux.

La conclusion de l'auteur est aussi philosophique: Il faut savoir suivre les chemins que la Nature nous indique.

SUMMARY

Local Enzymatic Manifestations at the Level of the Burned Surface

C. Nicolétis

The generalized toxic manifestations, which are related to the massive proteolysis taking place in burns, have already been studied by other authors. Leaving these aside, the present author has devoted attention the local biological manifestations which play a major role in the wound. These processes have an enzymatic character — cleansing of cellular origin and also bacterial — can be compared with processes taking place in the alimentary tract during the digestion of protein substances: food proteins must be subjected to the action of all proteolytic ferments separately and in correct sequence. No ferment can replace another because of the very strict specificity of the action of each on the protein chain. The analogy is very similar. This local proteolysis must be respected in its natural development in the majority of cases. In particular, no attempt must be made systematically to destroy the local microflora by the misuse of antibiotics. It is, of course, necessary to combat virulent infection but one must know how to respect flora which are actually symbiotic and whose proteolytic activity can be very useful and assist in local cleansing in the shortest possible time.

In some cases the proteolytic effect is increased, leading to increase in the depth or extent of the wound. Transplants may even be digested. In that case the activity must be slowed down. The use of inhibitors for this purpose appears very promising for the future. In some cases proteolysis may even be in inadequate. The cleansing of the wound stops. It is necessary to bring assistance. The author puts forward his own method which simulates the succeeding phases of the digestion of proteins. That we are interested in maximal decrease of the cleansing phase (detersion) is clear since this phase necessarily precedes the phase of reparation and in its course inflammatory processes develop with resultant sclerosis and retraction. The "guidance" of the cleansing (detersion) of the wound by physiological means leads to the gaining of valuable time.

The conclusion of the authors is of a philosophical character: "It is necessary to know how to follow the paths indicated to us by Nature."

ZUSAMMENFASSUNG

Lokale enzymatische Vorgänge in der Verbrennungswunde

C. Nicolétis

Die toxischen Gesamterscheinungen, die mit der massiven Proteolyse im Verlaufe der Verbrennungskrankheit verbunden sind, wurden bereits von anderen Autoren untersucht. Der Verfasser richtet sein Augenmerk auf die lokalen biologischen Phänomene, denen eine wichtige Rolle zukommt. Die in der Wundfläche sich abspielenden Vorgänge sind enzymatischer Natur — Wundreinigung durch zelluläre Aktivität, gehen aber auch auf die Tätigkeit von Bakterien zurück und können mit den Vorgängen verglichen werden, die sich im Magen-Darmtrakt bei der Verdauung von Eiweisstoffen abspielen: sämtliche proteolytischen Fermente wirken auf die eiweisshaltige Nahrung gesondert und nacheinander ein, keines von ihnen kann den Platz eines anderen Ferments einnehmen, weil hier eine strenge Spezifizität der Angriffsweise auf die Polypeptidketten besteht. Die Analogie ist auffallend. Diese lokale Proteolyse ist in den meisten Fällen in ihrer natürlichen Entwicklung zu respektieren, insbesondere soll man nicht versuchen, die lokale mikrobielle Flora durch unüberlegte Verwendung von Antibiotika zu vernichten. Natürlich muss man gegen eine virulente Infektion kämpfen, muss es aber verstehen, die wirklich symbiotische Flora zu schonen, da ihre proteolytische Aktivität von grossem Nutzen sein und zu einer Wundreinigung in kürzester Zeit beitragen kann.

In manchen Fällen ist die proteolytische Wirkung gesteigert und verschlimmert die Tiefen- oder Flächenausdehnung der Verbrennungswunde; so kann auch ein Transplantat verdaut werden. In solchen Fällen muss diese Wirkung gebremst werden. Die Verwendung von Inhibitoren gerade zu solchen Zwecken besitzt, wie es den Anschein hat, eine vielversprechende Zukunft. Schliesslich gibt es Fälle, wo die Proteolyse nicht hinreichend ist. Die Wundreinigung kommt zum Stillstand und erfordert Hilfe. Der Verfasser empfiehlt eine eigene Methode, die die aufeinander folgenden Phasen der Einweissverdauung nachahmt.

Das Interesse für eine maximale Verkürzung der Reinigungsphase ist begreiflich, da diese Phase notgedrungen der Reparationsphase vorangeht und sich in ihr entzündliche Prozesse abspielen, die zu Sklerose und Retraktion führen. Durch „Steuerung" der Wundreinigung auf physiologische Weise kann man wertvolle Zeit gewinnen.

Der Verfasser schliesst philosophisch: Man muss die Wege verfolgen können, die uns die Natur weist.

RESUMEN

Los fenómenos enzimáticos locales al nivel de las áreas quemadas

C. Nicolétis

Sin tomar en consideración fenómenos tóxicos generales ligados a la proteólisis masiva en el transcurso de la quemadura, lo que fué ya estudiado por otros autores — el autor se dedica al estudio de los fenómenos biológicos locales que juegan el papel más importante. Estos fenómenos son del carácter enzimático — la detersión de la lesión del origen celular — tanto como del origen bactérico; pueden ser comparados con aquellos procedimientos que tienen lugar dentro del aparato de digestión (tubos de digestión) durante la digestión de las materias albuminosas: el alimento albuminoso debe sucumbirse al efecto de todos los fermentos proteolíticos por separado y gradualmente, mientras que ninguno de éstos no puede ocupar el lugar del otro, porque cada

uno posee su rasgo específico definido en cuanto a su ataque a las cadenas de las albúminas. La analogía es muy parecida. En la mayoría de los casos es necesario respetar esa proteólisis local en su desarrollo natural, sobre todo, no se puede destruir sistemáticamente la flora micróbica local con un uso imprudente de los antibióticos. Es necesario — desde luego — luchar contra la infección virulenta pero hay que respetar la flora verdaderamente simbiótica cuya actividad proteolítica puede ser muy útil contribuyendo y ayudando a la detersión local dentro del período más corto.

En algunos casos el efecto proteolítico puede ser elevado, conduce al empeoramiento de la hondura y extensión de la quemadura hasta puede digerir el transplante. En tal caso es necesario frenar esa actividad. El uso de las materias inhibitorias destinadas precisamente para este fin parece tener un provenir muy prometedor. Pero en algunos casos la proteólisis no está suficiente. La detersión de la lesión queda parada. Es necesario ayudarle. El autor recomienda su propio método que imita las fases graduales de la digestión de las albúminas.

No cabe duda de que hay un gran interés por lorgrar la reducción máxima de la fase de la detersión, ya que esta fase tiene que preceder a la fase reparatoria, mientras que durante su transcurso suceden procesos inflamatorios de los cuales resultan esclerosis y retracción. Bajo esta „dirección" que se observa en la detersión de la lesión por el método fisiológico se gana tiempo precioso.

La conclusión del autor es una conclusion filosófica: es necesario saber observar el camino que nos señala la naturaleza.

(Dr. C. Nicolétis): 158, Rue de Courcelles, Paris XVII, France

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Société Anonyme Cockerill-Ougrée, Service Médical, Seraing (Belgique)
Chef: Dr. G. Proyard

RÉSULTATS DU TRAVAIL ACCOMPLI DANS L'HÔPITAL D'ENTREPRISE COCKERILL-OUGRÉE

G. PROYARD

Il ne s'agit pas d'envisager l'entièreté du problème du choc des brûlés mais bien d'exposer certains points précis qui retiennent notre attention. Spécifions d'emblée que nous ne parlerons que de brûlures de 20% et au delà de la surface du corps, qui nécessitent la greffe ultérieurement. En effet, les brûlures de moins *de 20% full skin ou de plus de 20% part skin* ne justifient pas les mêmes considérations et ne conduisant plus à l'heure actuelle à des difficultés majeures qu'exceptionnellement.

Nous voudrions soulever brièvement 5 points particuliers:

1. Le trouble rénal qui se manifeste par une oligurie-anurie ou par une diurèse normale en quantité mais non en qualité, nous parait fréquent et présentant une importance variable. D'autres auteurs avant nous, S e v i t t, C r e y s s e l et bien d'autres, ont insisté sur l'existence de cette complication.

Elle peut être purement transitoire mais elle est souvent grave et constitue, dans notre pratique, un accident majeur. L'oligurie-anurie peut être, à notre avis, extrèmement précoce et s'installer dans les 2 premières heures; elle peut aussi être plus tardive et n'apparaître que vers le 4ème.—5ème. jour; ce second cas nous paraît moins fréquent que le premier.

Un choc cardio-vasculaire avec effondrement tensionnel provoque bien entendu pareil accident mais cette étiologie de l'oligurie est peu fréquente et la cause de l'accident rénal nous paraît être ailleur. Sa rapidité d'installation, sa précocité doivent faire admetre que la cause ne peut être que soit un phénomène réflexe d'ordre neurologique, soit un phénomène toxique provoqué par la brûlure. C'est cette 2ème. hypothèse qui nous paraît probable. En effet des expériences de physiologie rénale effectuées à l'Université de Liège semblent bien montrer qu'il existe au niveau des globules rouges un ou plusieurs composants dont la libération amène une vasoconstriction intense et définitive au niveau des tubes rénaux. Ces substances, dont l'effet vasoconstricteur peut être négativé par le tissu pulmonaire ou le tissu hépatique, seraient déversées en quantités anormalement élevées dans le torrent circulatoire et les barrières physiologiques habituelles ne parviendraient pas à neutraliser leur effet nocif. Il s'agit là d'une explication non encore formellement démontrée mais qui nous conduirait à une attidude thérapeutique qui sera exposée ultérieurement. Le

trouble rénal ne serait pas donc dû uniquement à un déséquilibre de la masse sanguine circulante mais pourrait être la conséquence d'une véritable intoxication non pas à partir des tissus brûlés mais bien à point de départ globules rouges détruits ou altérés.

Le trouble rénal du 4ème.—5.ème. jour pourrait être lui dû à une toxine à point de départ tissu brûlé ou à point de départ septicémique.

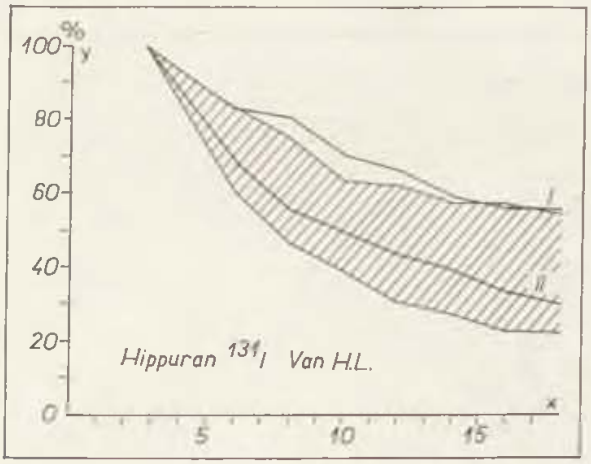

Fig. 1. Cas 1 — Van H. L. Hippuran ^{131}I. — x — min., y — radio-activité précordiale, I—14e jour, II — 44e jour.

Mais l'accident précoce des premières heures est beaucoup plus fréquent et retient notre attention. Pour clarifier ces 2 possiblités d'accident rénal, nous voudrions exposer très brièvement 2 cas précis.

Le premier est un brûlé dont l'accident s'est produit aux environs de 9 h. du matin et que nous avons dans nos mains, un quart d'heure après la brûlure. La brûlure porte sur 65% de la surface du corps, avec approximativement 40% de full-skin. Il est sondé immédiatement et on recueille 20cc d'urine mais dans l'heure qui suivra, il s'installera une anurie complète. Il est à noter que la pression artérielle n'était pas trop basse que pour pouvoir obtenir une diurèse puisqu'elle se trouvait aux environs de 10,5—11 de maxima et que la diurèse ne s'est rétablie qu'ultérieurement, c'est-à-dire aux environs de la 7ème. heure. De plus, cette diurèse rétablie était une diurèse que nous qualifierons d'irrégulière en ce sens que si l'on fait très attention et si l'on recueille les urines ½ h. par ½ h., on s'apercevra qu'à certains moments la diurèse est importante et que l'on obtient pendant une heure 120 ou 130 cc d'urine mais que pendant les deux ou trois heures qui suivront, on n'obtiendra plus une seule goutte d'urine.

Le 2ème. cas est un brûlé très important également, sur environ 55% de la surface du corps, mais brûlures extrèmement profondes puisqu'il s'agit d'un accident d'automobile avec cōma et brûlures, le blessé n'ayant eu aucune tendance à fuir la brûlure puisqu'il était dans le cōma par commotion cérébrale. Le trouble cérébral s'est rétabli très rapidement puisque le cōma a disparu dès la 3ème. heure. Les 48 premières heures ont eu un déroulement favorable avec

une diurèse tout à fait satisfaisante et un pouvoir de concentration uréique normal. A partir du 3ème. jour, la diurèse a continuée en quantité à être satisfaisante mais le pouvoir de concentration de l'urée dans l'urine a diminué progressivement; malgré une élimination d'urée à raison de 15 à 20 gr. d'urée par litre d'urine et une diurèse de 1,200 l. à 1,800 l. par 24 heures, nous avons vu le taux d'urée sanguine monter régulièrement pour atteindre un chiffre de 4,60 gr., et décès ultérieur.

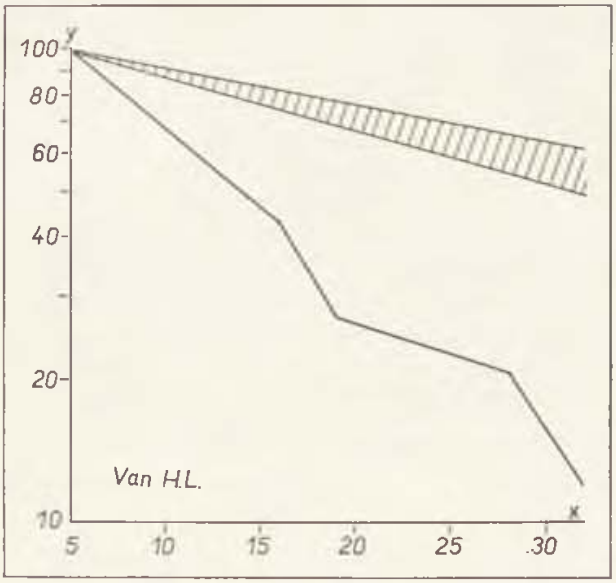

Fig. 2. Cas 1 — Van H. L. x — jours après la brûlure, y — ^{51}Cr-radio-activité des erythrocytes (% de la valeur initiale).

Pour nous, ces deux complications sont différentes et n'ont probablement pas la même origine.

Nous avons exploré la fonction rénale chez le brûlé par l'hippuran marqué à l'iode 131. Le sel de sodium de l'acide o-iodo-hippurique, injecté par voie intra-veineuse, est rapidement capté par le rein et secrété par les cellules tubulaires, tout comme le sel de sodium de l'acide p-amino-hippurique (PAH). Dans le sang, la disparition progressive de l'hippuran marqué à l'iode 131 et injecté par voie intra-veineuse, peut être suivie en mesurant la radio-activité de différents échantillons de sang, prélevés dans la demi-heure qui suit l'injection. Il est néanmoins plus simple, de suivre de façon continue la diminution de la radio-activité dans la région précordiale (Merchie, Baudinet, Cuypers, Humblet). Dans les premières secondes qui suivent l'injection de l'hippuran marqué, la radio-activité précordiale est fort élevée: tout le produit radio-actif se trouve dans les cavités cardiaques. Ensuite, la radio-activité diminue rapidement. Cette diminution est due, d'une part au mélange de l'hippuran dans la masse sanguine, et d'autre part à l'élimination de l'hippuran par les reins. A partir de la 160ème. seconde, la décroissance plus lente de la radio-activité est uniquement en rapport avec l'élimination rénale. Une décroissance rapide est l'expression d'un bon fonctionnement rénal; une décroissance lente

témoigne d'une insuffisance rénale. Parallèlement à l'exploration isotopique, nous avons dosé le Na, K, Cl et l'urée dans le sang et dans les urines de 24 heures.

RESULTATS

Cas 1 — Van H. L. (Fig. 1, 2). Il s'agit d'un homme de 35 ans, dont 75% de la surface du corps était brûlée et dont 50% de la surface a dû être greffé.

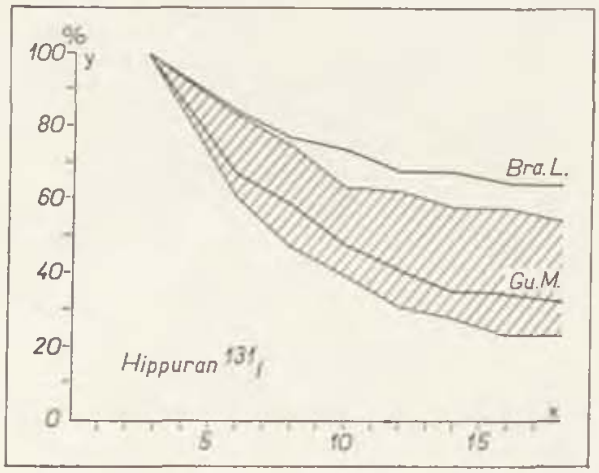

Fig. 3. Cas 2 — Bra. L. Cas 3 — Gu. M. Hippuran ^{131}I. x — min., y — radio-activité précordiale.

L'évolution de l'affection a été sans difficulté majeure. Deux séries d'homogreffes, suivies d'autogreffes ont permis la guérison.

La diurèse a toujours été très satisfaisante. Les reins réalisent des gradients de concentrations élevés entre l'urine et le sang en ce qui concerne le Na, Cl, K et urée. Il y a de l'albuminurie et de l'hématurie les premiers jours.

Le test à l'hippuran, fait le 14ème. jour après la brûlure, met en évidence une insuffisance rénale alors que toutes les autres données biologiques sont normales. La masse sanguine mesurée au ^{51}Cr, est normale à ce moment. Le 33ème. jour, l'élimination de l'hippuran est devenue normale.

Cas 2 — Bra. L. (Fig. 3). Ce patient, âgé de 60 ans, présentait des brûlures profondes sur 50% de la surface du corps et surtout au niveau du périnée. La verge ne permettant pas le passage de la sonde, une taille vésicale a été pratiquée.

Les premières urines ainsi obtenues, sont noires et contiennent de grandes quantités d'hémoglobine. La diurèse est faible pendant toute la durée de l'observation et il y a de l'hématurie et de l'albuminurie. Les reins ne réalisent pas les gradients de concentration normaux entre l'urine et le sang en ce qui concerne le Na, Cl, K et l'urée. Cette insuffisance rénale grave est confirmée par le test à l'hippuran fait le 2ème. jour. L'élimination de l'hippuran se fait très lentement. Le malade est décédé le 7ème. jour d'insuffisance rénale.

Cas 3 — Gu. M. (Fig. 3, 4). Il s'agit d'une femme de 55 ans, dont l'état général était plutôt déficient; elle ne pesait que 45 Kgs. Les brûlures s'étendaient sur

45% de la surface du corps, mais étaient moins profondes que dans les cas précédents.

La diurèse est satisfaisante dès le premier jour. Les gradients de concentration entre l'urine et le sang sont normaux en ce qui concerne le Na, Cl, K et l'urée. Le test à l'hippuran, fait de 3ème. jour après la brûlure, est normal. L'évolution a été très satisfaisante.

Cas 4 — Deb. V. (Fig. 5). Cet homme, âgé de 60 ans, était brûlé sur 80% de la surface du corps. Environ 55% de la surface cutanée aurait dû être greffée.

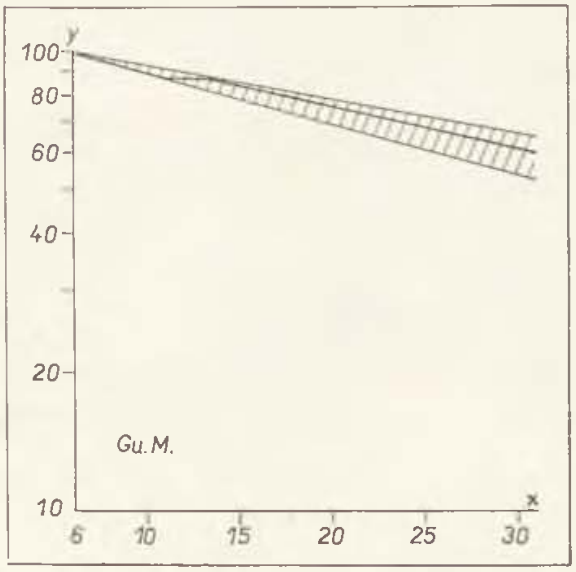

Fig. 4. Cas 3 — Gu. M. x — jours après la brûlure, y — ^{51}Cr-radio-activité des erythrocytes (% de la valeur initiale).

La diurèse est faible pendant les 7 jours de l'évolution. Les gradients de concentration entre l'urine et le sang sont satisfaisants en ce qui concerne le Na, Cl et K. La concentration de l'urée est faible dans les urines. Le test à l'hippuran du 1er. jour montre une insuffisance rénale. Celle-ci est encore plus grave au 4ème. jour. La masse sanguine mesurée au ^{51}Cr, est de 2820 cc.; la valeur normale pour un homme du même poids est de 4800 cc. Le patient est décédé le 7ème. jour, suite à l'insuffisance rénale et probablement aux troubles hémodynamiques.

L'exposé très bref de ces 4 cas démontre bien que les brûlures graves se compliquent d'une insuffisance rénale dans les premiers jours de l'évolution et que cette insuffisance peut être mise en évidence par le test à l'hippuran de façon valable. Il est cependant à noter que l'élimination de l'hippuran peut être retardée non pas par une lésion rénale mais bien par un trouble hémodynamique grave avec insuffisance de circulation rénale.

2. Nous nous sommes intéressés, comme la plupart des auteurs, à la mesure de la masse sanguine et il faut reconnaître que par les mesures de la masse globulaire au chrome radioc-actif 51, on obtient des résultats qui sont parfois fort surprenants car on constate que des brûlés qui ont cependant des hémato-

crites satisfaisants, une diurèse dans des limites normales, ont parfois des réductions considérables de la masse sanguine circulante. Cette diminution de la masse circulante avec un hématocrite normal peut parfaitement expliquer des oliguries importantes, précoces ou tardives, et dont l'explication n'apparaît pas au vu des autres examens de laboratoire. Un des cas cités plus haut en est une démonstration valable.

Nous avons abandonné à l'heure actuelle la mesure de la masse sanguine circulante par la sérum-albumine marquée à l'iode parce que les causes d'er-

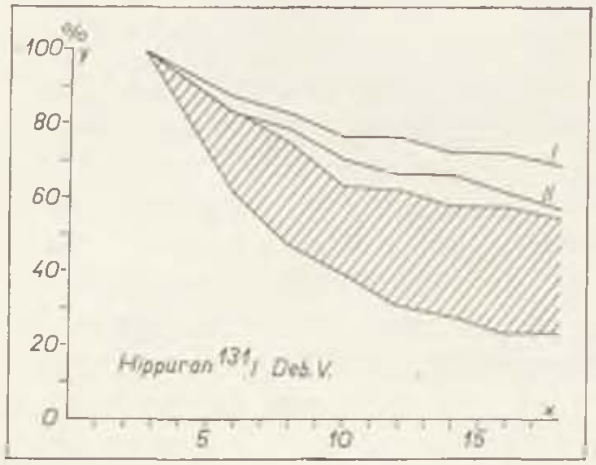

Fig. 5. Cas 4 — Deb. V. Hippuran ^{131}I. x — min., y — radio-activité précordiale, I—4e jour, II — 1er jour.

reur sont trop importantes et que notamment le passage d'albumine marquée du torrent circulatoire dans les tissus brûlés ne permet pas d'obtenir de résultat valable.

3. Nous n'avons pas d'expérience de la fragilité éventuelle globulaire rouge dans le Crush syndrome mais chez les brûlés, l'étude de la survie des globules rouges par le même procédé du chrome radio-actif nous a permis de vérifier les théories notamment de Miss T o p l e y sur la réduction de vie des globules rouges.

La diminution de la radio-activité globulaire est due à une destruction des globules rouges marqués et à leur remplacement par des cellules néoformées non radio-actives, c'est-à-dire par une dilution progressive des globules rouges marqués restants. Lorsque la masse globulaire est constante, grâce à un équilibre dynamique existant entre l'hématopoïese et la destruction globulaire, une courbe de radio-activité à décroissance rapide indique une survie réduite des hématies avec une hématopoïese compensatrice accrue. Lorsque la masse globulaire diminue pendant la durée du test, une courbe à décroissance rapide est également le signe d'une survie globulaire réduite. Dans ce cas, l'hématopoïese tout en étant normale ou augmentée, ne parvient pas à compenser la destruction globulaire importante.

Nous avons vérifié à plusieurs reprises l'existence d'une disparition prématurée des globules rouges. Nous n'avons pas eu la possibilité d'étudier la survie de globules rouges transfusés d'un donneur normal à un brûlé grave.

En conséquence, les globules rouges qui continuent à circuler sont certainement plus fragiles et ont une durée de vie plus courte que normalement. Le phénomène peut se prolonger pendant tout un temps et les globules rouges peuvent continuer à être plus fragiles et à être détruits en plus grande quantité pendant plusieurs semaines après la brûlure. Cette notion justifierait notamment l'anémie fort classique chez le brûlé.

4. Devant la gravité de l'oligurie du brûlé, nous avons, comme beaucoup d'autres auteurs, tenté l'épuration sanguine extrarénale par rein artificiel. Nous n'avons jamais obtenu de succès parce que nous pensons que nous avons utilisé ce rein artificiel trop tard.

Un point nous parait important: si dans des cas de néphrite aïgue toxique ou autre, on peut sans difficulté atteindre des taux d'urémie dépassant 5 gr/litre, chez le brûlé, des taux de ce genre sont toujours mortels car ils s'accompagnent d'une élévation concomittante, notamment du taux de potassium qui peut rapidement atteindre des chiffres mortels. Ce déséquilibre est bien plus grave chez le brûlé et la possibilité d'ascension rapide d'électrolytes toxiques comme le potassium est grande. Il faut donc utiliser les moyens d'épuration beaucoup plus tôt qu'on a l'habitude de le faire chez le néphrétique classique. Il semble bien cependant que même pour les brûlés où on a utilisé à 2—3 reprises des méthodes d'épuration comme de dialyse péritonéale, jamais on n'a obtenu un rétablissement de la fonction rénale.

La lésion rénale serait-elle irréversible? C'est bien entendu dans le domaine possible.

Dans ces conditions, ce problème urinaire étant pour nous un problème important, nous nous proposons avec cette théorie de l'existence d'une toxine se développant à partir de la destruction globulaire rouge ou d'un autre point de départ que nous ignorons, sur des brûlés très graves dont le pronostic est mauvais, d'effectuer une dialyse péritonéale précoce afin d'essayer d'éliminer cette toxine avant qu'elle n'ait le temps de se fixer en quantité suffisante sur le rein.

Il semble que les toxines vasoconstrictrices des globules rouges soient des polypeptides à poids moléculaire peu élevé et qui seraient donc dialysables.

Nous savons parfaitement qu'il s'agit là d'une vue peut-être futuriste ne se basant pas sur des travaux de laboratoire suffisamment importants. Nous croyons cependant que la réalisation en laboratoire d'une brûlure superposable dans tous ses aspects cliniques à celle que l'on peut obtenir chez l'homme est difficile, pour ne pas dire impossible.

5. Nous voudrions encore faire quelques remarques sur le plan des points discutés à l'heure actuelle dans la pathologie des brûlures.

Les discussions sur l'emploi du plasma, des solutions à grosses molécules du type Dextrane ou Macrodex, sont un peu byzantine. Il n'y a pas de différence essentielle entre les deux. S'il y a incontestablement un certain risque d'hépatite en employant le plasma, ce risque n'est pas tel que le produit doive être rejeté définitivement.

Le but que nous essayons d'atteindre à l'heure actuelle est de pouvoir greffer certainement le 14ème. jour. Chez les grands brûlés, nous greffons pratiquement toujours le 14ème. jour et nous greffons le plus souvent avec des homogreffes, sans avoir pris de précautions spéciales vis à vis du donneur, qu'il s'agisse de groupes sanguins voisins ou non. La couverture par greffes donne des résultats fort satisfaisants et elle permet d'attendre en toute sécurité la guérison des brûlures qui doivent guérir spontanément et qui peuvent être le terrain favorable pour la prise d'autogreffes ultérieures.

Quand on est arrivé à une stabilisation du brûlé satisfaisante le 14ème. jour, on peut sans risque spécial effectuer l'intervention sous hypotension contrôlée afin de diminuer les pertes sanguines anormales.

Pour terminer, nous voudrions insister sur les difficultés que nous rencontrons dans le prélèvement sanguin chez les grands brûlés. Nous avons effectué des dénudations de la crosse de la saphène avec introduction de sonde dans l'iliaque ou la veine cave et nous avons eu, nous semble-t-il, des accidents thrombotiques. Je dis bien nous semble-t-il, car nous disposons dans notre pays de peu d'autopsie et par conséquent, nous n'avons pas toujours la vérification de la cause de la mort de notre brûlé.

Nous sommes décidés à l'avenir à effectuer la dénudation de l'artère fémorale et de prélever par sonde du type Sedlinger, placée dans l'artère fémorale afin d'obtenir ainsi moins d'incidents phlébitiques, car nous pensons que la thrombose aïgue d'une artère est certainement moins fréquente que la thrombose veineuse.

Nous vous avons ainsi communiqué quelques points qui soulèvent dans notre pratique journalière, des difficultés majeures. Nous espérons que certains des points de vue exposés denneront lieu à discussion.

RÉSUMÉ

L'auteur expose les résultats obtenus par l'emploi des isotopes radio-actifs dans les examens qui peuvent être effectués pendant la période du choc de la brûlure, à savoir: l'emploi des globules rouges marqués au chrome radio-actif; la mésure de la masse sanguine par la méthode au chrome radioactif et par la méthode de la sérum-albumine marquée à l'iode; l'utilisation de la mésure de l'élimination de l'hippuran marqué à l'iode radio-actif; l'étude de la dégradation des globules rouges marqués au chrome.

En un second point, l'auteur insiste sur la valeur de la mésure de la diurèse, sur l'importance de la rétention du potassium et sur la valeur relative de la rétention urémique dans les troubles de l'anurie ou de l'oligurie qui peuvent accompagner les premiers jours de la brûlure.

Egalement est exposé le problème des troubles urinaires sans oligurie.

En 3ème lieu, l'auteur expose sa manière de faire en général chez le brûlé avec l'utilisation des divers produits injectés.

Il est aussi mentionné le problème du rein artificiel ou de la dialyse péritonéale.

L'auteur terminera en disant quelques mots sur la façon d'envisager le problème de la greffe ainsi que sur quelques difficultés pratiques rencontrées lors des injections médicamenteuses ou lors des prises de sang pour dosages.

SUMMARY

The Results of Work in the Factory Hospital of Cockerill-Ougrée

G. Proyard

A report is given of the use of radioactive isotopes for investigations that can be carried out at the period of burns shock. They are as follows:

The use of erythrocytes labelled with radioactive chrome. The measuring of blood volume with radioactive chrome and the method of iodized serum-albumin. The determination of the excretion of labelled hippuran from radioactive iodine.

In the second place the author stresses the importance of measuring urine volume, the importance of the retention of potassium and the relative importance of uraemic retention in disturbances — anuria and oliguria — which may be present in the first few days after sustaining burns.

He also deals with the problem of urinary disturbances without oliguria.

The method of treating burns with the injection of various substances is also discussed.

Artificial kidney and peritoneal dialysis are mentioned.

The author gives an account of his own work with transplantation, he gives a statement of the problem and the difficulties confronted on injecting various drugs and during the withdrawal of blood for investigations.

ZUSAMMENFASSUNG

Arbeitsergebnisse im Betriebskrankenhaus Cockerill-Ougrée

G. Proyard

Die vorliegende Arbeit berichtet über die Verwendung von Radioisotopen bei Untersuchungen, die im Stadium des Schocks bei Verbrennungen durchgeführt werden können. Es sind dies folgende:

Verwendung von mit radioaktivem Chrom markierten Erythrozyten. Messung des Blutvolums mit Hilfe radioaktiven Chroms und der Jodierung von Serumalbumin. Messung der Ausscheidung von mit radioaktivem Jod markierter Hippursäure.

An zweiter Stelle möchte der Verfasser die Bedeutung der Messung der Diurese hervorheben sowie die Wichtigkeit der Kaliumretention, besonders bei Anurie oder Oligurie, die in den ersten Tagen nach der Verbrennung auftreten können.

Es werden auch Probleme der Harnstörungen ohne Oligurie erörtert.

Der Verfasser erwähnt die Behandlung von Patienten mit Verbrennungen mit verschiedenen Injektionspräparaten,

erörtert Probleme der künstlichen Niere und der Peritonäaldialyse

und diskutiert schliesslich die eigentliche Arbeit bei der Transplantation und einige andere Schwierigkeiten, die bei der Injektion verschiedener therapeutischer Präparate und bei der Blutentnahme zu Untersuchungszwecken vorkommen können.

J. Šmahel, Z. Charvát

FATTY TISSUE IN PLASTIC SURGERY

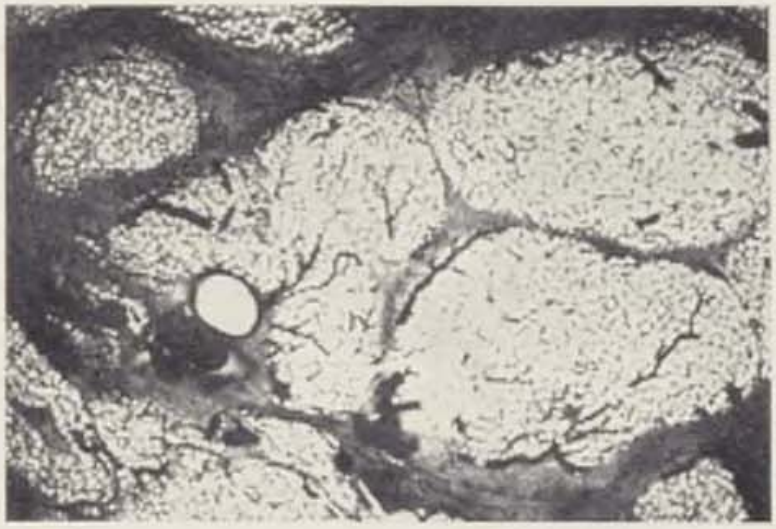

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

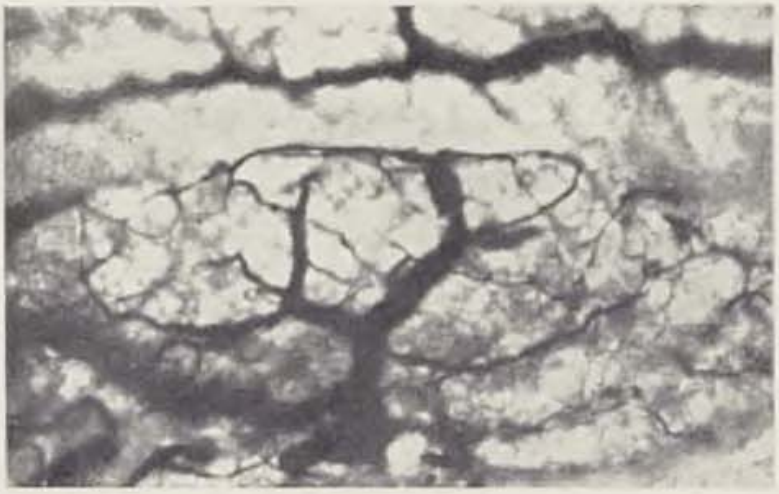

Fig. 5.

Fig. 6.

Fig. 7.

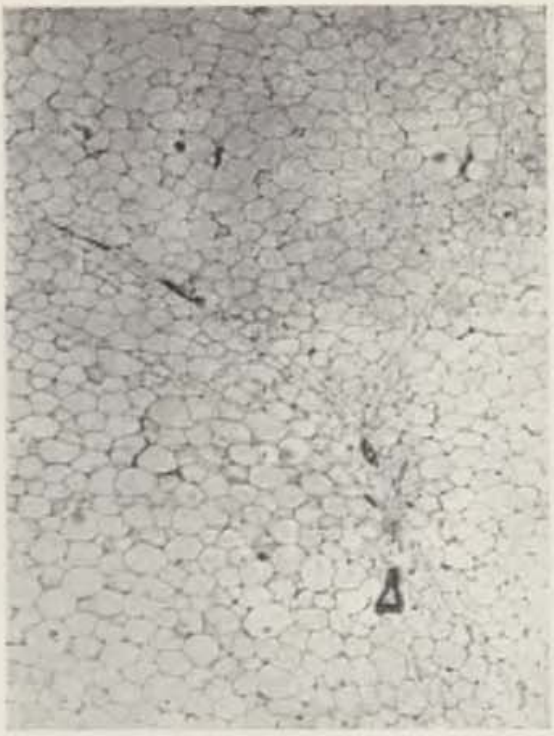

Fig. 8.

Fig. 1. Frozen section of fatty tissue from subcutaneous tissue of human forearm. Vessels filled with injection solution. Left upper corner, 2 isolated microbules, in centre and to right agglomeration of several microlobules, separated by fine septae. — Fig. 2. Section of fatty tissue, about 1 mm. thick, high magnification. Below in centre, joint entry of arteriole with narrow lumen (right) and venule with wide injected lumen (left) into-microlobule. — Fig. 3. Section of fatty tissue, about 500 μ thick, with same magn. as Fig. 2. Microlobule sectioned longitudinally, showing afferent arteriole with its typical acute-angled branches running longitudinally. — Fig. 4. Section of fatty tissue, about 500 μ thick, with same magn. as in Fig. 2. Microlobule shown in plane perpendicular to that in previous figure. In centre arteriolar branches running to periphery, cut close to branching off from afferent arteriole. — Fig. 5. Section of fatty tissue, about 1 mm. thick. Marginal course of branches of venules draining microlobule which is in this way exactly defined against the neighbouring fatty microlobule. — Fig. 6. Section of subcutaneous tissue of about 1 mm. thickness. Single microlobules separated from each other by thick connective tissue septae, in which there are no blood capillaries. — Fig. 7. Diagram of vascular system of fat microlobule. Smaller vessel entering microlobule on right below is arteriole; thicker is the venule collecting its branches from surface of microlobule. — Fig. 8. Paraffin section of fatty tissue. Detail of agglomeration of three already joined microlobules. Only little evident boundary between two microlobules runs from right lower corner to centre, where near a small venule it runs in Y-shape to the border of the third microlobule.

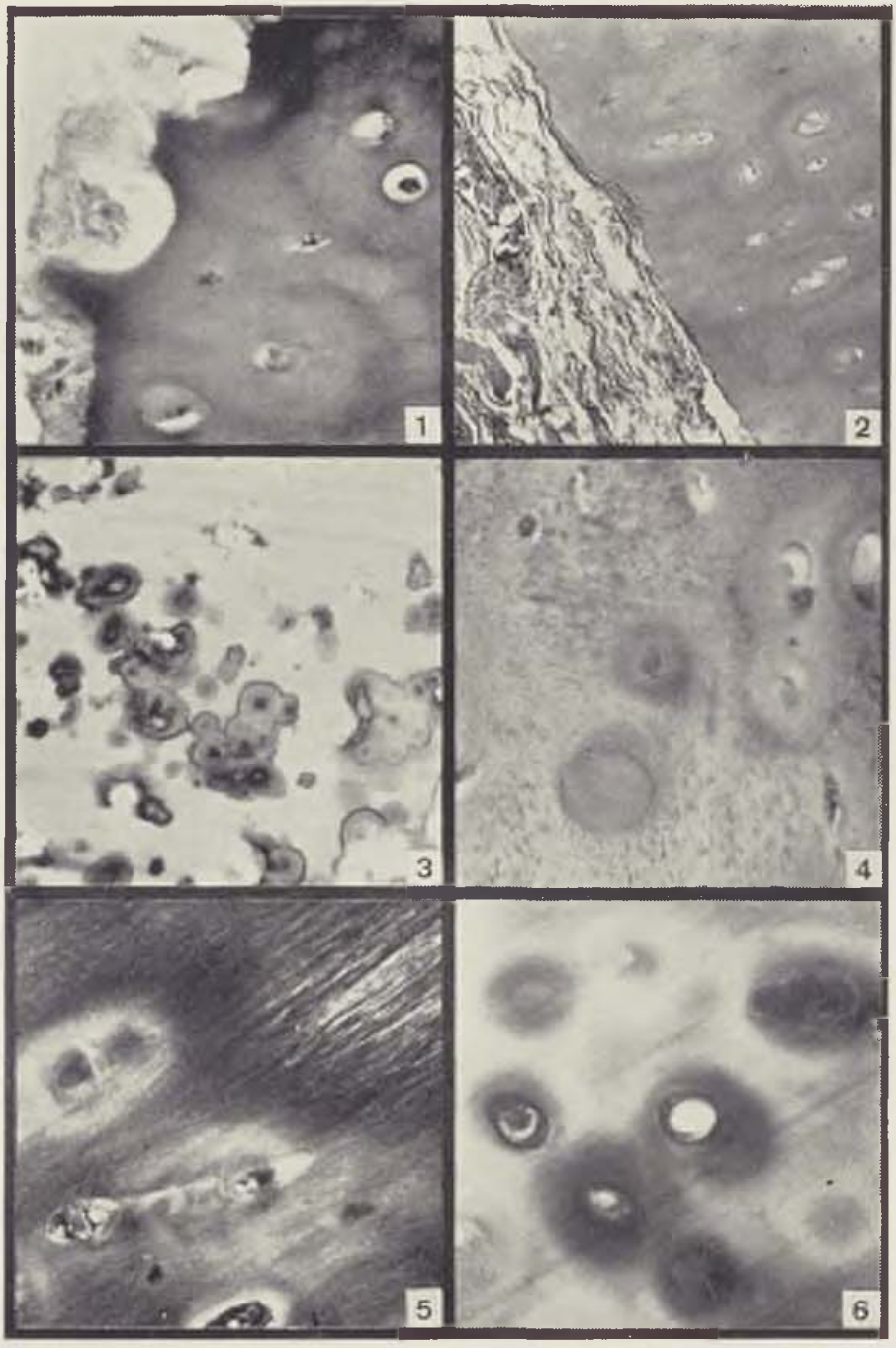

Fig. 1. Graft after 4 weeks. — Preserved cartilage structure and well visible chondrocytes. At the periphery of the graft are recesses invaded by connective tissue. — Stained with haematoxylin and eosin. Magn. 550×. — Fig. 2. Graft after 4 years. — Hyaline cartilage with preserved histological structure and enveloped in fibrous connective tissues. — Stained with haematoxylin and eosin. — Magn. 350×. — Fig. 3. Graft after 2 years. — Calcification in matrix of implanted cartilage. — Stained with haematoxylin and eosin. — Magn. 350×. — Fig. 4. Graft after 18 months. — Parvigranular decomposition in matrix of implanted cartilage. — Stained with haematoxylin and eosin. — Magn. 550×. — Fig. 5. Graft after 1 year. — Appearance of argentaffin fibres in matrix of graft. Impregnation with silver according to Gordon-Sweet. — Magn. 550×. — Fig. 6. Graft after 13 months. — Acid mucopolysaccharides around cartilage capsules preserved, demonstrated with Astra blue. — Magn. 550×.

RESUMEN

Los resultados del trabajo adquiridos en el hospital de empresa de Cockerill-Ougrée

G. Proyard

En este trabajo el autor nos informa sobre el empleo de los isótopos radioactivos en las examinaciones las que pueden ser efectuadas en el período del choque en los quemados.

Se trata de los siguientes isótopos:

El empleo de los eritrocitos marcados con el cromo radioactivo. La medición del volumen sanguíneo con ayuda del cromo radioactivo y por el método del suero-albúmina con yodo. El empleo de la medición del relajamiento del hipurano marcado por el yodo radioactivo.

En el segundo lugar el autor quiere enfatizar la importancia de la medición de la diuresis, la importancia de la retención del potasio y la importancia relativa de la retención urémica durante perturbaciones — anuria y oliguria — que pueden aparecer durante los primeros días después de la quemadura.

Simultáneamente se presentan en este trabajo los problemas urinarios sin oliguria.

Se presenta la técnica de la asistencia a los quemados con ayuda de varios preparados inyectables y

el problema de un riñón artificial y de la diálisis peritoneal.

El autor, luego, presenta algunas notas acerca de su propio trabajo referentes a la transplantación y su actitud en cuanto a unas dificultades que aparecen durante la inyección de algunos remedios y durante la toma de la sangre necesaria para la investigación.

(Dr. G. Proyard): Société Anonyme Cockerill-Ougreé, Service Médical, Seraing, Belgique

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Presenté en novembre 1963 à Prague à l'occasion de la Conférence de toxémie des brûlures.

Centro Nacional de Especialidades Quirúrgicas, Servicio de Cirugía Plástica,
Madrid (España)
Jefe: Dr. B. Vilar-Sancho

CIRUGÍA DE LAS CICATRICES ALOPÉCICAS DEL CUERO CABELLUDO

B. VILAR-SANCHO

Las pérdidas de sustancia del cuero cabelludo dan lugar a defectos tanto en el orden funcional como en el estético; los primeros, es decir, los funcionales son generalmente de fácil solución, pues suelen reducirse a úlceras, más o menos tórpidas, susceptibles de tratamiento mediante plastias locales o injertos libres, en cambio, el factor estético que implican estas pérdidas de sustancia, aunque evidentemente está limitado a la pérdida del cabello, es de mucho más difícil solución, por ser el cuero cabelludo un órgano muy diferenciado y su localización circunscrita al cráneo.

A nuestro juicio, no todas las partes del cuero cabelludo tienen el mismo valor estético y es más, consideramos en muchas ocasiones una cicatriz alopécica relativamente grande situada en una zona poco aparente de menos enjundia que otra menor radicada en una parte muy visible. Así en terminos generales, creemos poder dividir de delante hacia atrás el cráneo en tres segmentos cuya importancia estética varía considerablemente. 1. La zona anterior temporo-frontal, con sus prolongaciones pre-auriculares o patillas, de decisiva trascendencia al constituir la línea de demarcación más clara y conspicua del cuero cabelludo (Kazanjian, 1; Stark, 2; Vilar-Sancho, 3) cuya destrucción es debida, en general a caídas frontales sobre el fuego. 2. La zona media parietal, que constituye la zona donante por excelencia, porque siendo la menos ostensible es la que, como más adelante veremos, nos proporciona el cuero cabelludo necesario para las reconstrucciones; sus lesiones provienen con gran frecuencia de derramamientos accidentales de líquidos calientes sobre la cabeza de los niños. 3. La zona posterior occipital en la que el factor estético sin llegar a tener el alcance que tiene en la parte anterior, no deja de ser de consideración, especialmente si la alopecia tiene una cierta magnitud y aún más, si implica la línea posterior de implantación; tienen estas lesiones su origen en caídas de espaldas sobre el fuego, cuando no son secuelas, como en el grupo anterior, de derramamientos de líquidos calientes.

Las demarcaciones que hemos descrito, aunque ciertamente artificiales, son de una importancia considerable para sistematizar el tratamiento de las cicatrices alopécicas, a pesar de que es evidente la imposibilidad de amoldar a zonas de límites precisos las quemaduras y sus secuelas.

Fig. 1a.

Fig. 1b.

Fig. 1 a, b. Cicatriz alopécica de la zona fronto-temporo-parieto-occipital derecha.

Aunque generalmente las quemaduras que producen cicatrices alopécicas van unidas a defectos más o menos graves de las partes contiguas, especialmente las anteriores o frontales, no es menos cierto que no son raros los casos en que esta correspendencia, que parece lógica, no existe. El motivo por el cual una quemadura superficial produce, sin embargo, grandes cicatrices alopécicas, no puede ser otro que la infección. Es esta infección la que trae consigo la destrucción de los folículos pilosos que resisten el efecto directo de la quemadura y aun es la responsable de la extensión del área alopécica a zonas alejadas de la región quemada (Gonzalez Ulloa, 4). A lo anterior podemos añadir que en ciertos

Fig. 1c.

Fig. 1d.

Fig. 1 c, d. Resultado del tratamiento mediante colgajo fronto-parietal del lado sano para la reconstrucción de la parte anterior y colgajo occipital para la parte lateral inferior.

casos, a pesar de no sobrevenir infección alguna, puede producirse una pérdida del pelo con posterioridad a la quemadura, debida a la retracción cicatrizal que occurre por el mecanismo mismo de la reparación y que puede producir por constricción una reducción del aporte sanguíneo a los folículos pilosos, muy sensibles a ella, con la subsiguiente pérdida del cabello.

Consideramos necesario insistir una vez más, antes de entrar en los detalles de pura técnica local, en una serie de conceptos de carácter general en el tratamiento quirúrgico del cuero cabelludo, que juzgamos esenciales para poder llevar a feliz término cualquier operación en ese terreno.

La reparación del cuero cabelludo sólo es posible de una manera efectiva mediante el empleo del mismo cuero cabelludo, (Smith, 5) osease por plastias locales, pues no hay ningún lugar del organismo capaz de proporcionar nada que se asemeje ni aún remotamente, al aspecto peculiar de esta zona cutánea (Pick, 6; Correa Iturraspe, 7), por ello el estudio y el planteamiento previo de las operaciones es tan esencial en esta cirugía, de forma que no haya la menor pérdida de cabello y se consiga obtener lo máximo del existente. Las características anatómicas del complejo que denominamos cuero cabelludo, son especialmente propicias, por una parte, y desfavorables por otra, para realizar la cirugía que, como hemos dicho, es axiomática en esta región, es decir, la de los colgajos locales. La disposición de los vasos sanguíneos en el cuero cabelludo con una dirección general de la periferia hacia el centro, así como la práctica falta de irrigación profunda, es esencialmente favorable para el trazado de plastias locales, pues siempre resulta fácil incluir en el colgajo un vaso importante. Sin embargo, la presencia de la gálea aponeurótica hace del cuero cabelludo un elemento prácticamente inextensible, lo que limita mucho las posibilidades de las plastias por deslizamiento y colgajos de avance a no ser en sentido antero-posterior y merced a grandes despegamientos o bien en la periferia donde la gálea es más delgada y por tanto de menor consistencia. Esto hace que tengan aquí especial indicación los colgajos de rotación (Gillies, 8; Lagrot. Greco, Coriat, Bensoussan y Py, 9; Kazanjian y Webster, 10; Figi y Morgan, 12) y de una manera particular los de transposición, que aprovechando la ventaja primeramente expuesta, soslayan el inconveniente de la falta de extensibilidad y aún la utilizan en su propio provecho, pues constituye una protección para la vascularización del colgajo que queda preservado de una excesiva elongación. Aunque de todo lo expuesto se deduce la posibilidad de trazar colgajos extraordinariamente largos, hasta de seis veces su ancho, prácticamente imposible en cualquier otra parte del organismo, nunca dejamos de hacer una dilación y aun a veces dos, especialmente cuando el vaso sobre el que basamos el colgajo no es muy importante, o cuando sobrepasamos, lo que ocurre con frecuencia, la línea media. La dilación por otra parte, podemos reducirla al trazado de la incisión, sin necesidad de levantar el colgajo de su lecho (Dingman, 13). pues, como ya hemos apuntado, y es comúnmente sabido, los vasos emisarios son de escasa importancia y reducido número; sin embargo, hay que tener en cuenta que la incisión debe profundizar a lo largo de toda su extensión hasta el espacio subaponeurótico, de forma que nosotros la realizamos superficialmente primero con bisturí dividiendo luego la parte profunda con tijera, a fin de ase-

Fig. 2a.

Fig. 2b.

Fig. 2a. Cicatriz alopécica fronto-temporal izda. — Fig. 2b. Resultado inmediato obtenido con un colgajo temporo-parietal.

gurar tanto la completa sección del cuero cabelludo como la integridad del periostio. En general, no realizamos otra hemostasia que la sutura (Vilar-Sancho, 14; Gillies y Millard, 15) y siguiendo a Gillies (15) infiltramos previamente la línea de incisión con novocaína-adrenalina, a fin de reducir la hemorragia, pues tratamos de evitar dejar cuerpos extraños en la línea de sutura y también procuramos evitar las escaras de la electrocoagulación.

Del factor negativo del cuero cabelludo, es decir, de su escasa elasticidad, se sigue que las áreas donantes de los colgajos de transposición no son susceptibles de ser cerradas por aproximación en la mayoría de los casos, como lo son en otras partes del organismo, sino que requieren ser cubiertas mediante un aporte cutáneo de otro lugar. Cuando consideramos que la zona alopécica que va a ser sustituida por el colgajo portador de pelo, nos de garantías suficientes de estabilidad, la utilizamos para cubrir el área donante, o bien en forma de colgajo o en forma de injerto libre de piel total; para ésto último la desproveemos previamente de la gálea y tejido celular subcutáneo que pudiera llevar. Con este proceder evitamos al paciente las molestias que representa la obtención de un injerto libre de piel hendida de otra parte de su organismo. En general, no reducimos a un injerto libre de piel hendida la piel excindida, por la relativa complicación que supone y porque esta piel no es nunca del todo normal. En caso contrario, es decir, cuando la zona a ser sustituida es cicatrizal y en particular cuando ha sufrido ulceraciones, la desechamos y pasamos a obtener un injerto libre fino de piel hendida con el que cubrimos el área cruenta del lecho del colgajo. El motivo de preferir el injerto fino al grueso es por su mayor tendencia

Fig. 3a. Fig. 3b.

Fig. 3a. Cicatriz alopécica fronto-biparietal. — Fig. 3b. Trazado del colgajo temporo-biparietal izquierdo.

a la retracción, pues lo que en otras partes constituye un inconveniente, aquí redunda en ventaja, pues esta retracción tiende a achicar la propia área alopécica del injerto.

Nosotros por principio, en cualquier operación estética realizada en adultos, somos contrarios a cortar el pelo, pues aunque es cierto que facilita tanto la limpieza como la realización de la operación misma, también constituye de por sí un empeoramiento estético, especialmente en la mujer, que tarda bastante en compensarse y hay que considerar que la operación se realiza para mejorar justamente la estética. Sin embargo, en niños de ambos sexos y aún en hombres, procedemos con frecuencia al rapado no demasiado corto y, desde luego, nunca al afeitado. Prevenimos de ésto a los noveles, pues en niños, especialmente en los de pelo muy claro, es difícil después del afeitado, distinguir la línea de implantación. na limpieza a fondo con soluciones antisépticas acuosas y detergentes,

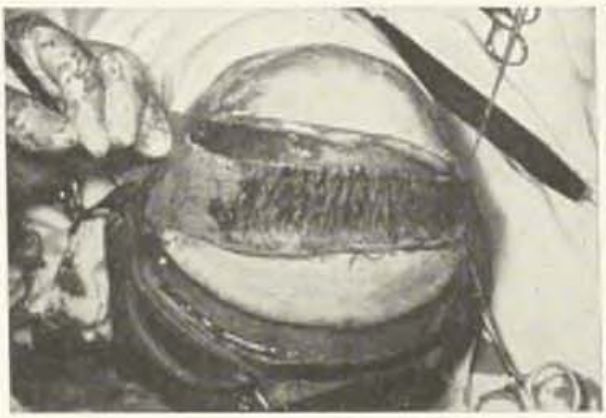

Fig. 3c. Fig. 3d.

Fig. 3c. Transposición del colgajo de piel alopécica y del colgajo temporo-biparietal. — Fig. 3d. Resultado final.

de toda la cabeza, es suficiente para prevenir cualquier infección que pudiera tener su punto de arranque en el pelo.

Ya analizados los factores generales del tratamiento quirúrgico de los defectos del cuero cabelludo por medio de plastias locales, centraremos nuestra atención, en primer lugar, en la reparación de la zona anterior o frontal y la dividiremos en tres sectores, uno central, correspondiente a la frente misma y dos laterales que abarcan aproximadamente desde un punto imaginario situado en la prolongación vertical de la cola de la ceja correspondiente, hasta la región pre-auricular comprendiendo la patilla; la lesión de esta última región del cuero cabelludo si está aislaba es debida, en la mayor parte de los casos, a caídas laterales sobre el fuego.

Nuestra manera de actuar varía considerablemente no sólo con la extensión de línea anterior destruida, sino en relación a la profundidad en dirección parieto-occipital de la cicatriz alopécica, es decir, si se limita al área anterior o invade también la zona media y aún la posterior, ya que plastia que cada tipo requiere para su reconstrucción es esencialmente diferente.

Podemos dividir los colgajos que nosotros empleamos en la reconstrucción de la región anterior, en cinco grupos fundamentales: el colgajo fronto-parietal (Vilar-Sancho, 14), que usamos en las quemaduras con destrucción del pelo correspondiente a la mitad o más en sentido sagital de la zona anterior y zona media. Segundo, el colgajo temporo-parietal que tiene especial indicación en las quemaduras laterales de la región anterior. Tercero, el colgajo temporo-biparietal indicado en las alopecias de toda la región anterior y por último, los dos colgajos que empleamos para la reconstrucción de la región-preauricular o patilla: complementario el uno del colgajo temporo-parietal, mientras que el otro es un colgajo fronto-parieto-temporal.

El trazado del colgajo fronto-parietal que realizamos con base frontal, la construimos de un ancho nunca inferior a los 3 cm. y lo trazamos contiguo al área alopécica con una longitud que nos viene dada por la cuantía de línea destruida, pues debe ser suficiente para reconstruir todo el área central y aun parcialmente la lateral, una vez que se ha girado 90 grados; requiere una operación de dilación previa cuando su longitud es de tres veces su anchura y es conveniente repetirla cuando esta relación se inclina hacia la longitud. De esta forma es posible, de una manera muy aceptable, reconstruir una zona de pelo de gran importancia estética, (Fig. 1 a, b, c, d), siendo la zona donante muy poco visible y fácil de disimular. En algunas ocasiones cuando el colgajo transpuesto es muy ancho, conviene, unos meses después, hacer una pequeña operación para aplanar la obligada orejuela que el giro del colgajo ocasiona en su base.

Como ya dijimos, los colgajos temporo-parietales tienen aplicación para reparar las destrucciones laterales puras o cuando el área central afecta es escasa; no los consideramos indicados cuando la zona alopécica rebasa considerablemente la línea posterior de la oreja. La máxima ventaja de estos colgajos sobre los anteriormente descritos, es que, en general pueden solucionar el problema con una simple rotación hacia adelante y si requieren una transposición, la nueva área alopécica creada es mínima. (Fig. 2 a, b). También es de destacar que si son suficientemente anteriores, es posible basarlos en la arteria temporal

Fig. 4a. Fig. 4b.

Fig. 4a. Cicatriz alopécica fronto-biparietal y temporal derecha. — Fig. 4b. Resultado inmediato después de la transposición de un colgajo temporo-biparietal derecho (observese la franja de pelo en la zona central del cráneo).

superficial, con lo que se hace innecesaria la operación de dilación. Su trazado es siempre continguo a la zona alopécica.

El tercer tipo de colgajo que hemos mencionado, el temporo-biparietal, lo llamamos así por sobrepasar la línea media y tomar el cuero cabelludo de la región media del lado opuesto a su base. Su aplicación, como ya dijimos, es de gran valor cuando la destrucción del pelo abarca toda la línea anterior de implantación. Este colgajo por su gran longitud y por sobrepasar, como ya hemos dicho, la línea media, no lo transponemos sino después de dos dilaciones previas, lo que nos da suficientes garantías. En cuanto a su relación con la zona alopécica podemos hacerlo continguo a la misma o bien dejar una zona intermedia con pelo; lo primero lo realizamos especialmente cuando la quemadura se limita al área del frontal, (Fig. 3 a, b, c, d) es decir, que profundiza poco en dirección antero-posterior, mientras que cuando ocupa la mitad o más de la cabeza, dejamos una franja de un ancho semejante a la del colgajo para dividir en esta forma en dos la gran superficie alopécica y de esta forma hacerla menos conspicua (Fig. 4 a, b); en este caso el colgajo es en parte occipital. Preferimos nosotros este tipo de colgajo único al colgajo doble de Kazanjian y Converse (16) por no dejar de esta forma cicatriz de unión en la línea media y porque podemos movilizarlo después de dos dilaciones, es decir, terminar con tres operaciones, en total, cuando con los colgajos dobles a poco largos que tenga que ser y esto ocurre siempre cuando la zona alopecica sea muy posterior, necesitamos cuatro operaciones.

Atención especial con Benaim (17) y Correa Iturraspe (18), nos merece la reconstrucción de la zona pre-auricular llamada patilla, de considerable interés estético, tanto en el hombre como en la mujer, aunque hemos de renunciar, es cierto, en aquellas cicatrices alopécicas de gran extensión, pues no compensa emplear una porción de cuero cabelludo en esta zona, que aunque importante, lo es menos que otras. Para su reparación hemos venido empleando dos procedimientos diversos que son parte al mismo tiempo de la reconstrucción de la

Fig. 5a.

Fig. 5b.

Fig. 5a. Cicatriz alopécica de la zona fronto-parieto-temporal izquierda. — Fig. 5b. En una primera intervención se ha trazado un colgajo de rotación temporo-parietal sobre el que posteriormente se ha trazado un colgajo retrogrado para reconstruir la zona pre-auricular.

Fig. 5c. Resultado final.

parte lateral de la implantación anterior del pelo. En nuestro más primitivo procedimiento comenzamos por trazar un colgajo de rotación basado en la región retro-auricular y que bordea la zona alopécica en la misma forma que procedíamos en el apartado segundo. A este colgajo le damos un ancho de 5 a 6 cm. y en un solo tiempo, es decir, sin dilación previa, lo giramos hacia delante reduciendo de esta manera la región alopécica temporal y creando una nueva detrás del colgajo, aunque dada la forma de movilizar éste, es decir, mediante rotación, es siempre menor que la cubierta. En un segundo tiempo trazamos sobre la parte anterior del colgajo cercana a su base, un colgajo retrogrado de suficiente longitud y anchura para formar la patilla, limitándonos en este primer tiempo a una dilación. Este colgajo se transpone por encima de la oreja hasta reconstruir con él la parte más inferior de la línea de implantación anterior y formar la patilla a las 3 semanas de la dilación. La superficie cruenta la cerrabamos parcialmente por aproximación, cubriendo el resto con la piel excindida. De esta forma se consigue normalizar de una manera casi absoluta toda la región lateral y anterior (Fig. 5a, b, c), con un minimo de defecto facil de ocultar y aún de excindir en tiempos sucesivos. Tiene su mayor aplicación cuando el área alopécica penetra hacia atrás profundamente, pero no sobrepasa la vertical de la parte posterior de la oreja. Su mayor inconveniente estriba en que la formación de la patilla en la forma indicada conlleva un mínimo de 2 ó 3 operaciones, pues la situación retrogada del congajo obliga en algunos casos a repetir la dilación previniendo su posible necrosis.

En la actualidad, sin desechar en forma alguna la manera de proceder descrita, nos inclinamos en muchas ocasiones por el empleo de un colgajo fronto-parieto-temporal de base por tanto anterior, que bordeando la cicatriz alopécica se dirige hacia atrás y que rotamos o transponemos, según la cuantía del defecto, hacia delante, después de una dilación previa. Este colgajo lo trazamos suficientemente largo para que su extremo venga a formar la patilla. En general, después de transpuesto el colgajo, cuyo defecto cubrimos teniendo por principios los que expusimos para cubrir las áreas cruentas, queda el borde anterior un poco rectilíneo, lo que se remedia posteriormente en una operación encaminada a reducir el área alopécica y que al tirar de la parte posterior del colgajo lo desplaza hacia atrás, mejorando su aspecto final (Fig. 6 a, b, c).

Nada tenemos que decir en cuanto al tratamiento de las cicatrices alopecicas de la zona media, pues como hemos dicho, no tiene transcendencia suficiente de por sí merecer una operación y solamente cuando son extensas y salen de sus límites propios para adentrarse en la frontal y occipital, es cuando podemos tratar de reducirlas por medio de excisiones múltiples; pues a pesar de que dijimos que las plastias de deslizamiento era de muy limitada utilidad en el cuero cabelludo, tambien dijimos que podemos obtener algo de ellas cuando la realizamos en sentido antero-posterior y con ello y merced a muy amplios despegamientos, en la forma que también ya apuntamos, con seguir unos resultados bastante aceptables. No somos por otra parte, partidarios de incindir la gálea, como preconizan varios autores (Smith, 5; Gillies y Millard, 15; Kazanjian y Converse, 16; McCash, 11), paralelamente a la línea de

Fig. 6a. Fig. 6b.

Fig. 6a. Cicatriz alopécica fronto-temporal derecha. — Fig. 6b. Resultado inmediato después de la utilización de un colgajo de rotación fronto-parieto-temporal para reconstruir la línea de implantación frontal y la zona pre-auricular.

Fig. 6c. Resultado después de resección parcial de la zona alopécica residual (observese la mejoría de la línea de implantación frontal).

excisión para conseguir una mayor elasticidad, pues es una maniobra que se raliza prácticamente a ciegas y por tanto podemos lesionar los vasos que discurren justamente por encima de ella y por otra parte, desprovistos estos vasos de su protección natural, pueden fácilmente ser colapsados contra la rígida pared del cráneo al traccionar fuertemente el cuero cabelludo para cerrar el defecto.

La región occipital o posterior nos merece una atención mayor que la zona media. Las cicatrices alopécicas que puede sufrir sin ser tan conspicuas ni tan difíciles de ocultar como las de la región anterior, entre otros motivos por la dirección hacia atrás en que se peina el cabello generalmente, tienen suficiente importancia como para merecer desplazar cuero cabelludo normal de la zona media parietal paar cubrirlas. Conseguimos estos desplazamientos a col-

Fig. 7a. Fig. 7b.

Fig. 7a. Cicatriz alopécica occipital. — Fig. 7b. Resultado mediante empleo de colgajo occipito-biparietal.

gajos de rotación o transposición en forma semejante a la que procedimos en la región anterior, pero no siendo tan necesario como en aquélla conseguir una perfección, podemos simplificar las operaciones aun a pesar que queden algunas pequeñas áreas alopécicas sin cubrir en la zona occipital, fácilmente ocultables, por otra parte. (Fig. 7 a, b.)

Queremos por último destacar que sistemáticamente reducimos en operaciones posteriores las zonas alopécicas, tanto las que no pudimos cubrir, como las que nuestra movilización de colgajo produce, pues siempre compensan estas operaciones en las que obtenemos el máximo que las plastias por deslizamiento pueden dar de sí en esta zona del organismo y que en muchas ocasiones, es ciertamente de consideración.

Tal vez considerada en su conjunto, se le pueda objetar a la cirugía de las cicatrices alopécicas del cuero cabelludo, la escasa trascendencia que la falta de pelo constituye para muchos, ya que un tanto por ciento bastante elevado de la población, pierde el cabello de una forma natural en zonas que aquí hemos descrito como muy importantes, sin que ello represente un grave trastorno para estos sujetos. A esta objeción, que no carece de cierta lógica, podemos oponer que una gran parte de la cirugía de las alopecias se realiza en individuos del sexo femenino y que en cuanto a los hombres, el defecto natural de la calvicie se instaura de una manera simétrica y paulatina, generalmente a una edad en que la natural presunción y vanidad va menguando y, aun así, si hubiera unas ciertas garantías de éxito en cualquier tratamiento, un gran número de estos "indiferentes" se sometería a él gustoso. La mejor prueba de lo dicho lo constituye el florenciente negocio de los „tónicos capilares" ...

RESUMEN

Las dificultades del tratamiento de las cicatrices alopécicas estriba fundamentalmente en la falta de áreas donantes similares al cuero cabelludo fuera del mismo cráneo.

Para una mejor sistematización del estudio de las cicatrices alopécicas y su tratamiento, se divide el cráneo en tres zonas: anterior, media y posterior, a las cuales se le da diferente importancia, destacando la frontal por ser la más visible y en la que la destrucción del pelo es más difícil de disimular.

Como la reparación estética del cuero cabelludo sólo es posible mediante el empleo de las zonas vecinas, se estudia con amplitud la utilización de los colgajos locales. Así mismo se repasan una serie de factores y de detalles de la técnica quirúrgica peculiar de esta zona, tales como la dilación de los colgajos, la forma de cubrir las zonas donantes de los mismos, etc.

Sequidamente se pasa al estudio detallado del tratamiento de las cicatrices alopécicas, describiendo los distintos colgajos empleados en las tres diferentes zonas anteriormente descritas, anterior, media y posterior. Para la primera de estas áreas, el autor se vale de 5 tipo de colgajos que denomina: 1^0 fronto-parietal, 2^0 temporo-parietal, 3^0 temporo-biparietal, 4^0 colgajo retrogrado sobre el temporo-parietal y 5^0 el fronto-parieto-temporal. Las distintas aplicaciones de todos estos colgajos, algunos de ellos originales del autor, son estudiados „in extenso", así como tambien se presta atención especial a la reconstrucción de las zonas de pelo pre-auriculares o patillas. Por su poca trascendencia se trata muy someramente de las alopecias de la región media, dando una relativa mayor importancia a las de la zona posterior.

SUMMARY

Surgical Treatment of Alopecia Cicatrisata of the Hairy Skin

B. Vilar-Sancho

The difficulties in the treatment alopecia scars chiefly arise from the lack in donor areas which, apart from the scalp itself, would have similar qualities as those of the hairy skin.

To make investigation and treatment of alopecia scars more systematic, the scalp is divided into three areas: the frontal, parietal and occipital. Each of these areas is of different importance; the most important is the frontal area, because it is most conspicuous, but, at the same time, the easiest to cover if its hair has been destroyed.

Cosmetic repair of the hairy skin can only be achieved by using local flaps. — In this chapter the author deals with many factors and details of the surgical technique specific for this region, such as the formation of flaps, coverage of the donor area, etc.

Then the author gives a detailed study of the treatment of alopecia scars and describes the various flaps used for the mentioned three areas, i.e. the frontal, parietal and occipital. For the frontal area he uses five types of flaps: 1. the fronto-parietal, 2. the temporo-parietal, 3. the temporo-biparietal, 4. the reverse temporo-parietal and 5. the fronto-parieto-temporal (flaps). The different modes of employment of these flaps, some of which have been originated by the author himself, are dealt with in minute detail and particular attention is paid to the preauricular hairy region, i.e. the side (whiskers, beard). Because of their lesser importance the author currently speaks of middle size baldheads paying relatively more attention to alopecias of the occipital region.

RÉSUMÉ

La chirurgie de la calvitie cicatricielle de la peau couverte de cheveux

B. Vilar-Sancho

Les difficultés que présente la thérapie des cicatrices alopéciques consiste essentiellement dans l'insuffisance des zones de prélèvement semblables à la peau couverte de cheveux, en dehors du crâne lui-même.

Pour faciliter des études plus systématiques sur les cicatrices alopéciques et leur thérapie, on a divisé le crâne en trois régions: la zone antérieure, moyenne et postérieure, en attribuant une importance différente à chacune de celles-ci et en insistant surtout sur la position de la zone frontale qui est la plus visible et où il est le plus difficile à masquer le manque des cheveux.

On peut réaliser une réparation esthétique de la peau couverte de cheveux uniquement à l'aide de lambeaux locaux. A cette occasion, certains facteurs et détails de la technique chirurgicale appropriée pour l'intervention dans cette région sont discutés, telles que la préparation des lambeaux et la façon de couvrir la région fournissant les lambeaux.

On présente également une étude détaillée de la thérapie des cicatrices alopéciques en décrivant les différents lambeaux employés pour les trois régions en question, c'est-à-dire la région antérieure, moyenne et postérieure. En ce qui concerne la première de ces régions, l'auteur utilise cinq espèces différentes de lambeaux auxquels il a donné les noms respectifs de: 1⁰ lambeau frontal-pariétal, 2⁰ lambeau temporal-pariétal, 3⁰ lambeau temporal-bipariétal, 4⁰ lambeau renversé temporal-pariétal et 5⁰ lambeau frontal-pariétal-temporal. Les applications diverses de tous ces lambeaux, dont certains sont originaux à l'auteur, sont étudiées «in extenso» et on insiste également sur la reconstruction de la région pré-auriculaire couverte de cheveux et de la région des favoris. Etant donné leur importance plus faible, on s'occupe moins des calvities de taille moyenne en consacrant le plus d'attention aux calvities de la région postérieure.

ZUSAMMENFASSUNG

Die Chirurgie der durch Narben bedingten Alopecie

B. Vilar-Sancho

Die Schwierigkeiten der Behandlung narbiger Alopecien beruhen vor allem im Mangel an geeigneten Stellen der Hautentnahme ausserhalb des Kopfes, die über eine ähnlich behaarte Haut verfügen.

Um das Studium der narbigen Alopecien und deren Behandlung systematischer zu gestalten, wird der Kopf in drei Regionen eingeteilt und zwar in eine vordere, mittlere und hintere Gegend, von denen einer jeden verschiedene Bedeutung zukommt, wobei das grösste Gewicht auf die Frontalgegend gelegt wird, da sie am sichtbarsten ist und ein Defekt der Behaarung hier am schwersten zu verdecken ist.

Eine ästhetische Korrektion von Defekten der behaarten Haut kann nur mit Hilfe lokaler Hautlappen vor sich gehen. In der vorliegenden Arbeit wird eine ganze Reihe von Details der chirurgischen Technik bei Eingriffen gerade in dieser Gegend angeführt, wie z. B. die Bereitung des Lappens, die Art, wie das Spendergebiet durch Lappen zu decken ist und anderes mehr.

Hierauf befasst sich der Verfasser mit dem eingehenden Studium der Behandlung narbiger Alopecien und beschreibt die einzelnen Lappen, die in den angeführten drei

Gegenden (der vorderen, mittleren und hinteren Kopfgegend) zur Anwendung gelangen. Für die vordere Kopfgegend verwendet der Verfasser 5 Arten von Lappen, die er folgendermassen bezeichnet: 1. der fronto-parietale, 2. der temporal-parietale, 3. der temporal-biparietale Lappen, 4. der Gegenlappen zum temporal-parietalen Lappen, und 5. der frontal-parietal-temporale Lappen. Die verschiedenen Applikationen dieser Lappen, von denen einige vom Verfasser stammen, werden in extenso studiert und besondere Aufmerksamkeit auch der Rekonstruktion der präaurikulären behaarten Gebiete und der Gegend des Backenbarts gewidmet. Im Hinblick auf ihre geringere Bedeutung wird die Glatze mittlerer Grösse nur kurz behandelt, wobei relativ grössere Aufmerksamkeit der Glatze in der Okzipitalgegend gewidmet wird.

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(Dr. B. Vilar-Sancho): Paseo de la Castellana, 88, Madrid - 6, España

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ERRATA

We wish to ask our readers to kindly correct the erroneous caption under the diagram on p. 25, Acta chirurgiae plasticae 5, 1, 1963. The diagram, according to which the author operates, is that of P. Randall, published in the latter's paper in Plastic and Reconstructive Surgery, Vol. 23, p. 331, 1959. Which improves upon Tennison's principle in that it permits more precise planning of the operation and preserves the discarted but a valuable portion of the lip. In the original recommendation of Tennison, like in Le Mesurier's operation, this portion is partly lost.

At the same time, the author wishes to apologize to Mr. P. Randall, M. D.

Š. Demjén, M. D.

Urologische Klinik der Medizinischen Akademie, Kraków (Polen)
Vorstand: Prof. Dr. E. Michałowski

EIN BEITRAG ZUR OPERATIVEN BEHANDLUNG DER HYPOSPADIE

E. MICHAŁOWSKI

In einer Arbeit, die im J. Urol. 89, 5, 698, 1963 erschien, wurden die an unserer Klinik bei operativer Behandlung der Hypospadie angewandten Verfahren ausführlich besprochen.

Nun möchte ich über eine Methode berichten, die in der erwähnten Arbeit nur angedeuted wurde, weil wir sie damals bloss in zwei Fällen angewandt hatten. Inzwischen wurden aber 7 Fäile auf diese Weise operiert und zwar mit vollem Erfolg. Dies berechtigt die folgende kurze Mitteilung.

Der Hauptvorteil dieser Operation besteht darin, dass man in einer einzigen Operationssitzung den Penis aufrichtet und den ersten Akt der Harnröhrenplastik ausführt (Abb. 1). Die Operation hat folgenden Verlauf: Aufrichtung und Verlängerung des Penis durch Ablösung der Harnröhre mitsamt der Chorda von den Corpora cavernosa penis. Nach vollständiger Aufrichtung des Penis rückt die abpräparierte Harnröhre zurück und zwar meistens bis zum penoskrotalen Winkel. Jetzt wird auf der vorderen Skrotumfläche ein Hautlappen gebildet und die lateralen Skrotumhauträndер abpräpariert. Ein plastischer Katheter wird in die Blase zur Harnableitung eingeführt; die Penishaut wird mit dem Skrotum vernäht.

Im zweiten Operationsakt wird der Penis von dem Skrotum abgetrennt.

Die Idee, bei Harnröhrenplastik die Skrotalhaut anzuwenden, ist ziemlich alt (Lenander, Bucknall, Cacci). In dem uns zugänglichen Schriftum fanden wir aber keinen Hinweis darauf, dass eine solche Plastik gleichzeitig mit der Aufrichtung des Penis ausgeführt werden kann. Das Verfahren scheint deshalb beachtenswert, weil eine Operationssitzung vermieden wird.

Der einzige Einwand, den man gegen die Methode anführen könnte, ist die Möglichkeit späteren Haarwuchses im Harnröhrenkanal. Diese Gefahr scheint uns aber geringfügig in Fällen, die in der ersten Lebensjahren operiert werden.

Die Skrotalplastik sollte nicht als Methode der Wahl betrachtet werden. Wegen möglichen Haarwuchses scheint sie für ältere Knaben und Erwachsene nicht angebracht. Sie sollte aber in Betracht gezogen werden bei Fällen, die in den ersten Lebensjahren operiert werden oder bei denen die ventrale Penishaut sich für die Plastik nicht eignet.

Krankengeschichten

Fall 1. B. A., 4 Jahre alt. Hypospadiasis penilis. Am 24. 8. 1962 die erste Operationsetappe: Aufrichtung des Penis; die Harnröhre wurde bis zum penoskrotalen Winkel verschoben. Aus der vorderen Skrotalhaut wurde ein Hautstreifen gebildet, der proximal direkten Anschluss an die Harnröhrenöffnung hatte und distal am Skrotalende gestielt wurde. Die Penishauträndei wurden mit den Skrotalhaurändern vernäht. Der Harn wurde durch einen plastischen

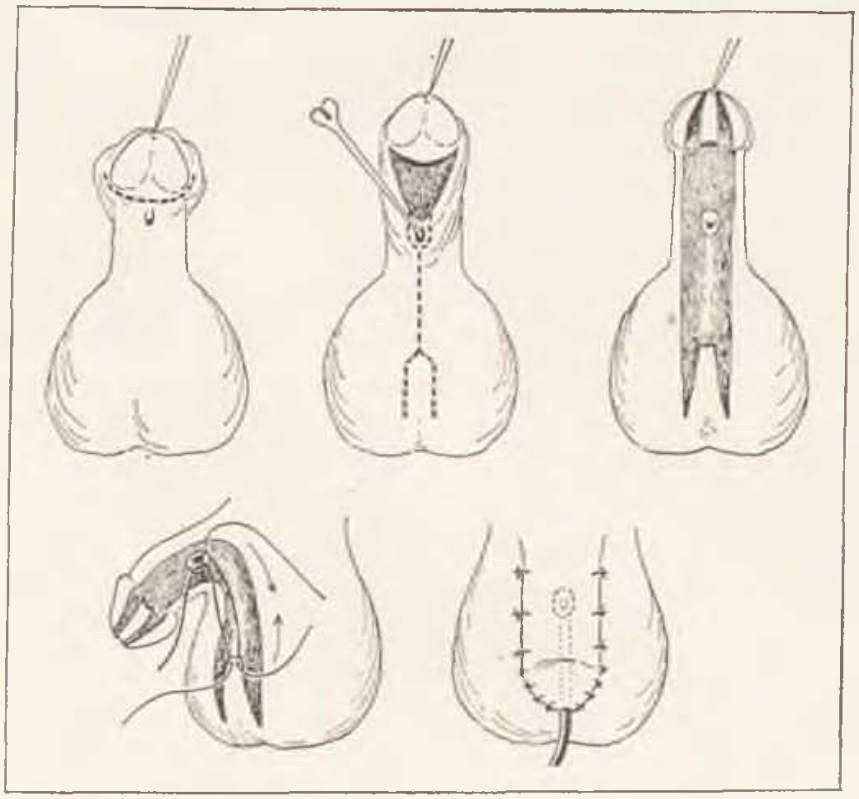

Abb. 1. Schematische Darstellung der gleichzeitigen Aufrichtung und skrotalen Harnröhrenplastik.

Drain nach aussen geleitet. 12 Monate später wurde der Penis vom Skrotum freipräpariert und die Hauträänder in der Mittellinie vernäht. Gutes funktionelles sowie kosmetisches Resultat. Die Harnröhrenmündung lag an richtiger Stelle am peripheren Ende der Glans.

Fall 2. H. K., 6 Jahre alt. Hypospadiasis penilis. Am 25. 8. 1962 wurde in einer Operationsetappe die Aufrichtung des Penis und Harnröhrenplastik mit der oben beschriebenen Technik ausgeführt. 3 Monate später wird der Penis vom Skrotum freipräpariert. Gutes funktionelles und kosmetisches Resultat.

Fall 3. K. K., 4 Jahre alt. Hypospadiasis retroglandularis. Nach Aufrichtung des Penis (am 11. 9. 1962) entstand eine Hypospadiasis penilis. Es wurde deshalb nur das periphere Segment der Harnröhre durch die skrotale Plastik ersetzt. 4 Monate später wurde der Penis vom Skrotum abgelöst.

Fall 4. H. S., 7 Jahre alt. Hypospadiasis penilis. Aufrichtung des Penis (am 8. 2. 1963) mit gleichzeitiger skrotaler Harnröhrenplastik vom peno-skrotalen Winkel bis zur Spitze der Eichel. 3 Monate später wurde der Penis vom Skrotum abgetrennt. Guter funktioneller und kosmetischer Erfolg.

Fall 5. K. A., 4 Jahre alt. Hypospadiasis penilis. Nach einer früher anderswo versuchten Aufrichtung war der Penis weiterhin gekrümmt. Es wurde deshalb von uns eine neue Aufrichtung und dabei auch der erste Akt der skrotalen Urethroplastik durchgeführt. Nach 6 Monaten Abtrennung des Penis vom Skrotum. Gutes funktionelles und kosmetisches Resultat.

In den letzten 2 Monaten wurden wieder zwei weitere Fälle nach dieser Methode operiert; die zweite Operationsetappe, d. h. die Ablösung des Penis vom Skrotum, wird aber erst in 2—3 Monaten ausgeführt werden.

ZUSAMMENFASSUNG

Es wird ein Verfahren beschrieben, bei dem der Penis aufgerichtet und gleichzeitig der erste Akt der Harnröhrenplastik durchgeführt wird. Dies vereinfacht und verkürzt wesentlich die operative Behandlung der Hypospadie.

(Prof. Dr. E. Michałowski): Ul. Grzegórzecka 18, Krakow, Polen

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The Czechoslovak Society of Plastic Surgeons and the Czechoslovak Academy of Sciences together with the Czechoslovak J. Ev. Purkyně Medical Association — surgical section — and the Slovak Academy of Sciences will hold a Surgical Congress with international participation in Bratislava, from June 28th to July 1st, 1965.

Main topics of programme: I. Surgery of Congenital Malformations. — II. Topical Subjects of Experimental and Plastic Surgery.

The main subjects will be discussed in the following sections: 1. Plastic surgery, 2. Paediatric surgery, 3. Cardiosurgery, 4. Neurosurgery, 5. General surgery.

We hereby invite plastic surgeons of all countries to participate actively in this Congress.

Kindly send applications for participation to the secretariat of the Congress by Nov. 15th, 1964. The title of the paper the participant intends to read, should be sent in two copies by Nov. 15th, 1964 and a short summary (20 lines at the most) in three copies by Dec. 15th, 1964.

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Department of Histology and Embryology, Medical Faculty, Hradec Králové
(Czechoslovakia)
Director: Prof. Vlastimil Vrtiš, M.D., RN.D.

FATTY TISSUE IN PLASTIC SURGERY

J. ŠMAHEL, Z. CHARVÁT

Observations about fatty tissue, particularly its origin, development, distribution and function, are of the utmost importance for plastic surgery since a large part of the fatty tissue in the human body is in the subcutaneous tissue in close morphological and functional connection with the skin which is the main sphere of interest of plastic surgeons.

The reactability and fate of fatty tissue concerns the surgeon most when considering its transfer in direct or tubed flaps or the free transfer of fatty tissue alone or together with part of the corium. Surgeons also take heed of fatty tissue in all free skin transplants when taking a graft superficial to the upper border of the fatty tissue or when carefully removing fatty lobules from the under surface of the skin, as they present a known obstacle to the take of free skin grafts. It is strange that despite this so little study has been carried out to increase our knowledge of fatty tissue, and the results of this are often controversial. We are in complete agreement with Wells (1940) and Peer (1959) that fatty tissue is a neglected subject of research.

Probably most surgeons who have made an implantation of a free fatty flap, either alone or together with the corium, would agree that the success of such a transplant is primarily dependent on the early formation of connections between the vessels of the recipient site and those of the graft, and on the renewal of the circulation. This process was studied in detail by Rossatti (1960) in rabbits. Part or complete loss of the graft is usually explained as due to the process of revascularization proceeding too slowly or failing completely.

Whether we accept the theory of the survival or of the replacement of the original vessels of the graft, these original vessels are of great importance in the process of revascularization and a knowledge of the blood supply of fatty tissue would therefore appear to be necessary for surgical practice. However, it is just at this point where our knowledge is small. The blood supply of fatty tissue has only been studied in detail by Spalteholz (1927), Petersen (1935) and Simon (1962). The important results of their work, however, are not generally known and are not even quoted in the clinical and theoretical literature. In addition, the results of these three authors show some discrepancies at certain points and also no attempt has yet been made to interprete them in relation to the problems of plastic surgery. For these reasons we felt justified in investigating the problem of the blood supply of fatty tissue.

MATERIAL AND METHODS

The investigations were made on human skin taken from various parts of the body, including the palm, finger tips, abdomen, gluteal region and hair-bearing skin of the scalp, etc. Most of the material, however, was forearm skin obtained at amputation. Immediately after the operation the vascular system was injected with a mixture of gelatine and Indian ink, which method was described in our previous paper (Šmahel and Charvát 1963). The investigations were made on frozen sections of forearm skin, 10—1,000 μ thick, which were cleared in glycerine and examined under the stereoscopic microscope and in a series of paraffin sections. The investigation was complemented by examining paraffin and frozen sections of the skin from other areas, stained with haematoxylin and eosin or by the benzidine method of showing up haemoglobin according to Pickworth.

ACTUAL OBSERVATIONS

The basic structure of units of fatty tissue in the subcutaneous tissue is the primary fatty microlobule (Fig. 1). It is a roughly circular or elliptical formation with a diameter of about 1 mm., composed of quite a large number of fat cells, covered with a fine connective tissue capsule. Such microlobules occur in the subcutaneous tissue either singly or, as is often the case, in agglomerations just forming secondary lobules of fatty tissue of varying size but usually of about 1 cm. in diameter, surrounded by a distinct connective tissue capsule (Fig. 1). The septae between microlobules in agglomerations in such a case are usually thin and sometimes hardly evident. The border between fatty tissue and the corium above it is irregular. Fatty tissue reaches nearest to the skin surface in the close vicinity of hair follicles.

Fatty microlobules are supplied with branches from the blood vessels of the subcutaneous plexus or from the so-called chandelier arteries (Petersen 1935), which branch off from the subcutaneous plexus, run roughly vertical to the surface of the skin and are the main vessels supplying the corium.

The arteriole and venule enter the primary microlobule together at one pole (Fig. 2). After running together for a short distance they separate. The arteriole and its branches run more towards the centre (Fig. 3, 4), and branch into a close network of capillaries round each fat cell. Blood from this capillary network collects into branches of the venules which mostly run along the circumference of the microlobules (Fig. 5). The vascular systems of the microlobules do not form capillary connections between one another or with the veins of the corium under which they are found (Fig. 6). They are thus independent vessel units and their afferent arterioles have the character of end arteries. A diagram of the vascular system of the fat microlobules is given in Fig. 7.

The secondary fat lobules, i.e. the agglomerates of microlobules, have a more complicated vascular system. The merging of the vascular system of the separate microlobules can occur and the typical course of the arterioles

and venules is apparently altered since, for example, on the confluence of three microlobules, the original marginal venules get to the centre of the agglomeration (Fig. 8). However, the vascular system of such an agglomeration as a whole has again a terminal character and does not form capillary connections with other agglomerates or with the vessels of the corium.

DISCUSSION

From the results obtained we consider it important to stress that the vascular systems of fat microlobules and their agglomerations, lobules, forms an independent vascular unit with a terminal character and does not form capillary connections with the vessels of the corium or with the vascular systems of other microlobules or lobules.

If we compare our results with the conclusions of Spalteholz (1927), Petersen (1935) and Simon (1962) we see that in the question of the terminal character of the blood supply to the fat lobules, our results are in accord with the findings of Petersen (1935) and Simon (1962). In the question of the course of the vessels in the microlobule our results support and complement the findings of Petersen (1935).

We can make three important deductions from the results obtained. First, although skin and fatty tissue are found in close morphological and functional connection, they are, to a certain extent, independent organs from the point of view of blood supply. This conclusion fills out the concept of Wells (1940) that fatty tissue is not ordinary connective tissue with fat stored in its cells but to a high degree, structurally, morphologically and functionally an independent and special organ. Secondly, nutrients and oxygen cannot be brought to the corium by the vascular system of fatty tissue since there is hardly any capillary connection between the two vascular systems. Thirdly, in view of the blood supply, the fat microlobule can only exist as a whole. Damage or cutting through a microlobule seriously endangers the nutrition of its fat cells resulting mostly in their necrosis, particularly in the part of the microlobule left without the vessel stem.

We will now attempt to apply these findings and conclusions in the explanation of some facts from surgical practice without implying that the whole question can be reduced merely to the angiological aspect.

It is a well known fact that the healing of skin wounds, whether sutured or not sutured, is often complicated by the disintegration and necrosis of fatty tissue in the base of the wound and under the undamaged edges. In extreme cases a lipophagic granuloma can develop. This can be explained by disruption of the entirety of the fat microlobules in the wound by the trauma with consequent necrosis of parts of the microlobules cut off and thereby deprived of their blood supply without themselves being necessarily mechanically or otherwise damaged.

The cutting through of microlobules of fatty tissue and its bad consequences should be considered in the free transplantation of fatty tissue on its own and

we are in agreement with Peer (1956) on the basic necessity of avoiding all unnecessary traumatization of fatty tissue. This is perhaps the reason why fat grafts lose more weight when implanted divided into a number of pieces, as found by Peer (1950).

It is generally recognized that the free transplantation of fatty tissue with part of the corium gives better results than the implantation of a fatty flap on its own. Bames (1953) assumes that the favourable factor is that the fat graft is transferred in conjunction with the highly vascularized corium. However, the fatty tissue itself has a excellent capillary blood supply. It thus seems probable that the favourable effect of transplanting fatty tissue with corium is due to the vascular system of the fat microlobules remaining undamaged on one of the two large surfaces of the graft, thereby increasing the chances of its survival.

As shown by the results of a whole series of clinical works cited by Peer (1959), the free transplantation of a fatty graft by itself is possible and is successful in many cases, although a great reduction of fatty tissue occurs when judged by the final results. These facts, however, are in sharp contrast with the experience of plastic surgeons that the transplantation of a skin graft with fatty tissue is nearly always unsuccessful, and that even the presence of quite a small amount of fatty tissue on the under surface of a free skin gratf is a serious hindrance to healing. It must certainly be borne in mind that a fat graft is usually fitted into a subcutaneous pocket so that the entire surface of the graft is in contact with the issue of the recipient area, as pointed out, for example, by Thompson (1960). But the amount of fatty tissue usually transferred in this way is nearly always large and from this aspect the disparity cannot be cleared up.

Hynes (1954), Karfík (1958) and Rees (1960) conclude that the lack of success in the free transplantation of a skin graft with fatty tissue on its under surface is due the presence of the fatty tissue preventing the penetration of tissue fluid from the bed into the graft and that it further prevents the forming of vascular connections between the bed and the graft.

Our findings on the separate nature of the vascular systems of the corium and fatty tissue support and complement these findings and proffer their morphological explanation.

SUMMARY

A study was made of the blood supply of the fatty tissue of the human skin, particularly of the forearm.

The blood supply of the fat microlobule, the basic structural unit of fatty tissue, is an independent vascular entity with a terminal circulation. It does not form capillary connections with the surrounding tissues, in particular not with the corium.

From the aspect of blood supply, fatty tissue is to a certain degree an independent organ. The discussion puts forward some considerations pertinent to the problems of plastic surgery and arising out of these findings.

RÉSUMÉ

A propos du problème du tissu adipeux en chirurgie plastique

J. Šmahel, Z. Charvát

L'approvisionnement vasculaire du tissu adipeux de la peau humaine, surtout dans l'avant-bras, a été étudié.

Le système vasculaire du micro-lobule adipeux, élément de construction fondamental du tissu adipeux, représente une unité vasculaire indépendante avec une circulation terminale et ne forme pas des anastomoses capillaires avec les tissus voisins, surtout pas avec le derme.

Du point de vue de l'approvisionnement vasculaire, le tissu adipeux représente, dans une certaine mésure, un organe indépendant. Certains problèmes de la chirurgie plastique en rapport avec cette constatation sont discutés.

ZUSAMMENFASSUNG

Zum Problem des Fettgewebes in der plastischen Chirurgie

J. Šmahel, Z. Charvát

1. Es wurde die Blutgefässversorgung des Fettgewebes der menschlichen Haut, insbesondere am Unterarm, untersucht.

2. Die Gefässe eines Mikrofettläppchens, der grundlegenden Baueinheit des Fettgewebes, bilden eine selbständige Einheit des Gefässystems mit terminaler Zirkulation, die über keine Kapillarverbindungen mit dem benachbarten Gewebe, insbesondere nicht mit dem Korium, verfügt.

3. Vom Gesichtspunkt der Gefässversorgung ist das Fettgewebe gewissermassen ein selbständiges Organ; in der Diskussion werden einige mit dieser Feststellung zusammenhängende Betrachtungen bezüglich der Probleme der plastischen Chirurgie angeführt.

RESUMEN

Algunas notas al problema de los tejidos lipoideos en la cirugía plástica

J. Šmahel, Z. Charvát

1. Fue estudiado el abastecimiento vascular del tejido lipoideo de la piel humana, en particular del antebrazo.

2 El sistema vascular del microlóbulo lipoideo, el elemento fundamental que construye los tejidos lipoideos, constituye una unidad vascular independiente con circulación terminal y no forma comunicación capilar con los tejidos vecinos, no ante todo con corio.

3. Desde el punto de vista del abastecimiento vascular el tejido lipoideo representa hasta cierto punto un órgano independiente y en la conclusión los autores discuten algunos problemas de la cirugía plástica que se desprenden de su averiguación.

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(Dr. J. Šmahel): Šimkova 870, Hradec Králové, Czechoslovakia

ANNOUNCEMENTS

The Mexican Association of Plastic Surgeons "Asociacion Mexicana de Cirujanos Plasticos" announces that for the period of 1964—1965 following members of the directory was elected:

President: Dr. Jorge Gonzáles Rentería

Secretary: Dr. Angel Gonzáles Rodrígues

Treasurer: Dr. Carlos Hernández Ramírez

Adress of the Association: Apartado Postal 4 - 028, Mexico, D. F.

XIIe CONGRES ANNUEL de la Société Française de Chirurgie Plastique et Reconstructive, Paris, 25 et 26 septembre 1964.

Le XIIe Congrès de la Société Française de Chirurgie Plastique et Reconstructive aura lieu à Paris, les vendredi et samedi 25 et 26 septembre 1964, sous la Présidence du Professeur Claude Verdan, de Lausanne.

La journée du vendredi 25 sera couplée avec la Société de Dermatologie, présidée cette année par le Professeur Claude Huriez, de Lille. Elle sera consacrée à l'étude des angiomes cutanés.

Le samedi 26 septembre, communications et films sur des thèmes libres.

Le Secrétaire du Congrés, Dr. D. Morel-Fatio 60, Boulevard de Latour-Maubourg, Paris-7B, France.

Clinic of Faciomaxillary Surgery, Medical Academy, Lodz (Poland)
Director: Doc. Dr. J. Bardach
Institute of Pathology, Medical Academy, Lodz (Poland)
Director: Prof. Dr. A. Pruszczyński

RESEARCH ON GRAFTED CONSERVED HOMOGENOUS CARTILAGE

A. ALICHNIEWICZ, J. BARDACH, H. KOZŁOWSKI, M. PRUSZCZYŃSKI

The choice of the proper material for grafting in filling contour depressions in the face is still a matter of discussion. In the surgical treatment of the various jaw deformities and disfigurements of the face, autogenous grafts of cartilage and bone or plastic material are used most frequently. Conserved homogenous cartilage obtained from cadavers has, up to the present, found but few advocates. The majority of surgeons and pathologists are convinced that stable results cannot be ensured, because the grafts are gradually absorbed by invading connective tissue (3, 5, 7, 8). Only a few authors consider conserved homogenous cartilage to be a highly valuable material whose employment is fully justified because of both stable late results and histological findings (1, 2, 4, 6). A number of these authors is of the opinion that absorption of the graft either does not take place at all or is so slight and lasts such a short time that it is practically insignificant from a clinical point of view. Slight absorption of the cartilage can usually be seen in the first weeks after implantation. In the following period, however, this process undergoes spontaneous retardation. Of the changes taking place in the graft bed, infiltrations of lymphocytes or plasma cells have been described (6, 7) and only a few authors observed giant cells in the connective tissue formed around the graft, such as can be found in the vicinity of foreign bodies (5, 7). In the cartilage grafts depletion and depolymerization of mucopolysaccharides was observed which, according to some authors, is connected with the appearance of minute fibres in the cartilage matrix (so-called demasking of fibres) (7, 8). Similar changes are found in ageing cartilage and are called asbestiform degeneration (5, 8, 9). Calcification, even ossification in grafts of conserved cartilage have been described quite frequently. It needs, however, to be stressed that the morphological changes, which take place in cartilage grafts, have not yet been studied in detail and that their description still appears only as marginal notes in clinical papers.

At the Clinic of Faciomaxillary Surgery of the Medical Academy in Lodz homogenous cartilage (from the cartilage bank) has been used since 1955. The favourable late results after various plastic operations in the face have induced

us to start research aimed at an all-round evaluation of conserved homogenous cartilage as plastic material. The clinical observations were, as far as possible, confirmed by histological and histochemical examinations.

We are also presenting a series of experimental studies (Pruszczynski). This paper, however, only deals with a part of the whole problem and its purpose is to evaluate, on the basis of a clinical analysis, the morphological changes which have taken place in homogenous cartilage grafts at diferent time intervals after their implantation into the human body.

Costal cartilage is taken from cadavers of people not older than 40 years within the first six hours after death. The specimens are stored in Ringer-Locke solution with the addition of antibiotics at a temperature of 0^0 C. Only after a double check of the solution for sterility is the thus conserved cartilage considered fit for grafting. Sterility tests are carried out systematically throughout the entire duration of conservation.

Such grafts were used in 149 patients; in 81 for disfigurement of the nose, in 48 for hypo- or aplasia of an auricle, in 6 for disfigurement of the face due to trauma and in another 7 for facial deformity due to osteomyelitis and, finally, in 7 for the loss of the entire half or for hemiatrophy of the face.

In 142 of these patients the cartilage grafts took without complications; in the remaining 7, the grafts had to be removed due to complications arising during the postoperative period. In one woman the cause of the unfavourable outcome of cartilage graft implantation to the region of the dorsum nasi, was necrosis of the skin which had been sutured over the graft under tension. In two patients the graft was lost due to suppuration. In four patients the grafts had to be removed because of partial necrosis of the free skin graft covering the dorsal aspect of a reconstructed auricle which subsequently led to exposure and infection of the implanted cartilage.

Evaluation of late results was carried out in 65 patients at various time intervals after implantation (Tab. 1).

Tab. 1

Time after implantation	From 2 to 12 months	From 1 to 2 years	From 3 to 5 years	Total
Number of checked—up patients	16	34	15	65

In ten patients the cartilage grafts were found to be fractured 1 to 2 years after implantation. These grafts formed the skeleton of reconstructed auricles. Fracturing of the graft could be explained by the circumstance that, prior to implantation, the cartilage was modelled into a thin plate and them embedded to a site particularly exposed to trauma. In all remaining 55 patients no signs of damage to the implanted cartilage were found, nor were there any changes in shape or dimensions.

Twenty-two patients required corrective operations which were carried out without removal of the graft from its bed. On operation it was possible to de-

monstrate that the implanted cartilage had preserved its previous appearance and consistence. The material excised on that occasion, was subjected to our microscopic examination.

Homogenous cartilage may be stored at 0^0 C up to six months. During this period we have used conserved homogenous cartilage for grafting and have never observed any complications.

Twenty-nine specimens excised from homogenous cartilage grafts and the tissues surrounding them were fixed in calcium formalin for 48 hours at $0—4^0$ C. Then part of each specimen was cut into sections with a freezing microtone, the rest immersed in paraffin. If necessary, some specimens were decalcified prior to immersion in paraffin by placing them into 2% nitric acid for one hour or into a 2% formalin solution of disodium salt (EDTA-Na_2) for 2 weeks.

Since — as is known from the literature and was verified by our own observations — evaluation of morphological, particularly however, of histochemical changes is considered inconclusive, if based on examination of decalcified tissue, we based our conclusions mainly on observations made in tissue which had not been treated with decalcifying solutions.

The material investigated was divided into three groups according to the time the graft had remained in the recipient bed:

Group I (from 3 to 25 weeks) — 8 cases

Group II (up to 18 months) — 11 cases

Group III (up to 4 years) — 6 cases

The sections were stained with haematoxylin and eosin; the connective tissue according to van Gieson and Mallory; fat with oil red; PAS reaction according to Hotchkiss; acid mucopolysaccharides were demonstrated by Astra blue; silver impregnation was carried out according to Gordon-Sweet.

Group I

The structure of hyaline cartilage was preserved in all grafts. After two months a decrease in eosinophilic staining of the matrix together with a weakening of the PAS reaction was found with the expection of the cartilage capsules. Some foci of parvigranular decomposition (Fig. 4) and within these foci sometimes fine argentaffin fibres (Fig. 5) were also observed. The chondrocytes, everywhere well visible, contained pyknotic nuclei. Three months after implantation the number of fat corpuscles in the "vacuoles"* of chondrocytes had somewhat decreased. Already in the earliest period (3—4 weeks after implantation) small recesses had formed at the periphery of the grafts (Fig. 1) which were filled with granulation tissue poor in cells but rich in capillaries. In one graft, 10 weeks after implantation, there were recesses filled with granulation tissue which, however, had penetrated much deeper.

In none of the specimens examined did we find any sign of a foreign body tissue reaction.

* In the Polish text the term "wodniczki" is used in quotation marks but without further explanation (note of translator).

Group II

In most grafts of this group the cartilage capsules did not contain any chondrocytes and in those, which held cells, these included poorly stained nuclei; only a few "vacuoles" contained fat corpuscles. Depletion of acid mucopolysaccharides, which was marked in the matrix, appeared slighter around the cartilage capsules (Fig. 6). The recesses at the periphery of the grafts contained young tissue and were sometimes quite deep, even curved and multilocular. The connective tissue in these recesses consisted of minute vessels and a network of collagenous fibres; in some places there were numerous lymphocytes and scattered fibroblasts. At the beginning the described recesses developed at the graft periphery in the matrix between the cartilage corpuscles. Foci of parvigranular decomposition of the matrix were found in the central parts and they were somewhat more numerous than in group I. In two cases of group II disseminated minute foci of calcification could be observed in the matrix (Fig. 3).

Group III

The cartilage grafts, which had remained in the tissue of the recipient for the longest period (2, 3 and even 4 years) showed an, on the whole, preserved histological structure of the matrix. Only a few cartilage capsules still contained remnants of cytoplasm with poorly stained nuclei. The changes in the matrix were similar to those in the previous groups and consisted in a slightly increased number of parvigranular decomposition foci and a more marked depletion of acid mucopolysaccharides. The mass of the cartilage matrix, however, showed typical basophilic staining around the capsules and elsewhere acidophilic staining. The grafts showed a slightly undulated surface and were enveloped in a layer of fibrous connective tissue (Fig. 2). In some cases, however, the surface of the graft showed deep indentations filled with fibrous connective tissue poor both in cells and blood vessels. In the centre of this tissue there were islets of well preserved cartilage separated from the rest of the graft.

DISCUSSION

The results of the above investigation indicate, on the one hand, that granulation tissue enters the cartilage graft from its periphery and afterwards changes into connective tissue, on the other hand, point to changes in the cells and the matrix of the graft. Invasion of granulation tissue and its metamorphosis into connective tissue was already observed in the earliest period (3—4 weeks after implatation). This was ascertained in all specimens regardless of the time the graft had remained in its recipient bed. No foundation was found for the assertion that the amount of connective tissue increases with time, because this tissue had the character of granulation tissue at the beginning and later that of fibrous connective tissue. On the basis of the given findings and of reports in the literature (2, 4), it may be concluded that the so-called invasion of connective tissue from the periphery of cartilage grafts is most intensive in the early period; afterwards its progress is retarded until it finally ceases altogether. We would like to stress that in no case did we find signs

of foreign body tissue reaction after implantation of homogenous cartilage. In most cases of all groups parvigranular decomposition of the matrix was found which often appeared together with minute argentaffin fibres. These changes are probably indentical with those of so-called asbestiform degeneration (11). Since it has been ascertained that the number of these foci only slightly increased with the time elapsed from implantation, it may be concluded that some of these foci had been present prior to implantation, some had developed during conservation and the rest while the graft remained in the tissues of the recipient. Out of the total of 29 cases only 4 showed foci of calcification, a fact which stands in contradiction to the data reported in the literature giving a far higher incidence of this process. We are, however, unable to exclude that foci of calcification were present in the matrix prior to implantation. The histochemical investigation demonstrated progressive depletion of acid mucopolysaccharides in the matrix. It needs, however, to be stressed that a strong reaction, positive for acid mucopolysaccharides was, as a rule, present around the cartilage capsules. At the same time an increasingly worse capacity for staining was observed in the nuclei and the cytoplasm of chondrocytes together with a decreasing number oil-red stained fat corpuscles.

CONCLUSION

Our clinical experience and the results of microscopic investigation permit the assertion that conserved homogenous cartilage represents a valuable material for grafts to be implanted into the midst of tissues.

SUMMARY

After a short survey of the literature and of general data about the methods of lifting and conserving homogenous cartilage, the authors present their observation in 65 patients with regard to an evaluation of late therapeutic results. The results of the microscopic investigation of specimens of cartilage excised from grafts during corrective operations on patients, carried out at different time intervals from the date of implantation (2 months to 5 years), were dealt with in detail. Based on clinical experience and on the microscopic investigation the authors come to the conclusion that conserved homogenous cartilage represents a valuable material for grafts to be implanted into the midst of tissues.

RÉSUMÉ

A propos de la conservation du cartilage homogène en tant que matériel plastique

A. Alichniewicz, J. Bardach, H. Kozłowski, M. Pruszczyński

Après avoir résumé les données littéraires et générales en ce qui concerne le prélèvement et la conservation du cartilage homogène, les auteurs présentent des observations cliniques faites sur 65 malades, en tenant compte des résultats thérapeutiques tardifs. On discute en détail les résultats des examens microscopiques des préparations de cartilage, excisées des malades sur lesquels des opérations de reconstruction avaient été effectuées et qui avaient été prélevées à des périodes différentes à partir de l'im-

plantation (2 mois jusqu'à 2 ans). A base des expériences cliniques et des examens microscopiques, les auteurs démontrent que le cartilage homogène conservé constitute un matériel précieux pour les greffons implantés à l'intérieur du tissu.

ZUSAMMENFASSUNG

Konservierter homogener Knorpel als plastisches Material

A. Alichniewicz, J. Bardach, H. Kozłowski, M. Pruszczyński

Die Verfasser bringen in der vorliegenden Arbeit eine kurze Übersicht der Literatur und allgemeine Angaben über die Art der Entnahme und Konservierung von homogenem Knorpel und führen klinische Beobachtungen bei 65 Patienten unter Berücksichtigung der Spätergebnisse der Behandlung an. Eingehend wird über die Ergebnisse der mikroskopischen Untersuchung von Knorpel berichtet, der in verschiedenen Zeitabständen (2 Monate bis 5 Jahre nach der Implantation) aus Transplantaten bei Patienten exzidiert wurde, bei denen Korrektionsoperationen durchgeführt worden waren. Auf Grund ihrer klinischen Erfahrungen und der mikroskopischen Untersuchungen weisen die Verfasser in den Schlussfolgerungen nach, dass konservierter homogener Knorpel ein wertvolles Material für Transplantate darstellt, die in die Tiefe von Geweben zu implantieren sind.

RESUMEN

Algunas notas al problema del cartílago homogéneo conservado empleado como material plástico

A. Alichniewicz, J. Bardach, H. Kozłowski, M. Pruszczyński

Después de un resumen breve de la literatura y datos generales sobre la técnica de la toma y conservación del cartílago homogéneo los autores presentan en este artículo observaciones clínicas de 65 enfermos tomando en consideración los resultados tardíos del tratamiento. Se discuten en detalle los resultados de las examinationes microscópicas de los preparados del cartílago extirpados desde los injertos de los enfermos después de las operaciones correcionales efectuadas dentro de varios intervalos de tiempo desde el momento de la implantación (dos meses hasta cinco años). Apoyándose en las experiencias clínicas y examinaciones microscópicas, en la conclusión, los autores comprueban que el cartílago homogéneo conservado representa un material precioso para los injertos implantados adentro de los tejidos.

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(Dr. A. Alichniewicz): Ul. Kopcińskiego 22, Lodz, Poland

Central Lenin Institute of Haematology and Blood Transfusion Moscow (U.S.S.R.)
Director: Doc. A. Y. Kisselev

EMPLOYMENT OF IMMUNE BLOOD OR PLASMA TRANSFUSION IN BURNS SICKNESS

D. M. GROZDOV

The experimental investigations carried out at the Central Institute of Blood Transfusion (Fedorov, Skurkovitch) established that specific antigens develop in the burned skin of animal and man which enter the blood circulation in the first 10 to 14 days of burns sickness and are responsible for the severe clinical picture of burns toxaemia developing in large burns.

It was also established that specific auto-antibiotics appear in the serum of patients three to four weeks after a thermic injury.

Recognition of the leading role of auto-antigens in the development of burns sickless and the detection of specific antibodies in the blood of convalescents, logically suggests to the observer the expediency of transfusing convalescent blood in the second stage of burns sickness in order to utilize its capacity for neutralizing the burns antigens and thus detoxicating the patient's blood.

Numerous experiments led to the recognition that the transfusion of convalescent serum has a favourable effect by lowering haemoconcentration, leucocytosis, temperature and by the prevention of anuria or marked oliguria. Unlike the findings in the animals of a control group, glomerular filtration and renal blood circulation of experimental animals remained at an almost normal level and the secretory function of the tubular epithelium, too, was preserved. Transfusion of convalescent serum also decreased the negative nitrogen balance.

Tab. 1

Area burned in %	Dose in ml.					Total
	225	450	750	1000	1500	
10 — 20	162	1	—	—	—	163
21 — 40	128	5	1	—	—	134
41 — 50	87	38	3	1	—	129
51 — 60	16	49	7	3	2	77
61 — 70	17	35	3	—	2	57
Total	410	128	14	4	4	560

Tab. 2

	Indices	Number of patients	Decrease	Increase	Without change
Immuno-therapy	Leucocytosis	210	171	3	36
	Temperature	199	173	15	11
Without immunotherapy	Leucocytosis	70	19	24	27
	Temperature	50	11	16	23

On the whole, transfusion of immune serum markedly lengthened the life of experimental animals and even affected their survival.

Good results like those obtained with immunotherapy in burned animals, were, under corresponding conditions, also observed in patients.

As is well known, Segal, in 1937, published his paper on the good results with transfusion of convalescent blood in the third stage of burns sickness. We thought it more justified to study first the efficacy of immunotherapy in the early period of the second stage of burns sickness, because then the severity of the patient's condition depends on the quantity of specific antigens circulating in the blood.

In the period between 1955 and 1962, 561 transfusions of convalescent blood and plasma were carried out in 253 patients with a burned area ranging between 10% and 94% of body surface, at the surgical department of the Institute of Blood Transfusion.

Immunotherapy was started 12 to 20 hours after the accident and employed for three to seven days in doses of 200 to 1000 ml. per 24 hours (Tab. 1). The question of efficacy of immunotherapy in relation to the amount of fluid infused is rather complicated. Success of convalescent blood transfusion apparently depends on many factors, most frequently on the severity of toxaemia and the titre of antibodies in the fluid transfused. That is why dosage of convalescent blood must not be stereotype and can only be decided upon individually for each case with regard to the size and depth of the burns and the titre of antibiodies in the blood transfused.

It appears, however, that a dose of 250 to 500 ml. is sufficient in burns of medium severity; in more severe burns the dosage must be raised to 700, even 1000 ml. per 24 hours. The question as to how long convalescent blood trans-

Tab. 3. Disappearance of dyspeptic symptoms

	Number of patients	Days				
		1	2	3	4	5
Convalescent blood given	213	149	61	3	—	—
No convalescent blood given	50	2	27	—	18	3

Tab. 4. Normalization of uterine flow

	Number of patients	Days			
		2	3	4	5
Convalescent blood given	105	44	37	19	5
No convalescent blood given	50	2	17	28	3

fusion should be continued must also be decided individually with regard to the area burned.

In the majority of cases the clinical signs and symptoms of toxaemia recede and even disappear after convalescent blood transfusion; the patients regain consciousness and become fully orientated; restlessness, nausea and vomiting cease, they ask for food, their leucocyte-count and temperature become normal, renal function improves, etc. Investigation of toxicity of the blood in these patients before and after convalescent blood transfusion bore witness to the considerable detoxicating effect of convalescent blood.

Since immunotherapy was usually employed in severe burns together with other treatment, it appears appropriate to estimate the efficacy of convalescent blood transfusion by comparing the group of patients, who received immunotherapy„ with that without (Tab. 2). The table shows the normalizing effect of immunotherapy on the leucocyte count, usually raised in patients during the second stage of burns sickness. As can be seen, convalescent blood transfusion led to a decrease in leucocytosis in 171 out of 210 patients, i.e. 81%, as compared with the effect of non-immune transfusion fluid which led to normalization of the leucocyte count in only 19 out of 70 patients (27%).

Almost the same difference emerges from an analysis of the influence of immune and non-immune blood transfusions on body temperature. As can be seen from Tab. 2, the temperature dropped to normal in 173 out of 199 cases, i.e. in 86% of patients, whereas transfusion of non-immune blood had a normalizing effect on temperature only in 11 out of 50, i.e. 22%.

Tab. 3 shows diminution or cessation of dyspeptic symptoms in the majority (149 out of 213, i.e. 60%) of patients treated with transfusion of immune blood, whereas in the control group of patients, in whom non-immune blood was

Tab. 5. Efficacy of immunotherapy in second stage of burns sickness

Area burned in %	Total number of patients	Survived toxaemia	
		number	%
10 — 30	144	144	100
31 — 50	87	84	96,5
Over 50	22	16	72,7
Total	253	244 (9)	96,4 (3,6)

Tab. 6. Immunological activity of convalescent blood

Titre of plasma	Number of convalescents	Period after thermic trauma			
		up to 1 year	up to 2 years	up to 5 years	more than 5 years
1 : 64	15	8	6	—	1
1 : 32	14	7	3	1	3
1 : 16	10	8	2	—	—
1 : 8	6	3	2	1	—
Total	45	26	13	2	4
Inactive	8	2	1	2	3

used, relief from dyspepsia was registered much later, i.e. about the fourth day.

The efficacy of convalescent blood transfusion can be demonstrated quite clearly on the normalizing effect on renal function. Tab. 4 proved that already the first transfusion of convalescent blood brought about an increased urine flow in 44 out of 105, i.e. in 42% of patients, whereas the improvement of renal function after transfusion of non-immune blood took place much later; not until the fourth day did urine output become normal in 28 out of 50, i.e. in 56% of patients.

The favourable effect of immunotherapy on burns sickness observed in the clinical material could be verified on a number of laboratory observations. Because of limited space, we shall deal only with some of them.

The tests carried out by Derviz and Smiddovitch at the surgical department of the Institute permit the assertion that convalescent blood transfusion, which had a detoxicating effect, caused faster normalization of the oxidizing processes which are affected in large burns.

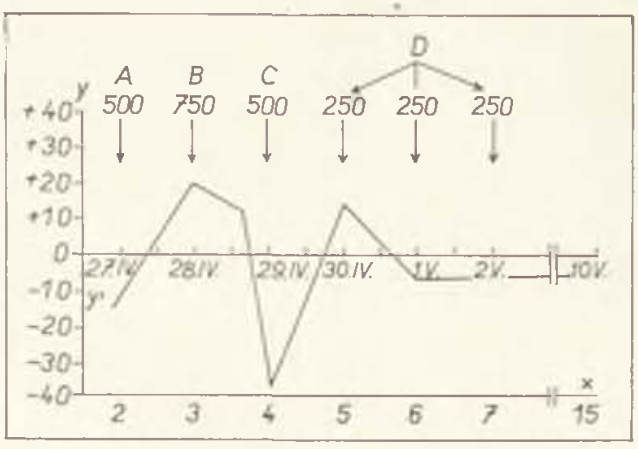

Fig. 1. Patient R. with II, IIIa, IIIb and IV degree burns on 50% of body surface. *x* — days of illness, *y* — degree of stimulation of culture migration, *y'* — degree of inhibition of culture migration, *A, B* — convalescent plasma in ml., *C* — convalescent blood in ml., *D* — convalescent dried plasma in ml.

The investigation of the degree to which the proteins of the blood had been denatured in large burns, carried out by Vassilev and Kozlova, showed that convalescent blood given in the first days of toxaemia effected earlier changes towards normalization of the blood protein system than was the case in the blood of patients who had received non-immune transfusions.

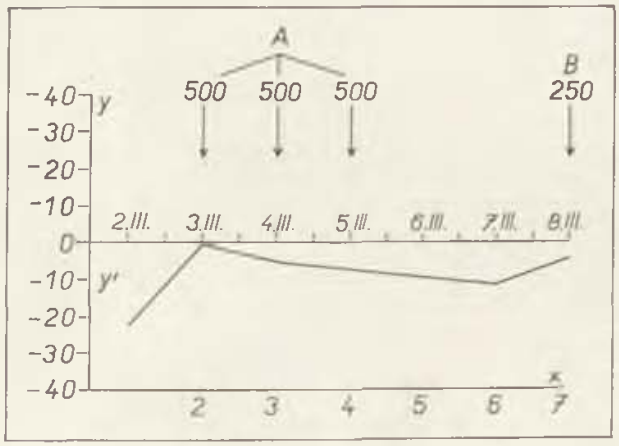

Fig. 2. Patient S. with IIIa and IIIb burns on 35% of body surface. x — days of illness, y — degree of stimulation of culture migration, y' — degree of inhibition of culture migration, A, B — dried plasma in ml.

The effect of convalescent blood transfusion in decreasing toxic signs in the blood of patients during the second stage of burns sickness can be demonstrated best on the findings of tissue culture investigation carried out by Fedorov and Koryakina. Contrary to the stimulating effect of the serum of healthy people on proliferation of a haemoculture, the serum of patients with burns has a marked toxic effect already 6 to 24 hours after the accident, and if added to the culture medium later, causes rapid inhibition of cell migration. Convalescent blood transfusion annuls these unfavourable effects of the serum of patients with burns on the growth of tissue culture (Fig. 1). The picture shows the dynamic effect of the blood of a patient with third-degree burns over 50% of body surface on the migration of cells. Immunotherapy neutralized the toxic effect of patient's blood which had been present prior to convalescent blood transfusion.

Fig. 2 shows the change in toxic qualities of the blood of a patient who had received non-immune fluid (dried plasma). The therapeutic measures taken in this patient, who suffered from IInd to IIIrd degree burns over an area of 35% of body surface, did not rid his blood of toxic qualities.

In connection with the above, we are tempted to demonstrate diminution of toxic qualities in the blood after convalescent blood transfusion in a patient with fatal burns, although this took place only over a limited space of time (Fig. 3). The figure shows that even in this doomed patient with IInd degree burns on 90% of body surface, convalescent blood transfusion had a definite detoxicating effect.

Investigation of the protein fractions in the blood serum permits demonstration of the well-known parallelism between the antitoxic qualities of the infused fluids and the increase in beta and gamma globulins.

Analyzing the clinical material of 253 patients treated with immunotherapy during the second stage of burns sickness, we came to the conclusion that in

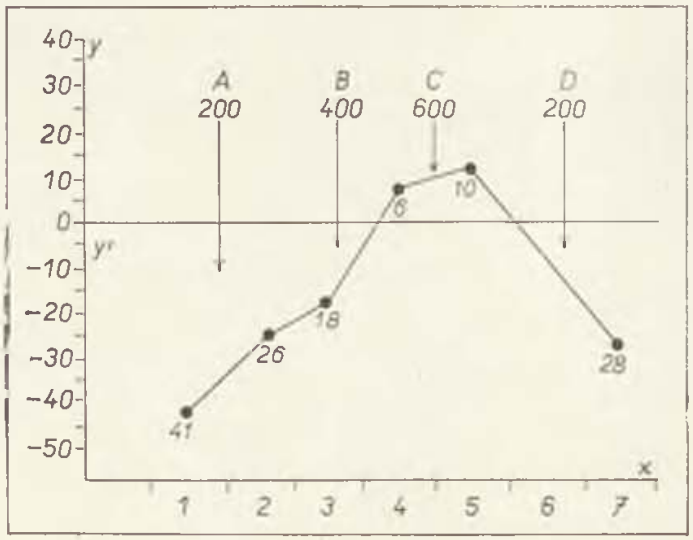

Fig. 3. Patient K. with II degree burns on 90% of body surface. x — days of illness, y — degree of stimulation of culture migration, y' — degree of inhibition of culture migration, A, B, C, D — convalescent blood in ml.

all 144 patients with a burned area up to 30% of body surface this treatment ensured the favourable results (Tab. 5). In 30% to 50% burns this treatment was successful in 84 out of 87 patients. In burns exceeding half the area of body surface good results were achieved in 16 out 22 patients; six patients died during the first week after the accident. Thus a total of 244 patients (out of 253, i.e. 96.4%) were helped in overcoming burns toxaemia; 9 patients (i.e. 3.6%) died during the second stage of burns sickness.

Employment of immune blood together with other therapeutic means in the treatment of burns sickness makes the course of the second stage less severe and decreases mortality from toxaemia even in large burns.

Finally, it ought to be stated that the immune blood was obtained from donors who had recovered from burns not smaller than 8% to 10% of body surface. Blood was taken the first time after the wounds had healed but the amount taken was replaced by a transfusion of stored blood. The second time blood was taken from these convalescents two to three years later. Tab. 6 demonstrated the change in immunological activity of convalescent blood several years after recovery from burns.

SUMMARY

1. Severe signs and symptoms of toxaemia during the second stage of burns sickness are due to specific antigen circulating in the blood of the patient.

2. Immunotherapy employed during the second stage of burns sickness effects the disappearance of the severe signs and symptoms of toxaemia, be-

cause the burns antigens are neutralized by the antibodies contained in the transfused convalescent blood.

3. Convalescent blood or plasma transfusion is indicated during the second stage of burns sickness in doses of 250 to 1000 ml. per day. The larger and deeper the burns the larger should be the daily dose of immune blood and the longer should immunotherapy be employed.

4. Immune blood can be obtained from donors who have recovered from burns not smaller than 8% to 10% of body surface over a period of 2 to 3 years after the accident; blood can be taken repeatedly in amounts of 500 ml.

RÉSUMÉ

Le traitement par transfusion de sérum ou de plasme immunisant dans les maladies des brûlures

D. M. Grozdov

1. Les signes et les symptômes graves de la toxémie qui se manifeste au cours de la deuxième phase de la maladie des brûlures sont dus à des antigènes spécifiques, circulant dans le sang des malades.

2. L'immunothérapie, employée pendant le deuxième stade de la maladie des brûlures, fait disparaître les manifestations et les symptômes graves de la toxémie, étant donnée que les antigènes des brûlures sont neutralisés par les anticorps qui existent dans le sang transfusé des convalescents.

3. La transfusion de sang ou de plasme de convalescent est indiquée pendant la deuxième période de la maladie des brûlures, à une dose quotidienne de 250 à 1000 ml. Cette dose quotidienne de sang immunisant devrait être d'autant plus grande et la durée de l'application de l'immunothérapie d'autant plus longue que les brûlures étaient plus étendues et plus profondes.

4. Le sang immunisant peut être prélevé de donateurs s'étant remis de brûlures d'une étendue d'au moins 8—10% de la surface du corps, à une période de 2—3 années après l'accident; le sang peut être prélevé à plusieurs reprises en recueillant chaque fois 500 ml.

ZUSAMMENFASSUNG

Die Anwendung von Immuntransfusionen bei der Verbrennungskrankheit

D. M. Grosdow

1. Die schweren Intoxikationserscheinungen in der II. Phase der Verbrennungskrankheit sind durch spezifische Verbrennungs-Antigene, die im Blut des Patienten zirkulieren, bedingt.

2. Die Immuntherapie in der II. Phase der Verbrennungskrankheit trägt zur Beseitigung der schweren Intoxikationserscheinungen bei und zwar durch Bindung des Verbrennungs-Antigens mittels Antikörper, die im übertragenen Rekonvaleszentenblut enthalten sind.

3. Übertragungen von Rekonvaleszentenblut und -Plasma in einer Menge von 250 bis 1000 ml täglich sind in der II. Phase der Verbrennungskrankheit angezeigt. Je ausgedehnter die Verbrennung und je tiefer die Hautschädigung ist, desto intensiver und desto länger ist die Immuntherapie anzuwenden.

4. Immunblut kann von Personen gewonnen werden, die eine Verbrennung überstanden haben, deren Ausdehnung nicht weniger als 8—10 % Körperoberfläche betraf; die Blutentnahme kann innerhalb 2 bis 3 Jahren nach der Verbrennung in einer Menge bis zu 500 ml wiederholt durchgeführt werden.

RESUMEN

Utilización de la transfusión de la sangre inmune o plasma en quemaduras

D. M. Grozdov

1. Las señas y los síntomas graves de la toxemia durante el segundo estadio de quemaduras están causados por antígenos específicos que circulan en la sangre del paciente.

2. El empleo de la inmunoterapéutica durante el segundo estadio de quemaduras causa la desaparición de las señas y síntomas graves de la toxemia, porque los antígenos de quemaduras son neutralizados por los antidotos contenidos en la sangre convaleciente transfundida.

3. La sangre convaleciente o la transfusión de plasma se indican durante el segundo estadio de quemaduras en dosis de 250 hasta 1000 ml. por día. Cuanto más grandes y hondas sean las quemaduras tanto más grandes debieran ser las dosis diarias de la sangre inmune y tanto más tiempo debiera ser empleada la inmunoterapéutica.

4. La sangre inmune la podemos obtener de los donantes quienes se han recobrado de las quemaduras no menores de 8% a 10% de la superficie del cuerpo dentro del período de 2 hasta 3 años después del accidente; la sangre puede ser tomada con repetición en cantidades de 500 ml.

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[Prof. D. M. Grozdov]: Novozykovskaya ul. No. 4, Moscow, U.S.S.R.

Based on a lecture given at a Conference at Prague on Toxaemia in Burns, November, 1963.

Second Surgical Department, Medical Faculty, Budapest (Hungary)
Director: Prof. E. Mester

THE SURGERY OF THE HAND — A NEW BRANCH OF SURGERY AND ITS DEVELOPMENT

R. KÓS

The hand, as an instrument of work, helps to differentiate man from the animals. The fact that the anterior limbs were freed and transformed from locomotor, into grasping and workperforming organs, led man to the control of his environment. The upright position made it possible to grasp stones and weapons and to produce tools. The hand gradually became more dextrous so that more complicated procedures could be carried out and this ultimately had a positive effect on the development of the brain. This interrelationship was already referred to in the Polemics of Aristotle and Anaxagorces. "Now it is the opinion of Anaxagorces that the possesion of those hands is the cause of man being of all animals the most intelligent. But it is more rational to suppose that his endowment with hands is the consequence rather than the cause of his superior intelligence. This instrument, therefore, the hand, of all instruments the most variously serviceable, has been given by nature to man, the animal of all animals the most capable of acquiring the most varied handicrafts." (Aristotle.)

Engels also regarded the freeing of the hand as the decisive factor in the development of man, since it permitted work, production and the creation of human society.

Primitive science was particularly concerned with the hand, leading to the development of *cheiromancy* (analysis of the hand), *chiromancy* (prophesy from the hand), *cheiroosophy* (philosophy concerned with the hand) and *palmistry* (reading from the hand). The hand of the patient can still disclose much to the experienced physician.

The terms "chirurg", chirurgien and "surgeon" denote the life-saving work made possible by the dexterity of the surgeon and indicate that the surgeon carries out his work by the aid of his hands, since the root of the French word "chirurgie" and the English word "surgeons" is the Greek word *cheiro.*

Thus, although the hand is only a small part of the human body it has a great function. From history we know that among primitive peoples the chopping off of the hand was one of the severest punishments since it made the offender powerless. This barbarous act was, so to speak, taken over in the treatment of wounds to the hand. Despite the popularization of the anatomical studies of Ve-

salius and others, it long remained the rule to amputate all severely wounded hands. The famous military surgeon of Napoleonic times, Larrey, amputated at least 200 hands in one day during the battle of Borodina. Although several decades later Pirogov enriched medical science by further anatomical studies and introduced the fixation of wounded hands by a plaster bandage in order to restrict the number of tragic amputations, the amputation of wounded hands still persisted for a long time. In the American Civil War 13% of soldiers suffering from hand wounds died and 64% became permanent invalids. Lexer, Rehn, Nicoladoni and others, laid the foundations of the reconstructive surgery of the hand, but fear of infection still led to about 30% amputation in hand wounds in the First World War.

Up to the beginning of the century, almost the only aim in treating hand wounds was the avoidance of infection. Pus was "let out" by any route, even by amputation, to preserve life. The treatment of acute hand wounds only improved after the way in which infection spread in the hand was discovered on the basis of the work of Ignatev and Kanavel. When the importance of the primary excision of the wound as recommended by Friedrich, was appreciated towards the end of the First World War, the surgery of the hand progressed a further step forward. Since many surgeons had more faith in antiseptics than in the primary excision of wounds, this method only advanced with difficulty into the peacetime treatment of hand wounds. In the meantime, Halsted pointed out that the healing of wounds depends on healthy tissue which is damaged by antiseptics. Iselin, Böhler and Bunnell further developed the theory of Halsted. Already in 1933, Iselin made a survey of the methods of treating hand infections to decrease the number of severe complications and functional damage. Böhler demonstrated the importance of the primary treatment of fresh injuries and Bunnell further found that not only the injury but also the mechanical trauma of treatment has a deleterious effect on the tissue of the hand. He proclaimed that the successful surgery of the hand with the elimination of infection is not possible without "atraumatic technique".

The removal of the fear of infection permitted the primary closure of wounds, a fact of first importance in the hand. The fine movements of the hand require a skin covering of good quality, secondary healing leads to the development of contracting scars. Plastic surgeons joined in finding a solution to the problem and the primary closure of wounds found its highest application in the surgery of the hand. One of the most difficult parts of the surgery of the hand is the surgery of the tendons. The results of operating on the flexor tendons brought much disappointment up to the time of Bunnel. Reliable statistics show that the suture of flexor tendons in the region of the tendon sheaths of the fingers, i.e. "in no-man's land" gave very bad results. Even Iselin could only write that up to 1933 he did not see a case of successful suture of a flexor tendon in the hand in France. The Bunnell technique of suturing tendons with removable wire stitches led to a great improvement in the results.

Except for some details, the development of the surgery of the hand reflects the general development of surgery. It is interesting that Mason sees the

whole development of the surgery of the hand in the recognition of the *functional position.* This observation is, in fact, so highly evaluated that Kanavel's brillant exposition places it at the centre of importance as follows: "If all our knowledge of the surgery of the hand were forgotten and only our knowledge of the functional position of the hand remained, from that alone, in the course of time, we would logically develop the treatment of the hand". It is important because the grasping power of the hand is the most essential of all its functions. This gave the hand its importance and made man the master of nature. It is understandable that the hand requires this position which is physiological and fixed by ontogenesis and that its fixation in any other position is deleterious.

These basic opinions were thrashed out between the two world wars and on their strength many surgeons pointed to the gravity of hand surgery. Despite this, the special branch of surgery of the hand arose and developed during the Second World War. The work and results of Soviet surgeons in the surgery of the hand are dealt with in detail in a special chapter of the 18th volume of "The Experiences of Soviet Medicine in the Great Patriotic War of 1941—1945". During the war special hospitals were established for the treatment of hand injuries Although only the most severe hand injuries were sent to these hospitals they attained good functional results in 77% and of the incapacitated only 0.7% had amputations of the hand. After the war many schools of Soviet surgery and traumatology were able to devote their attention to the problem of hand surgery These included Gorinevskaya, Rozov, Blohin, Shipachev, Vaishtein, Usol'tseva, Dzhanelidge, Parin and Nikolayev. The work of these authors is described in detail by Usol'tseva, in the carefully worked out and systematic introduction to his book "Injuries of the Hand" (1961). The speading of the method of "comprehensive functional treatment of injuries" elaborated by Soviet surgeons, had a great effect in improving the results obtained in patients with hand injuries. The rapid development of plastic surgery played a great role in the creation of modern hand surgery. In this field Burian (Prague) and his school have a significance extending far beyond the boundaries of Europe.

Before the Second World War the treatment of hand injuries was considered to belong to *minor surgery* even in the USA. During the war these "small injuries" were treated by inexperienced surgeons and for this reason the patients were often crippled. It is estimated that there were 592 wounded in the American Army. Of this number about 25% were injuries to the upper limb, i.e. nearly 89,000 hand wounds. Although three-quarters of these patients were able to return to the front, about one quarter were transported home for treatment. The war-time experience showed that is was better to tread hand wounds at special centres with a highly qualified and experienced personnel. This correct principle has, unfortunately, not even today won through in civilian practice.

Balmer characterizes development in the West as follows: "In the last war the surgery of the hand underwent rapid development. The war necessitated a small number of surgeons undergoing specialized training of a high standard;

these surgeons have remained faithful to this special branch of surgery even in peacetime. The undisputable successes of this group of surgeons has led to great development in recent years. Today, the special surgery of the hand forms part of the usual educational program of young surgeons, orthopaedic and plastic surgeons. Modern hand surgery does not depend on any basically new principles. A thorough knowledge of functional anatomy, consideration of tissue regeneration and wound healing and a knowledge of atraumatic surgical technique, these form the basis of modern surgery of the hand".

The specialization of surgery of the hand thus developed as a reaction to the results of hand surgery during the war. In USA, the Scandinavian countries and in England, attention was early paid to hand surgery. Voices were raised in its support in France, Japan and South America. In recent years, much has been done in Austria, Germany, Hungary and Czechoslovakia for the further development of this branch of surgery. Bunnell can be considered to be the Father of this branch of surgery and his book "The Surgery of the Hand" has become recognized internationally as the standard work on the subject. The surgery of the hand commands increasing interest, as shown by the fact that, in recent years, it has been one of the main themes in many congresses and by the surprisingly large number of surgical publications and books devoted to this subject. Departments of Hand Surgery, or sub-departments, have been set up everywhere, even in the smaller states. In 1946 a special Society of Hand Surgeons was established in the USA. At one of its last conferences in Chicago more than 700 surgeons were present. In 1952 the Hand Club was founded in Great Britain and recently similar societies have been founded in the Scandinavian countries, Japan and Brazil.

Many publications on hand surgery have appeared in recent years in addition to the work of Bunnell. Hilgenfeldt, Lange, Iselin, Karfík, Witt, Böhler, Parin, Shipachev and Schink and others have dealt with reconstructive methods. Moberg has the credit for working out a method for re-establishing tactile sensation (tactile gnosis) in the hand and at the same time proclaimed that the *surgery of the hand is actually the surgery of sliding surfaces and in this field the technique of major surgery does not afford good results.* The lectures at the International Traumatological Congress held in Budapest in 1961 pointed out that the importance of hand surgery was determined by the very large number of injuries and diseases of the hand. Bunnell had already pointed out that we live in a mechanical era resulting in many millions of hand injuries occurring annually; thus our age can be termed the traumatic era. On the other hand, Usolt'seva (1961) found that problems concerning injuries and diseases of the hand do not find their necessary place in the specialist journals of many states, even in the Soviet press, and the knowledge is not sufficiently introduced into practice, although his would be very important, not only for the patient but also for national economy. It is inevitable that the special branch of hand surgery will soon acquire a position comparable to its merits and results even though these have hitherto been to a certain extent placed in the shade by the development of thoracic and cardiac surgery.

SUMMARY

In historical sequence the author describes how surgery of the hand developed into an independent and special branch of the entire province of surgery. He also explains why patients with injuries or other damage to their hands ought to be treated by special methods and at departments separated from those of general surgery.

RÉSUMÉ

La chirurgie de la main, une discipline nouvelle de la chirurgie et son développement historique

R. Kós

L'auteur donne un aperçu historique sur le développement de la chirurgie de la main pour former une discipline indépendante, séparée de la grande chirurgie. En même temps, l'auteur explique les raisons pour lesquelles il semble nécessaire de soigner les blessés de la main dans des services spécialisés et en employant des méthodes spéciales.

ZUSAMMENFASSUNG

Die Handchirurgie — ein neuer Zweig der Chirurgie und seine Entwicklung

R. Kós

Der Verfasser stellt in chronologischer Reihenfolge dar, wie sich die Chirurgie der Hand zu einem selbständigen und separaten Zweig der grossen Chirurgie entwickelt hat. Zugleich begründet er, warum es nötig ist, die Patienten mit Handverletzungen und anderen Schäden der Hand in einer von der allgemeinen Chirurgie abgesonderten Abteilung durch spezielle Methoden zu behandeln.

RESUMEN

La cirujía de la mano — un nuevo ramo de la cirujía y su desarrollo

R. Kós

En secuencia histórica el autor describe cómo la cirujía de la mano se convirtió en un ramo específico independiente dentro del marco de la cirujía entera. El autor también explica la causa porqué los pacientes con lesiones u otros perjuicios de sus manos tienen que ser tratados por métodos especiales y en las secciones separadas de las de la cirujía general.

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(Dr. R. Kós): Baross utca 23, Budapest, VIII, Hungary

IN MEMORIAN

Doc. Andrzej Trojanowski, one of the most outstanding Polish surgeons, director of the Surgical Clinic and the Warsaw Haematological Institute, died on March 15th, 1964.

He underwent very thorough medical training. Already as a medical student, he worked for some years as assitant at the Institute of Anatomy, headed by Prof. E. Loth; after graduating from the medical school, in 1929, he was appointed senior assistant of the Institute of Pathology.

From 1932 to 1944 he worked under Professor Z. Radliński at the Surgical Clinic in Warsaw and took up scientific work at this outstanding Polish school of surgery.

After the war, Doc. Trojanowski became director of the Municipal Hospital No. 7 in Warsaw and head of its surgical department. From 1953 until his death he was director of the Surgical Clinic and Haematological Institute.

He has published more than 50 scientific and popular-scientific works dealing with many problems of surgery, including surgery of the haemopoietic system, tumours of the colon, the use of blood derivatives and substitutes. He was particularly interested in the surgery of the bile ducts, and as the first surgeon in Poland he applied cholangioscopy and cholangiomanometry; his latest paper in this field deals with watertight suturing of the bile duct after its surgical opening.

As head of the Burns Department at the Surgical Clinic, Doc. Trojanowski was very much interested in combustiology. Besides many publications about early transplantation

in the treatment of burns and on combating shock in burns, he also took an active part in congresses both in Poland and abroad. In 1961 he read several reports at the Liblice (Czechoslovakia) symposium about the treatment of burns.

As director of the Haematological Institute, Trojanowski had great merit for the organization of the "Blood Service", being concerned with the organization and scientific aspects of the blood transfusion stations in Poland.

Apart from his scientific, educational and organizational work, Doc. Trojanowski was also very active in public life. During the Hitler occupation, he actively participated in the resistance, giving aid to wounded partizans and members of the resistance organizations.

For many years he was member of the central committees of the Society of Polish Surgeons, the Polish Haematological Society and the Polish Medical Society.

For his great merits, Doc. Trojanowski was awarded the "Banner of Labour", 1st degree, the badge for "Model Work in the Health Service" and other distinctions both in Poland and abroad.

The death of Doc. Trojanowski is a great blow to the Polish people. A noble and kind-hearted man, a physician with great feeling for human sufferings, an illustrious and progressive man has died.

Honour to his memory!

I. Dziaczkowski, M.D., Secretary of the Institute of Haematology,
Chocimska 5, Warszawa, Poland

Professor Pomphret T. Kilner Has Died

We were told the sad news by Dr Ivy and Dr Marks in the hotel hall in Hamburg where we had just arrived for the Symposium on Harelip and Cleft Palate and where we had hoped to meet Professor Kilner. The grief following the news affected the joy over many meetings with friends with whom we had been in contact for a long time, exchanging information about hare-lip and cleft palate, a field in which Kilner had been a highly estimated authority.

Prof. Kilner with Prof. Burian in Stockholm 1956

We plastic surgeons of Czechoslovakia, who had made the acquaintance of Prof. Kilner already before the Second World War, had met him at various conferences and welcomed him with great pleasure in Prague in 1956, are particularly moved by the loss. The kindness which radiated from his face, his outstanding wit and, of course, his constant readiness to held, won him every heart.

Prof. Kilner, together with Sir Harold Gillies, was the founder of plastic surgery not only in Great Britain, but in the whole western world. Gillies had a high esteem for Kilner throughout his life. In his book he wrote: "In the period 1920—1930 one outstanding personality helped to put plastic surgery on a sound basis — T. P. Kilner."

In the last war, during which he worked in various hospitals, Kilner became the first professor of plastic surgery at Oxford University. He held this post until he retired in 1957. At the first post-war congress of the International Surgical Society in London (1947), Kilner reviewed the tremendous amount of his work as plastic surgeon during the Second World War. His report aroused great attention and admiration.

While at Oxford, he also directed the department of plastic surgery at Stoke Mandeville and at the Churchill Hospital. He has trained many plastic surgeons not only in Great Britain, but also of many other countries, particularly from the United States. He has written many outstanding scientific papers though literary work was not very much to his liking.

Professor Kilner was a great friend of Czechoslovak plastic surgeons. At international gatherings he always gave us effective support. We are extremely grieved by the death. Czech plastic surgeons will always remember him with great gratitude.

F. Burian

NEW BOOKS

The members of the editorial board of the Acta Chirurgiae Plasticae are greatly interested in the work of Academician Burian on his book, the Atlas of Plastic Surgery. To give necessary information to our readers a member of the editorial board visited Academician Burian giving him some questions about his book.

Academician Burian told us: It is very nice of you, and I greatly appreciate your interest in my work. The Atlas, which I have worked on together with my daughter, Dr. Olga Klaskova, is now at the State Health Publishing House which is preparing its publication.

Even before the second world war many suggestions were put to me, especially by our foreign visitors, asking me to write a larger work based on the extensive material of our institute which at that time was the largest institute of plastic surgery. The large amount of plastic and reparative surgery carried out in cases of injury, as well as many operations for congenital disorders, in particular cleft palate and hare lip, aroused lively interest.

Our following question was: *It took you a long time to carry out your plan, didn't it?*

Academician Burian answered: Yes, certainly, it took a very long time. There was the second world war, the occupation — a dark age full of hardship — the closing of our universities and colleges, isolation from the world of culture, etc. Scientific work was cut down to the minimum; yet the amount of work to be done kept mounting: mass injuries in air-raids and the fighting during the revolution, later the period of repairing the damage and of construction, then the introduction of teaching. The institute became an imporant college and a university clinic. It was necessary to train new specialists in plastic surgery for newly established hospital departments.

The following question was: *Could you kindly, Professor, explain us the main task of your Atlas?*

Academician Burian said: It is just because of the complexity of these tasks that the final plan for our Atlas came into being. It was to present a survey of the development of modern plastic surgery, to show how our institute participated in this development, to prove that a plastic surgeon need not be a great artist by birth, but that a surgeon who possesses the natural creative talent absolutely necessary for every good surgeon is able to master this field.

The Atlas demonstrates the mistakes which can be made and the failures which even a highly skilled specialist may have. Possibilities for better planning of operations are discussed: the successful results achieved by pupils and the technical conceptions which have led to these results are demonstrated, so that a beginner may observe these conceptions and be guided by them. That is why we have included a great number of cases, many operations, many mistakes, and good as well as bad results, had to be described.

According to this plan, we had to find an artist to draw the diagrams who could do so according to our plan and requirements. We rejected the usual slick and idealized drawings which make the various stages of the operation appear easy, smoothly following each other. We wanted to prevent disappointment in those who might test these procedures and find themselves in a confusing situation brought about by following a beautiful diagram. Even for Dr. Moserova, who is both an artistic and a surgeon, it was strenous work adapting her drawings to our requirements. We are glad to be able to say that she has succeeded, and hope her work will receive recognition.

That is how the final shape of this unusual atlas came into being. It consists of two parts, general and a special, divided into these sections: head, neck, thorax, abdomen, urogenital tract, upper and lower extremities.

There are 2305 photographs and 769 drawings. The text is summed up in short introductory chapters to each section, and in short but precise captions.

Thank you, Doctor, for telling the readers of Acta Chirurgiae Plasticae about our work. We hope they will not be disappointed when our book reaches their hands.

M. D.

ACTA CHIRURGIAE PLASTICAE — 6, 4, 1964

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First Stomatological Department, Charles University, Prague (Czechoslovakia)
Director: Prof. Jaroslav Toman, M. D., C.Sc.

CONTRIBUTION TO THE SURGICAL TREATMENT OF CANCER OF THE MAXILLA "BLOCK RESECTION OF THE FACE"

J. TOMAN

The problem of the treatment of cancer of the maxilla is still topical. I shall not discuss all the methods of treatment used today but concentrate only on the procedure which we have elaborated for treating cancer of the maxilla, orbit and soft tissues of the cheek.

The surgery of malignant tumours of the maxilla has one aim, i.e. the complete removal of the tumour. The extent of the operation varies, however, and is directly dependent on a number of factors, including the size of the tumour, its localization, histological picture and on the general condition of the patient. The maxilla is resected either partially or completely in accordance with these factors.

Partial resection of the maxilla is usually carried out in the initial stages of tumours of the alveolar process or palate, where it is sufficient for the complete removal of the tumour. The operations are named according to the part of the maxilla which is resected, e.g. alveolar-palatine, maxillo-palatine. If the maxilla is removed up to the inferior orbital margin, we speak of subtotal resection. The operation is performed using the intraoral route or extraorally through a suitable skin incision. We have discontinued intraoral operations because they do not provide a sufficiently clear view of the operative field.

The complete removal of the maxilla is undertaken in more advanced tumours which affect the greater part of the maxilla or which have already spread beyond it. This operation is, therefore, indicated in carcinoma of the antrum of Highmore, in carcinoma of the alveolar process or palate penetrating into the antrum and in ethmoido-antral and antro-orbital carcinoma insofar as they are not inoperable.

We have also seen forms of cancer where the orbit and soft tissues of the cheek have already been affected, in addition to the maxilla (Fig. 1).

This form of cancer is not common. It is seen in patients who present themselves late for treatment or who are suffering from a recurrence after removal of the maxilla or after X-ray therapy.

Fig. 1. Patient with cancer of maxilla, orbit and cheek.

Fig. 2. Preterminal stage of cancer affecting the maxilla, orbit and cheek.

Hitherto, we had no effective method of dealing successfully with such tumours. The tumour gradually increased in size accompanied by increasing pain, the patient became blind, the cheek disintegrated and death occurred from advanced cachexia (Fig. 2).

To avoid these results it was necessary to solve two basic problems: the radical removal of the malignant tumour and the continued existence of the patient after such an operation.

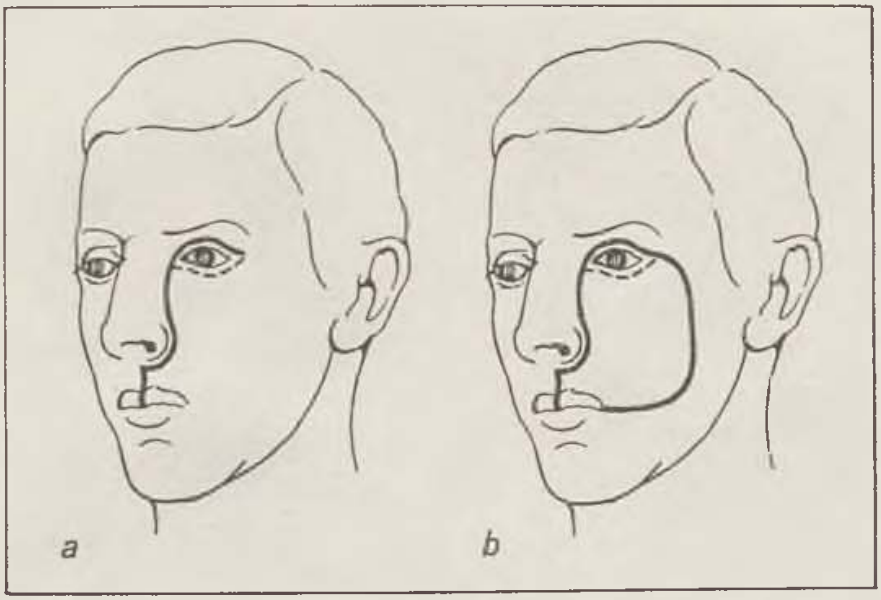

Fig. 3a. Weber-Küster incision. — Fig. 3b. Modification of incision for block resection of the face.

Effective surgery in the above form of cancer entailed resection of the maxilla and cheek and also evisceration of the orbit, i.e. block resection of half the face. Endotracheal anaesthesia made such an operation possible. It remained only to choose a suitable skin incision and to respect the flow of saliva from the parotid gland. In the choice of a skin incision, we started from the incision suggested by Weber and Küster for the simultaneous resection of the upper part of the maxilla and evisceration of the orbit. The incision starts from the mid-line of the upper lip in the direction of the columella, circles round the ala nasi and proceeds to the medial commissure of the eye-lids. From there it is continued along the margin of both lids and ends at the lateral commissure. The wound edges are sutured so that the palpebral fissure is closed.

We modified this incision for our purpose by continuing from the internal commissure of the eye-lids along the edge of the upper lid and prolonging it from the lateral commissure to end at the corner of the mouth of affected side (Fig. 3). After the removal of the tumour, the skin of the upper lid is used to cover the bony roof of the orbit.

After solving the question of the incision it was necessary to provide for the disposal of saliva from the parotid gland since the incision cut through

Stenson's duct together with the soft tissues of the cheek. Here we proceeded as follows: we put a sound into the duct if the extent of the tumour permitted and dissected it out from the lateral part of the incision up to its emergence from the gland. According to need, we resected the duct together with the tissue of the cheek and sutured the remaining stump to a new place medial to the suture line between the skin and mucosa.

The operation is completed by filling the defect with a vaseline tampon.

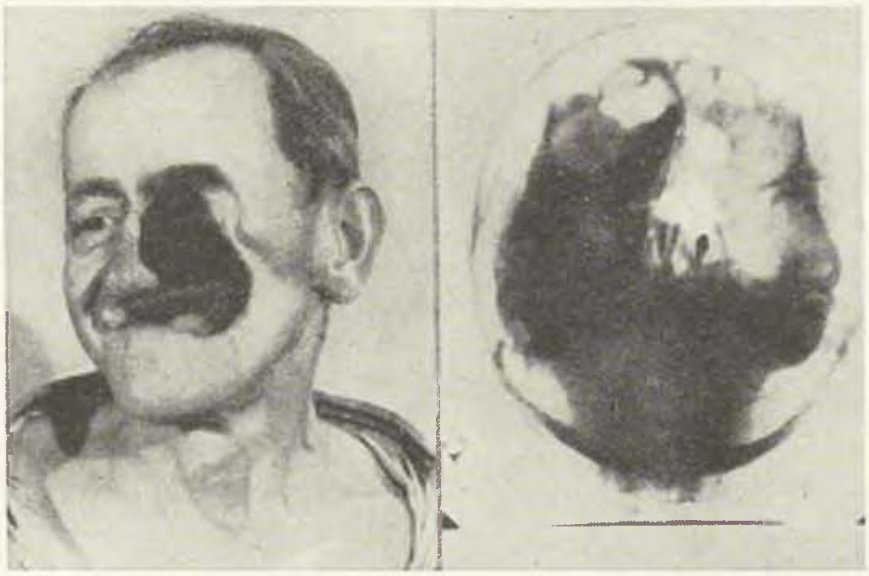

Fig. 4. Block resection of the face.

Block resection leaves severe sequelae — severe facial disfigurement and inability to chew and swallow food. The patient is unable to speak and saliva flows freely from the mouth (Fig. 4).

The patient could not continue to live under these conditions. It was therefore necessary to take measures to enable the patient to feed himself, to make speech understandable and to cover the hideous defect so that he could continue to take part in social life.

Unlike the methods used hitherto for closing the postoperative facial defect, in our patients we only separated the mouth cavity from the space left after the removal of the maxilla and evisceration of the orbit. We used a normal upper acrylic prosthesis provided with two supports to increase its stability. The vertical support leans on the root of the nose, the superior orbital margin and the gabella and prevents the prosthesis from tilting on biting and chewing food. The second, horizontal, support is taken over the lobe of the ear and prevents the prosthesis from falling on opening the mouth. A prosthesis constructed in this way serves as a support for the tongue, permits the biting, chewing and swallowing of food and speaking. The lower prosthesis then, in addition to its normal function, closes the mouth cavity from the outside and prevents the dribbling of saliva. The defect in the cheek and orbit is not covered by the prosthesis but by a bandage and scarf (Fig. 5). We do not fill this

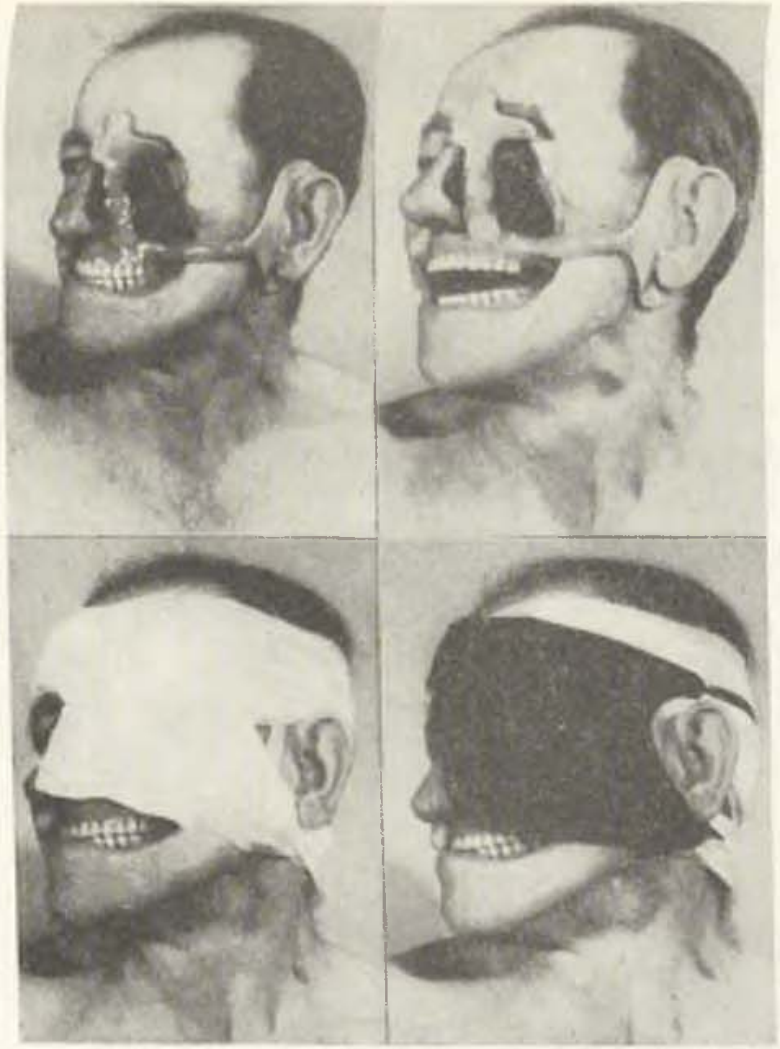

Fig. 5. Postresection prosthesis separating mouth cavity from the rest of the defect. Enables patient to bite, chew and speak. It does not press on surrounding tissue and when covered with a bandage allows patient to take part in social life.

Fig. 6. Reconstruction of upper lip, palate, lower part of cheek and closure of defect with nasopharyngeal tube flap.

space with an obturator intentionally, to spare the tissues pressure and irritation which are well-known local causes of cancer. The patient wears the prosthesis for three years. We always wait for this length of time and if, by then, no recurrence has occurred, proceed to the final closure of the defect.

The defect is closed in two stages.

The mouth cavity, palate and lower part of the cheek is first reconstructed. For this purpose we use an oblique tubed flap prepared according to Burian-

Fig. 7. Epithesis fixed to spectacles with bifocal lenses.

Bunnell, from the lateral part of the back. The flap is transferred by gradually advancing the pedicle up to the margin of the facial defect and, after several further modulations, is spread out to form the upper lip, complete the wall of the mouth cavity, part of the cheek, the hard and soft palate and close off the connection of the defect with the nasopharynx (Fig. 6). A flat bone graft from the ilium of the size of the resected hard palate is inserted into the thus prepared flap to provide support for the upper denture, which is later constructed together with the lower denture, thus making it possible for the patient to bite and chew food. Later, when the patient used the prosthesis normally, it was found that the bone graft gradually absorbed and lost its significance.

In the second stage of the reconstruction of the face we close the cranial part of the defect, the space behind the resected maxilla and the eviscerated orbit. To avoid pressure on the tissues, for reasons given above, we cover the remaining space with an epithesis. After modelling from wax we make a covering prosthesis from soft acrylic tinted and marked like the skin of the healthy side. The eye socket is filled with an eye prosthesis fixed from the back by a circular ridge. If necessary the prosthesis can be removed and cleaned. Eyelashes are attached to the margins of the lids of the same length and colour as on the healthy eye. The entire epithesis is then fixed to spectacles with bifocal lenses so that the patient does not have to change his glasses and thus each time remove the epithesis (Fig. 7, 8).

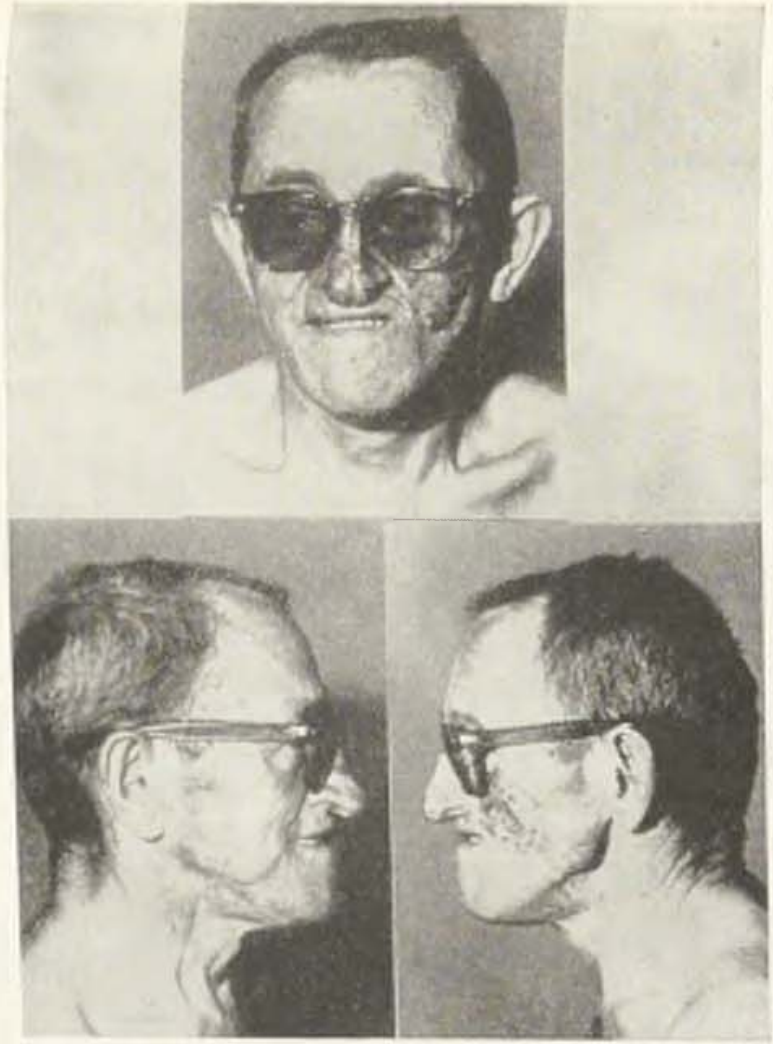

Fig. 8. Patient on discharge from hospital.

Fig. 9. Patient V. Ch. before operation, after block resection of the face and with prostheses.

Up to now three patients have been operated on by the above method. The first patient, J. B., born in 1907, in whom a block resection was completed by reconstruction of the face, is living without any evidence of disease in the ninth year after admission to the department (Fig. 4—8). His original condition was a differentiated squamous cell cornified carcinoma (histological examination No. 3192-A/55/Be, Second Department of Pathology).

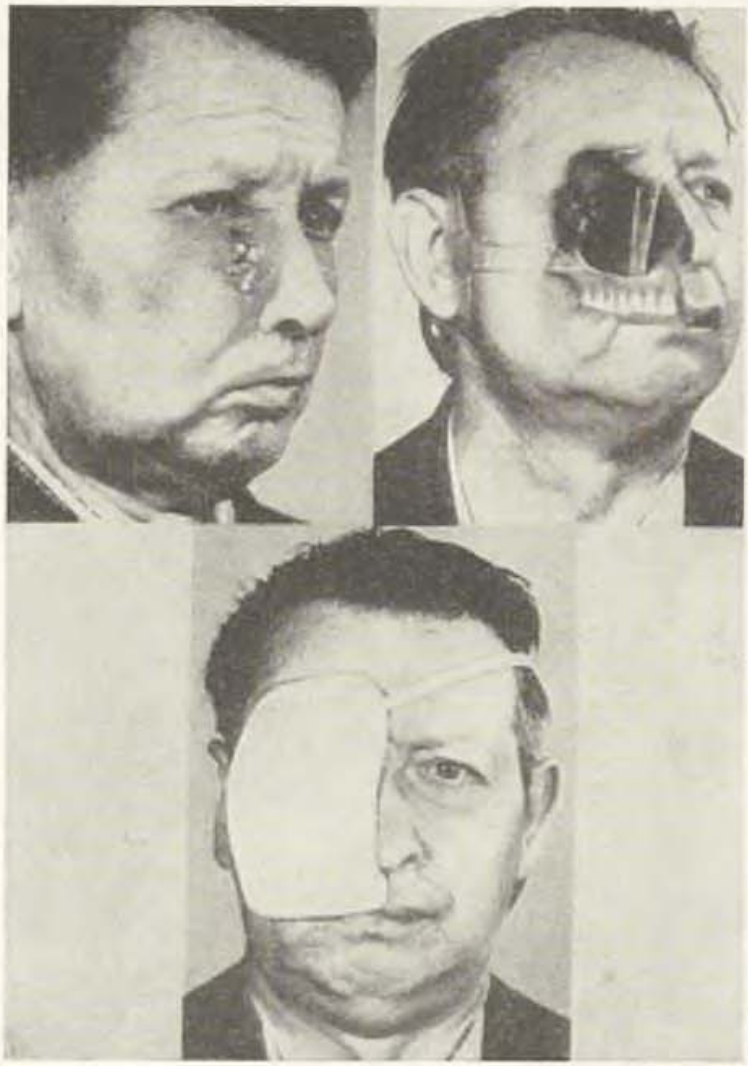

Fig. 10. Patient K. V. before operation, after block resection of the face and with prostheses.

The second patient, V. Ch. born 1898, only had a block resection of the face for carcinoma of the maxilla, orbit and cheek (Histological examination: 4196/56 A Be, First Department of Pathology — squamous cell, slightly cornified carcinoma). He is alive without evidence of disease eight years after admission to the department, and working in an agricultural cooperative. He has refused reconstruction of the face since he finds the prosthesis covered with a bandage completely satisfactory (Fig. 9).

The third patient, K. V., born 1907, was operated on after X-ray therapy, in a very advanced stage of the disease, having initially refused operation (Fig.

10). (Histological examination: 5376/62 A Be, First Department of Pathology: Granulation tissue invaded with very polymorphic tumour cells without sufficient characteristic coherence to permit histological diagnosis. It may be the marginal area to the invasive zone of a squamous cell carcinoma). One year after operation a metastasis appeared in the submandibullar glands. This was removed surgically and histological examination confirmed its connection with the primary tumour (Histological examination: lymph node invaded with a very pleiomorphic malignant new growth of the same essential character as in the previous examination. On account of the lack of differentiation of the tumour it is impossible to determine histogenesis).

In the last 15 years 76 patients have been treated in this department for cancer of the maxilla. Only two of these patients had metastases into the lymph nodes.

This confirms the wellknown clinical experience that cancer of the maxilla is regional in character and that it only rarely metastasizes, much more rarely than other carcinomas localized in the maxillo-facial area. This was also a reason for our attempt to elaborate an operation method which would not only lead to the permanent removal of the malignant tumour but also fully ensure functional and cosmetic restitution in view of the continued existence of the patient.

SUMMARY

A description is given of a method of operation — block resection of half the face — which was elaborated for the treatment of cancer of the maxilla, soft tissues of the cheek and orbit. A detailed account is given of the actual operation and postoperative rehabilitation, with a newly constructed postresection prosthesis. The sequence of reconstruction is given, consisting in reforming the walls of the mouth and buccal cavity with a tube flap and in covering the upper part with an epithesis made from soft acrylic.

Acknowledgement: I wish to thank the head dental technician of the department, Mr. L. Adámek, for his assistance in constructing the epithesis and the prostheses.

RÉSUMÉ

Contribution à la question du traitement chirurgical du cancer de la mâchoire supérieure „Résection en bloc de la face"

J. Toman

L'auteur présente une description de la méthode opératoire — la résection en bloc de la moitié de la face — qui avait été élaborée pour la thérapie du cancer de la mâchoire supérieure, des tissus mous de la figure et de l'orbite. Après avoir décrit en détail l'intervention chirurgicale proprement dite, ainsi que la réhabilitation post-opératoire, pendant laquelle une prothèse de construction nouvelle avait été utilisée, l'auteur indique les étapes successives des travaux de reconstruction, comprenant la néoformation de l'ouverture buccale et de la cavité buccale à l'aide d'un lambeau cylindrique, ainsi que la couverture par une épithèse en résine élastique.

ZUSAMMENFASSUNG

Beitrag zur chirurgischen Behandlung des Karzinoms des Oberkiefers „Die Blockresektion des Gesichts"

J. Toman

In der vorliegenden Arbeit wird die Beschreibung des operativen Vorgehens — der Blockresektion einer Gesichtshälfte — gebracht, das für die Behandlung des Karzinoms von Oberkiefer, Wange und Orbita ausgearbeitet wurde. Zuerst wird eingehend der eigentliche chirurgische Eingriff und die postoperative Rehabilitation, bei der eine neu konstruierte Prothese zur Anwendung gelangte, geschildert, sodann die Reihenfolge der Rekonstruktionsoperationen beschrieben, die in der Neubildung der Mundöffnung und Mundhöhle mittels eines tubulären Lappens und in der Deckung durch eine Epithese aus weichem Kunstharz bestehen.

RESUMEN

Contribución al tratamiento quirúrgico del cáncer de la mandíbula superior „Una resección de bloque de la cara"

J. Toman

En este trabajo se presenta una descripción de un modo operatorio — es decir, de la resección de bloque de la mitad de la cara — el que fue elaborado para el cáncer de la mandíbula superior, de los tejidos blandos, de la mejilla y de la órbita. El trabajo comprende una descripción detallada de la propia intervención quirúrgica y de la rehabilitación postoperatoria, durante la cual se usaba la prótesis nuevamente construída tras resección, y pues presenta una serie de los trabajos de reconstrucción, las cuales consistían en la neoformación de la cavidad oral y de la abertura oral por medio de un lóbulo cilíndrico y en la superimposición por epítesis hecha de la resina blanda.

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(Prof. J. Toman): Kateřinská 32, Praha 2, Czechoslovakia