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SURGICAL TREATMENT OF PROGRESSIVE FACIAL HEMIATROPHY

A. I. NEROBYEYEV, L. A. BRUSOVA, V. I. MALAKHOVSKAYA

The clinical picture of progressive facial hemiatrophy was first described by Romberg in 1896. The etiology and pathogenesis of this disease have not been extensively studied.

The opinions on the etiology and pathogenesis of this condition vary. Most authors consider it being based on an impairment of the central formations of the vegetative nervous system situated in the region of the diencephalon (M. G. Lepilin, 1970; E. K. Gur, 1961, and others). Injuries to the face and infectious diseases are of certain significance. The role of pathology of the trigeminal and facial nerves and the focal form of scleroderma (Rogers, 1964) is not excluded. Raff and Fulmek (1975) distinguish Romberg's disease — the idiopathic form of progressive facial hemiatrophy — from hemiatrophy following scleroderma. In similar clinical pictures of the two forms of disease in its late stages the substantial differential sign is the condition of the skin. Both forms are characterized by atrophy of the soft tissues and the facial bone structure of one side of the face leading to asymmetry. However, in Romberg's disease, the structure of the skin of the affected side is unchanged. In facial hemiatrophy following scleroderma, the skin is closely attached to the underlying tissues, hardly mobile, in places changed in a way reminiscent of atrophic scar, grey-brown in colour.

Up to the present time, there are no effective pathogenic methods of treatment of this condition capable of normalizing the atrophic processes and ridding the patient of this cosmetic defect.

Surgical treatment of progressive facial hemiatrophy is focused on the removal of the existing defect of the tissues, lessening the deformity of the face, and it is advantegeous to carry it out after stabilization of the process.

There are several methods of surgical treatment of the disease: using alloplastic materials (L. A. Brusova, 1975), free fat grafts, tissues of the Filatov flap (P. M. Garbushina and I. S. Karapetyan, 1975); autotransplantation of revascularized skin-fascia and skin-muscle flaps and the omentum (Yurkiewicz and Nahai, 1985).

In the literature of the last few years, the use of revascularized flaps and omentum is preferred. By means of this method it is possible to transfer

to the defect at one stage the necessary amount of well vascularized tissues similar in quality to the soft tissues of the face. Choosing the omentum or the flap depends on the extent of the defect and is only practised when removing extensive defects (Yurkiewicz and Nahai, 1985).

CLINICAL OBSERVATIONS

In the last 17 years, 64 patients with progressive facial hemiatrophy were observed and surgically treated in the clinic of the Central Research Institute of Stomatology. The disease was encountered more frequently in women (52 patients) with predominant affection of the left half of the face (35 patients). Most patients seeking aid were young persons aged 18 to 25 years. In 35 patients the idiopathic form of hemiatrophy was diagnosed and in 25 the hemiatrophy resulted from scleroderma.

In most patients, the atrophic process involved all of the half of the face (44 persons) while in 20 patients it was confined to 2—3 regions of one half of the face.

The focal form of hemiatrophy developed in the patients under observation following scleroderma and was more frequently localized in the innervation zone of the 3rd branch of the trigeminal nerve.

The degree of atrophy depends on the age of the patient at which the disease started: the higher degree of atrophy and more expressed deformity of the face (Pešková and Stockar, 1961). An analysis of the observations carried out permitted us to distinguish three degrees of atrophy.

Degree I is characterized by negligible atrophic changes in the soft tissues of the face: the skin, the subcutaneous adipose tissue, the muscles (13 patients); degree II shows pronounced atrophy of the soft tissues, the cartilages and the bones of the facial skeleton (44 patients); degree III shows clearly expressed atrophic changes in the soft tissues and the bones of the face accompanied by atrophy of the cranial bones; the eyelashes and eyebrows are often absent; alopecic parts can be observed on the affected side (7 patients).

Degree I and II of atrophy are encountered in both the complete and focal forms of hemiatrophy.

We consider it purposeful to distinguish the idiopathic form of disease or Romberg's disease from hemiatrophy following scleroderma, and also to differentiate between the degrees of atrophy because the degree, the size of atrophy and the condition of the skin determine the choice of the method of surgical treatment.

SURGICAL METHODS

The following methods of surgical treatment were used: application of polymeric materials (silicone implants and alantosil injections), autotransplantation of revascularized (thoracodorsal and parascapular) flaps, Filatov's flaps.

In patients with degree I—II facial atrophy and unchanged skin, polymeric materials were preferred. However, distinctly thinned skin covers

and atrophic soft tissues did not always permit complete restoration of the symmetry of the face by means of contour plasty using silicone implants. When modelling the implant, the tensibility of the skin is taken into account (Figs. 1 and 2).

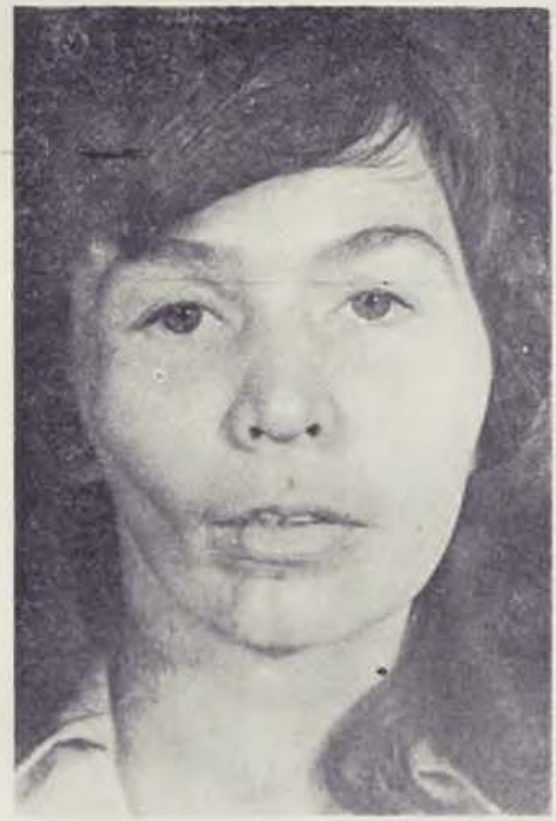

Fig. 1. Female patient V. Diagnosis: Degree II facial hemiatrophy on the right-hand side. Before operation. — Fig. 2. The same observation. After operation.

In patients with degree II atrophy of the tissues, and also of degree II however with considerable changes in the skin resembling a scar, the most preferable and frequently the only method is the autotransplantation using revascularized skin-muscle and skin-fascia grafts.

Silicone implants are made individually with the aid of a plaster of Paris mask of the patient. The implant is formed from dental wax and is, immediately fitted to the face of the patient to give a more accurate size and shape to the implant.

During the surgery, incision is made in the hairy part of the head, along the natural creases of the skin near the ear shell, in the region of the lower eyelid under the edge of the eyelashes or on the mucous membrane of the oral vestibule in correspondence with the regions of the defect. In cases of atrophy of the bony tissue of the skull, the upper and lower jaws, the silicone implants are inserted subperiosteally; for the removal of deformities of the cheeks, the lips, the nose and the temporal regions, the implants are sewn

over the muscles underneath the mobilised skin. The plasty of the face should preferably be performed by several individual implants as this allows preserving the function of the mimic and masticatory muscles and avoids limitation of opening the mouth (Fig. 3).

Contour plasty on defects of the face in hemiatrophy was performed in 44 patients with degree I—II atrophy. Surgical treatment using elastosil was carried out in 13 patients with degree I atrophy with affection of the perioral and cheek regions without pronounced thinning of the skin. Elastosil was injected subcutaneously. The amount of polymer necessary for the filling of the defect was established by a preliminary injection of novocain solution 2—3 days before operation or by shaping a wax model of the defect with subsequent melting of the wax and measuring its amount.

Autotransplantation of revascularized thoracicodorsal and parascapular flaps was performed in 9 patients with degree III atrophy. Thoracicodorsal flap was used in seven cases and parascapular in two.

Autotransplantation using free revascularized flaps makes it possible at one stage to transfer to the region of the defect the necessary amount of material which is well vascularized. identical in texture with the soft tissues of the face, restoring not only the defect of the bony and soft tissues of the face, but also the developing defect of the skin. When using the thoracicodorsal region as the donor zone while removing the complete form of hemiatrophy, we considered the following aspects: 1. the size of the defect, 2. the location of the donor zone at an unconspicuous site, 3. the length of the vascular pedicle, 4. the possibility of using only the muscular portion of the flap for the shaping of the outline.

In the preoperative period, a wax model is prepared by means of the plaster of Paris mask of the patient's face. This model makes it possible to determine the size and shape of the muscular part of the flap and the skin (Fig. 4).

At the first stage of operation we prepared the recipient bed and isolated the vessels of the recipient. In the complete form of hemiatrophy we gained access by a preauricular incision bordering on the angle of the lower jaw and, in cases of a circumscribed process, prolonged submandibularly. In four cases, when searching for more suitable vessels for anastomoses, we made an additional vertical incision in the anterolateral surface of the neck.

In order to form the recipient bed, we lifted the skin over the whole surface of the defect going beyond its borders. A pocket was formed in this way into which the wax model was inserted on which the shape and size of the skin defect were marked off.

In the second stage of operation, the flap was lifted on the side opposite to that of the defect taking into account the course of the vascular pedicle. In two cases where the muscle was rather thick in its upper layers, the flap was lifted in the lower, thinner portion of the latissimus dorsi muscle for which purpose the vascular pedicle was isolated from the upper portions of the muscle.

The flap was moulded with the aid of the model. The excess of cellular tissue and muscle was removed allowing, however, for correction with respect

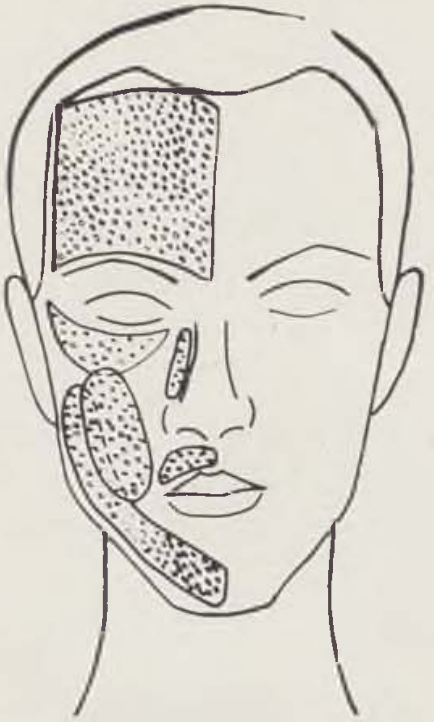

Fig. 3. Outline of disposition of the silicone implants in contour plasty of hemiatrophy.
Fig. 4. Wax model on the mask of the face of the patient with hemiatrophy.

Fig. 5. Outline of operation using autotransplantation of thoracicodorsal flap in the region of defect in hemiatrophy.

to the unavoidable atrophy of muscular tissues. In the lower portions close to the vascular pedicle, the flap included all layers. The donor wound in the back was sutured, the patient was turned to his back and the microsurgical stage of operation started. The moulded muscular flap was inserted into the prepared pocket in the face and fixed by transcutaneous bolster sutures in the lower temporal region, in the regions of the lateral surface of the nose, the upper lip and the chin.

Under optic magnification, microvascular anastomoses were formed between the vessels of the flap and the recipient (Fig. 5).

Fig. 6. Female patient R. Diagnosis: Degree III facial hemiatrophy on the right-hand side. Before operation. — Fig. 7. The same observation. After operation.

It is best to perform end-to-end anastomoses with the facial vessels provided their diameters are in correspondence. However, the facial artery was hypoplastic in four cases and the facial vein in two cases, so the anastomoses were made between the lingual artery (end-to-end) and the carotis externa artery (end-to-side). After complete restoration of the blood flow, which was determined according to the flow through the flap, and the reaction of capillary filling when pressing the flap on the skin, the wound was sutured fixing the skin portion of the flap to the edges of the wound. While putting in the stitches and after finishing the suture, the flap was under observation and the reaction of capillary filling was assessed.

When using the muscular portion of the flap for contour plasty of the middle and lower zones of the face and all the layers of the flap (muscle, subcutaneous fatty tissue and skin) for the removal of a skin defect, unavoidable excess of tissues occurs in the lower parts of the face. It is not possible, by means of this operation, to obtain complete symmetry of the face; additional corrective operations are necessary to achieve contours as symmetric as possible (Figs. 6 and 7).

Corrective operations were carried out 6—12 months later. In the late postoperative period, partial atrophy of the thoracicodorsal flap was observed

Fig. 8. Female patient E. Diagnosis: Degree III facial hemiatrophy following scleroderma on the left-hand side. Before operation. — Fig. 9. The same observation. After operation. The arrow indicates the area of the skin of the flap after replacement of the changed skin of the face.

in two cases in men, in the other patients, the volume of the flap remained unchanged. The tissues of the flap became less elastic, were displaced downwards and, consequently, the affected side of the face assumed the shape of a pear.

The character of corrective operations depended on the condition of the flap. In cases of excess of tissues of the flap in the lower parts of the face and lack in the suborbital and malar regions, the correction consisted in shifting the excess tissues to the upper parts to obtain optimum contours of the face. When atrophy of the flap was moderate, contour plasty of the suborbital and malar regions using shaped silicone implants, was performed

to improve the contours of the face. To remove deformities of the cranial region, it is more purposeful to use silicone implants by means of which complete symmetry of the face can be achieved (Figs. 8 and 9).

When necessary, we perform simultaneously plastic operation of the vermilion border and the nasal wing by means of local tissues.

CONCLUSIONS

1. Surgical treatment of progressive hemiatrophy depends on the degree of facial deformity and the condition of the skin on the affected side.

2. In degree I—II of facial atrophy and unchanged skin, contour plasty using alloplastic material is highly preferable.

3. In degree III of facial atrophy and in degree II atrophy with changed skin, autotransplantation of free revascularized flaps and contour plasty of the skull using shaped silicone implants are the methods of choice.

SUMMARY

On the basis of multiple clinical observations (64 persons), classification of the defects in progressive facial hemiatrophy is proposed. Three degrees of atrophy of the facial tissues have been pointed out and the methods of surgical treatment depending on them have been described. In degree I—II atrophy, contour plasty using silicone implants and injections of elastosil are preferred.

In degree III atrophy, autotransplantation of free skin-muscle and skin--fascia flaps is performed.

Key words: hemiatrophy; microsurgery; autotransplantation; silicone implants

RÉSUMÉ

Traitement chirurgical de l'hémiatrophie progressive du visage

Nerobeev, A. I., Brusova, L. A., Malachovskaja, V. I.

Sur la base de nombreuses observations cliniques (64 personnes), la classification des défauts de l'hémiatrophie progressive du visage est proposée. On a désigné trois degrés d'atrophie des tissus du visage et en dépendance d'eux, les méthodes du traitement chirurgical ont été décrites. S'il s'agit de l'atrophie de 1er et de 2ème degré, or préfère la plastie de contour avec les implants en silicone et les injection d'élastosile. Chez l'atrophie de 3ème degré, les autogreffes par les greffons libres dermomusculaires et dermofasciaux sont pratiquées.

ZUSAMMENFASSUNG

Die chirurgische Behandlung der progressiven Hemiatrophie des Gesichtes

Nerobejew, A. I., Brusowa, L. A., Malachowskaja, V. I.

Auf Grund zahlreicher klinischer Beobachtungen (64 Personen) wird eine Klassifizierung der Defekte bei progressiver Hemiatrophie des Gesichtes vorgeschlagen. Es

wurden drei Stufen der Atrophie des Gesichtsgewebes aufgezeigt und in Abhängigkeit davon die Methoden der chirurgischen Behandlung beschrieben. Bei einer Atrophie erster und zweiter Stufe wird einer Konturenplastik mit Silikon-Implantaten und Injektionen mit Elastosil der Vorrang gegeben. Bei einer Atrophie dritter Stufe wird eine Autotransplantation mit freien dermatomuskularen und dermatofaszialen Pfropfen ausgeführt.

RESUMEN

El tratamiento quirúrgico de la hemiatrofia facial progresiva

Nerobyeyev, A. I., Brusova, L. A., Malajovskaya, V. I.

A base de las numerosasa observaciones clínicas (64 personas), se propone una clasificación de los defectos de la hemiatrofia facial progresiva. Según ésta hay tres grados de la atrofia de los tejidos faciales y en dependencia de éstos el papel describe las técnicas del tratamiento quirúrgico. En los casos de la atrofia del primer y segundo grado se prefiere emplear la plástica de contorno por medio de los injertos implantados de silicon y por inyecciones de elastosil. En caso de la atrofia del tercer grado se ejecuta la autotransplantación con ayuda los injertos dermatomusculares y dermatofaciales libres.

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Author's address:
Prof. A. I. Nerobyeyev,
"Stomatologiya" Association
for Research and Production,
119840, GSP-3, Moscow,
Ul. Timura Frunze 16, USSR

Medical Institute, Vitebsk (USSR)
Chair of Traumatology, Orthopaedics and War Surgery,
Head Asst. Prof. M. A. Nikolski, M. D.

TWO-STAGE TENOPLASTY FOR INVETERATE DAMAGE TO FINGER FLEXOR TENDONS

M. G. DIVAKOV, S. K. ZYRYANOV, V. S. OSOCHUK, S. A. BATOVSKI

Two-stage tenoplasty for inveterate damage to finger flexor tendons at the site of fibrous canals (zone II), digital function is very difficult to reconstruct because of major scarring in the zone of finger damage, tendon defect and because of contractures developing in interphalangeal finger joints.

In such cases the conventional methods of tendon reconstruction (suture, autoplasty and alloplasty) are of little effect because the site of the suture or transplant tends to coalesce with the surrounding tissues around the fibrous canal, thus preventing full reconstruction of finger function (1—3, 5, 9).

In our opinion, for the treatment of patients with inveterate damage to finger flexor tendons of zone II it is of advantage to use the method of two-stage tendon reconstruction according to Paneva-Holevich (5) using preliminary tendon bed shaping with a silicon endoprosthesis according to Hunter (8, 10).

However, owing to the technical difficulties involved and the need for plaster-of-Paris fixation following the IInd stage of plastic operation, this method has so far failed to come into general use because the cross-phalangeal fixation of the rotation transplant is not regarded as strong enough. In addition, there is still a question open to discussion as regards the mode of shaping and vascular supply to the intertissular capsule surrounding the silicon implant as well as the possible development of epithelial lining on the inside of the capsular wall.

Hence our experimental clinical research for the purpose of improving the functional results in the treatment of patients with inveterate damage to finger flexor tendons, and of studying the specific features of a capsule developing around the silicon endoprosthesis.

MATERIAL, METHODS AND RESULTS OF EXPERIMENTAL OBSERVATION

40 white laboratory rats weighing 160—200 g were used for the experiments. Under aseptic conditions, in ether narcosis, the animals had one silicon

prosthesis implanted in the soft tissues of the hind legs (a total of 80 implants). The groups of animals were sacrificed after a period of 1—12 weeks. 12 rats had a mixture of Chinese ink and gelatine introduced via the abdominal aorta into the vascular system. The tissues, surrounding the silicon prosthesis, were fixed in 10% solution of neutral formole. Bioptic sections 6—8 μm thick were stained with hematoxylin-eosin and according to van Gieson. Transparent bioptic specimens 100 μm thick were made for stereomicroscopy to study the vascular system after being filled with the Chinese ink-gelatin mixture.

The histological material was scrutinized microscopically for morphometry of the capsular wall thus arising. Experimental data taken at intervals of 6—12 weeks were compared with histological data concerning the capsule newly developing in human patients 8—12 weeks after the first stage of tenoplasty. A portion of the capsule for histological analysis was taken from the patients during the 2nd stage of tenoplasty, using the same method of processing as in the animal experiment.

An analysis of the experimental results showed the formation of the capsule around the silicon implant as following the same pattern as a capsule being formed around a foreign body. After one or two weeks, a thin, smooth-walled capsule, up to 2 μm thick, was seen growing around the implant with a concentric pattern of collagen fibre formation. The capsular wall was intimately grown into the base. There was no evidence of epithelial lining on the inside of the capsule. After 3—5 weeks, the union between the capsule and the base appeared to be much stronger. There was no change in the pattern of concentric collagen fibres, and no evidence of epithelial lining. The blood supply to the capsular wall was effected by capillarization from the base with a circular orientation in the capsular wall (Fig. 1). By the end of six to eight weeks, the character of the histological data had remained unchanged as had the circular pattern of collagen fibre, fibroblast and capillary arrangement. The collagen fibres were seen proliferating in the neighbouring tissues, thus making for a firm union between the wall of the newly formed canal and surrounding tissues (Fig. 2). The thickness of the capsular wall kept growing up to 350—400 μm.

In the subsequent period of observation (9—12 weeks), the character of the histological data remained unchanged. With the silicon implant placed next to bone, the capsular wall remained intimately united to the adjoining bone by means of fibrous tissues throughout the period of observation. Not even after 12 weeks was there any evidence of any epithelial lining on the canal wall.

Comparisons of the morphology of the wall of the newly shaped canal in the patients' fingers at 8—12 weeks after surgery showed good agreement between the experimental data and the histological findings of the pattern of collagen fibres, fibroblast and fibrous tissue structure (Fig. 3). In the clinical and experimental material, the absence should be stressed of any epithelium or epithelium-like lining on the inside of the newly shaped canal.

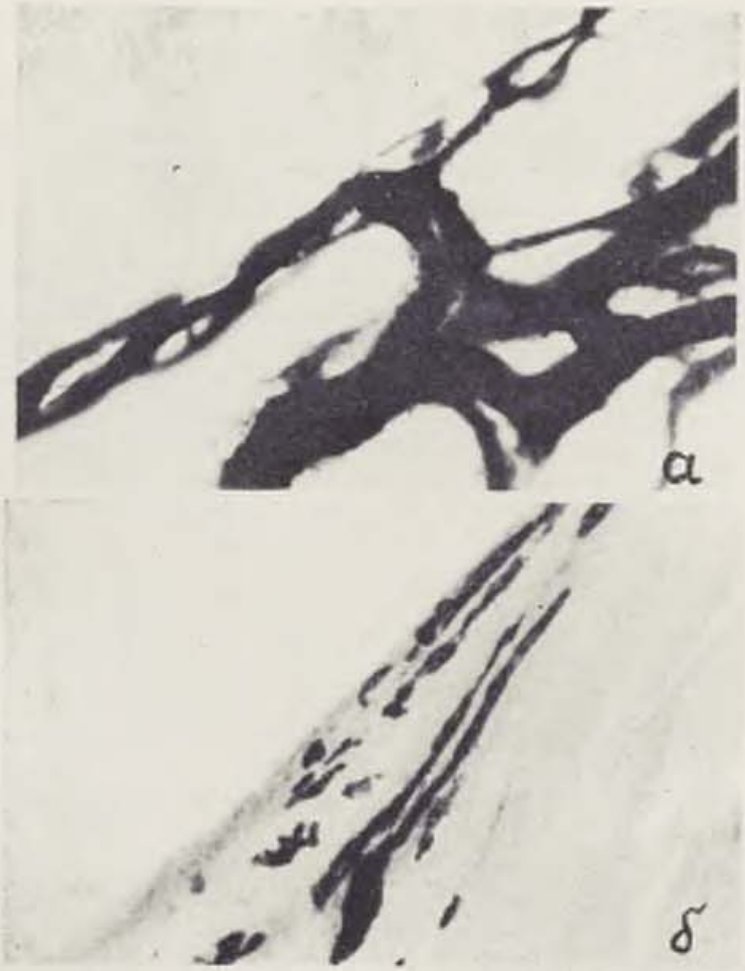

Fig. 1. Vascular system of capsular wall grown around a silicon endoprosthesis within four weeks of surgery. Chinese ink filling. Microphotograph. a) transparent biopsy, × 67, b) stained with haematoxylin-eosin, × 168.

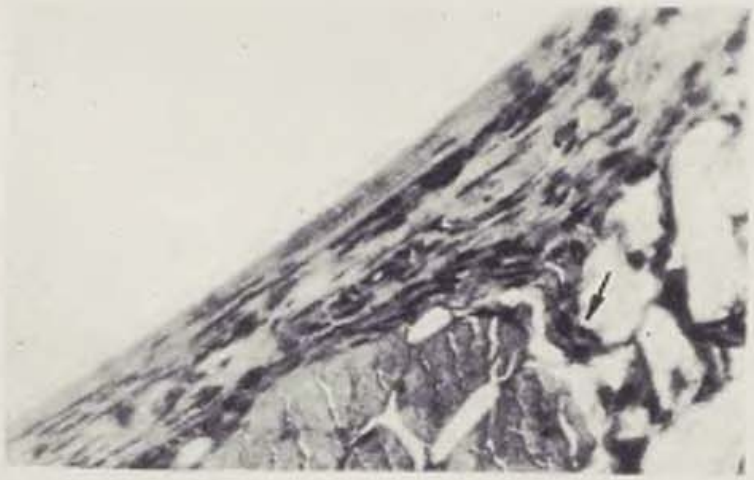

Fig. 2. Circular pattern of collagen fibre arrangement in the capsular wall and proliferation into surrounding tissue. 6 weeks after surgery. Microphotograph. Haematoxylin-eosin, × 168.

MATERIAL, METHODS AND RESULTS OF CLINICAL RESEARCH

The clinical part of the study was based on our experience of 15 cases of inveterate damage to flexor tendons of digits II—V of the hand (digit II — 2 patients, digit IV — 3 patients, digit V — 1 patient, digits II—III — 5 patients, digits II—IV — 2 patients, digits III—IV — 1 patient, digits IV—V — 1 patient, a total of 24 fingers). The patients' age ranged from 18

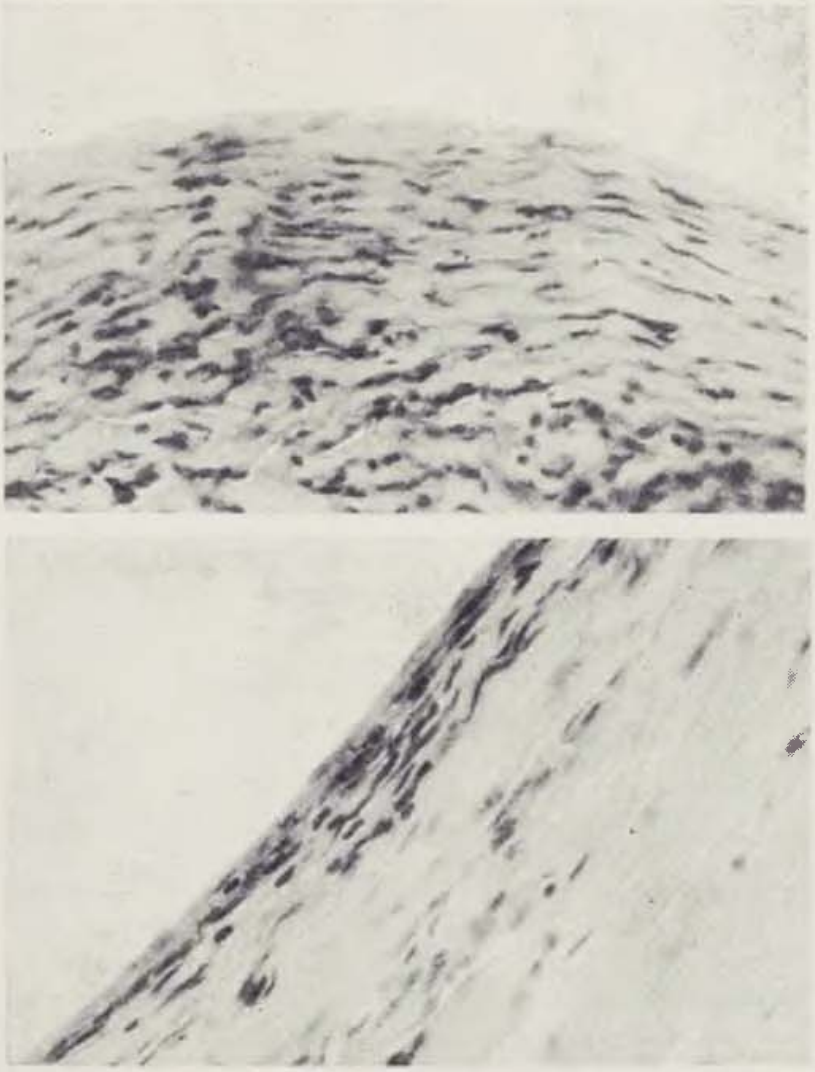

Fig. 3. Capsular wall grown round silicon endoprosthesis. a) experiment, b) 12 weeks post-operatively. Microphotograph. H—E, ×168.

to 45 years. The age of the trauma was two up to eight months. Prior to admission to our Department, six patients had been operated on elsewhere. 9 patients were capable of merely passive movement in the interphalangeal finger joints, and six had flexure contracture or articular rigidity in the damaged fingers.

Stage I of tenoplasty took a routine course. Z-plasty was used for making access. A piece of silicon tubing for single-time blood transfusion was used for the tenoprosthesis.

Stage II followed 8 weeks after stage I and, in three cases, after the elapse of two weeks. For the second stage of tenoplasty we had developed and employed a new technique of firm fixation to the distal phalanx of the rotated pedicled tenotransplant.

Principle: with the rotated tenotransplant introduced into the pre-shaped canal and taken out of the wound on the palmar side of the distal phalanx, the residual tissue of the deep flexor was removed at its insertion. A complementary incision was made on the dorsal side of the distal phalanx, and a canal, 3—4 mm in diameter, was shaped in it in the direction from the palm to the dorsum. As a passageway for the end of the rotated pedicled part of the tendon; this was subsequently split into two parts and both its pedicles were introduced into the wound on the palmar side through the canal in the soft tissues made lateral to the distal phalanx. The tendon pedicles were sutured with 3/0—4/0 suturing material and fixed to the tenotransplant with the muscle physiologically extended (Fig. 4). The wounds were closed layer by layer.

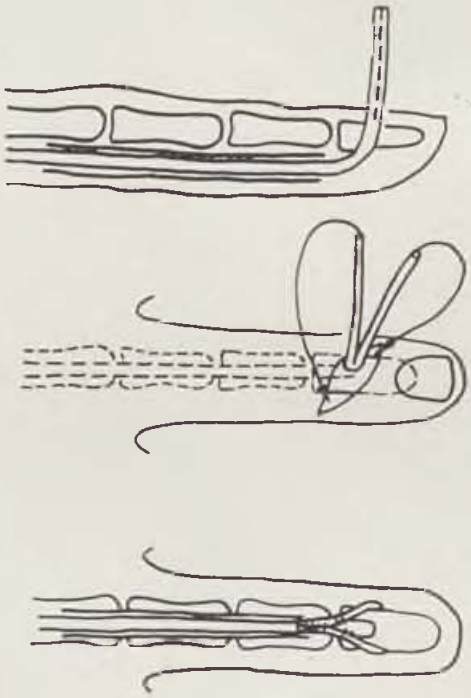

Fig. 4. Diagram of rotated tenotransplant fixation to distal phalanx of finger.

No plaster-of-Paris immobilization was used. As from postoperative days two or three, rehabilitation exercises were started. To enhance the effect of therapeutical rehabilitation, the surgically operated fingers were

fixed to their healthy neighbours with rings of adhesive tape. This was possible only in cases where only one or two fingers were damaged. The sutures were removed after 12 or 13 days and rehabilitation therapy was outlined for a period of three weeks. The patients were able to resume their regular work within five to six weeks of the 2nd stage of tenoplasty.

The results of our treatment of patients with inveterate damage to finger flexor tendons using two-stage tendon reconstruction according to Paneva-Hunter in our own modification were assessed six to two years postoperatively. The assessment took a five-point assessment rating scale according to V. I. Rozov (4). Excellent results were attained in nine patients (60 %) on 15 fingers, good results in 3 (20 %) patients on 6 fingers, satisfactory results in 2 (13.3 %) on two digits, and poor results in 1 patient (6.7 %) on one finger. Excellent and good results are the most difficult to obtain in the treatment of inveterated damage to flexor tendons of digits IV—V. Hence the following clinical observation to exemplify this.

Patient P., 22 years, was hospitalized at the department of traumatology and orthopaedic surgery, Vitebsk Medical Institute, for inveterate damage to flexor tendons of digits IV—V of the right hand at proximal phalanx level. Age of trauma — four months. Full extent passive movement in the joints of the digits damaged. Marked scarring of proximal phalanges on the palmar side.

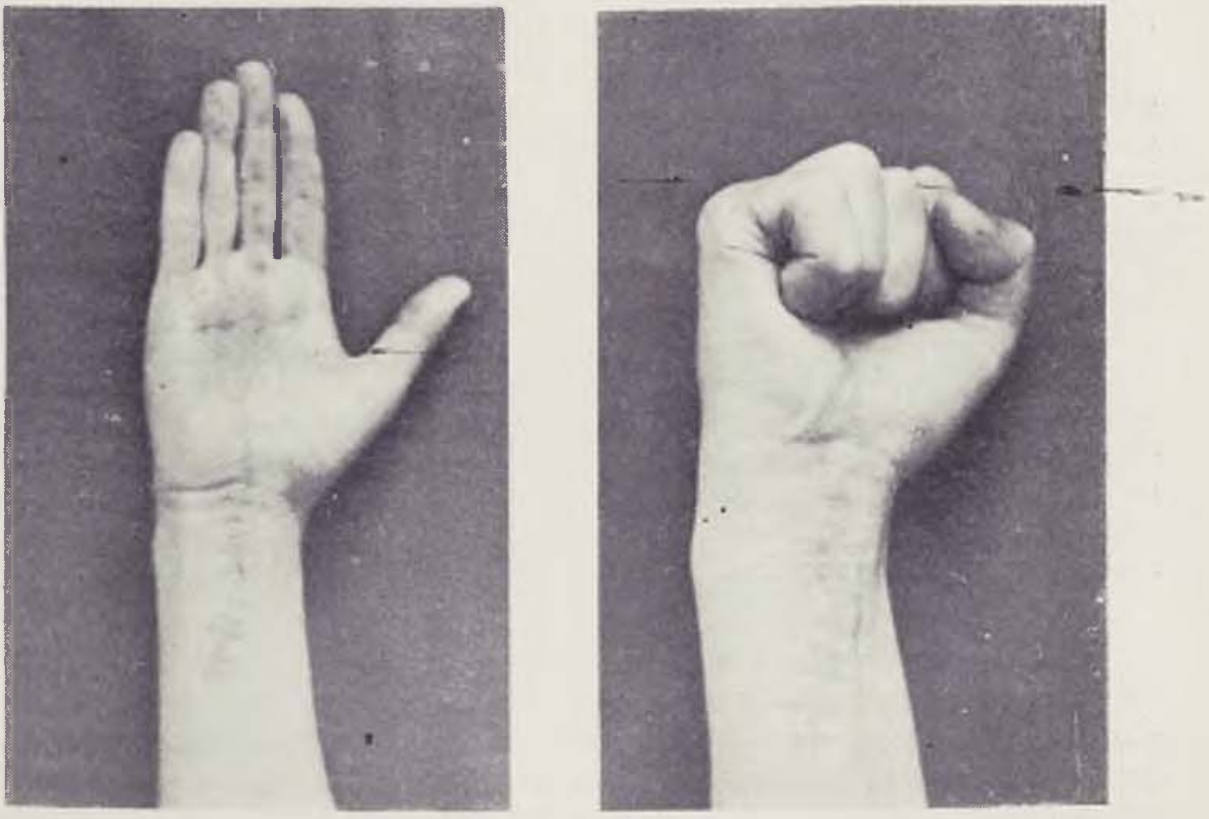

Fig. 5. Appearance of the hand (a, b) of patient B. 6 weeks after stage II of tenoplasty.

The patient was treated with our own modification of the Paneva-Hunter two-stage tenoplasty. The postoperative course was normal. Rehabilitation therapy was started. After six weeks, the functional capacity of digits IV—V of the right hand was fully restored (Fig. 5) and their working capacity, too. Following the first stage of tenoplasty, the patient was certified unfit for work for three weeks, following the second stage — for six weeks.

ASSESSMENT OF RESULTS, DISCUSSION

In what is the foremost advantage, the method of two-stage tenoplasty for the management of inveterate damage to finger flexor tendons in the critical zone II makes use a rotated pedicled tenotransplant taken from the superficial flexor. This is introduced into a pre-shaped canal, thus preventing union between the transplant and the surrounding tissue and creating optimum conditions for the free gliding of tendons and also suture transfer from the critical zone to the palmar region. In a histological analysis, T. P. Rozovskaya (6) found epithelial lining growing on the canal wall near the prosthesis. On closer scrutiny, however, we were unable to find any epithelium or epithelium-like lining either in our experimental work or in our clinical biopsies suggesting entirely free gliding of tendons. The canal wall remains smooth thanks to the firm adhesion of concentrically arranged collagen fibres.

The capsule development and union with neighbouring tissues is completed within six to eight weeks and later on the thickness of the capsular wall never grows more than 350—400 μm. Hence this term is optimum for the second stage of the plastic operation.

For its success the operation depends to a large extent on early start of movement in the surgically treated fingers. This is assisted by the strong first-stage union of the sutured tendons of the superficial and deep flexors just as well as by our own new method of rotated tenotransplant fixation to the distal phalanx as this helps to increase the strength of tendon fixation to the bone and earlier rehabilitation. Excellent and good results were attained where prior to stages I and II of tenoplasty full range of movement had been preserved in the damaged joints. The absence of full range of movement before stage II of tenoplasty, the presence of flexure contractures, preclude the attainment of full functional reconstruction of the digits damaged. Similar situations are particularly frequent after previously performed operations. The poor therapeutical result scored in one of our patients was due to disruption of tendon suture in the superficial and deep flexors following stage two of the plastic operation.

CONCLUSION

1. The shaping of the silicon implant capsule wall terminates in post-implantation weeks 6—8 without any epithelial lining developing on the inside of the wall. The collagen fibres in the capsular wall show a circular pattern of arrangement, blood is supplied from circularly growing vessels of the capillary trough.

2. The use of the method of rotated pedicled tenotransplant fixation to the distal phalanx permits to attain full tendon fixation to the bone, to dispense with plaster immobilization, to start rehabilitation treatment much earlier and to cut working incapacity time to 5—6 weeks.

SUMMARY

40 experimental rats had 80 silicon prostheses implanted in the hind legs for the purpose of studying the peculiarities of a capsule developing round the implant over one to twelve weeks. The silicon implant was found to help develop a smooth-walled inter-tissue capsule with a concentric pattern of collagen fibres and fibroblasts without the development of any epithelium-like lining on the inner surface of the wall. The thickness of the capsular wall becomes stabilized after six to eight weeks, never exceeding the 350 μm to 400 μm mark. The capsular wall is supplied from a concentrically growing capillary groove. The clinical material summarizes experience of 15 cases (24 fingers) of inveterate flexor tendon damage in digits II—V in the „critical" zone (II). The authors used a new method of rotated pedicled tenotransplant fixation to the distal phalanx. This permitted to dispense with plast-of-Paris immobilization, to start rehabilitation earlier, and to score excellent and good results in twelve patients (80 %) (21 fingers) within five to six weeks of the second stage of tenoplasty.

Key words: finger flexor tendons, inveterate damage, two-stage tenoplasty, rehabilitation

RÉSUMÉ

Plastie tendineuse à deux temps dans la thérapeutique des patients avec endommagements désuets des tendons fléchisseurs des doigts

D ivakov, M. G., Zyrjanov, S. K., Osotchuk, V. S., Batovskij, S. A.

Dans les expérimentations sur 40 rats, auxquels on a implanté 80 prothèses de silicone aux membres de derrière, nous avons étudié les charactéristiques liées à la genèse d'une capsule autour de l'implant, entre 1 à 12 semaines. On a constaté qu'autour de l'implant de silicone, une capsule intratissulaire à paroi lisse est formée, avec l'organisation concentrique des fibres collagènes et des fibroblastes, sans formation du tissu analogue à l'épithélium sur la surface intérieure de la paroi. L'épaisseur de paroi de la capsule devient stable vers 6—8 semaines et ne dépasse pas les limites de 350—400 mkm. L'alimentation sanguine de la paroi de capsule prend source dans les artères grandissantes concentriquement dans les stries capillaires. Notre matériau clinique implique l'expérience de la thérapeutique de 15 patients (24 doigts) avec les endommagements désuets des tendons fléchisseurs de II—V doigts dans la zone critique. On a appliqué une nouvelle méthode de fixation du greffon tendineuse de rotation sur la phalangette, grâce à quoi on a pu réprouver l'immobilisation plâtrée, etreprendre une rééducation précoce et obtenir de bons résultats chez 12 patients (80 %) (21 doigts) 5—6 semaines après la seconde étape de plastie.

ZUSAMMENFASSUNG

Die Sehnenplastik in zwei Etappen bei der Therapie von Patienten mit veralteten Beschädigungen der Sehnen der Fingergelenke

Divakow, M. G., Zyrjanow, S. K., Osotchuk, V. S., Batovskij, S. A.

Bei Versuchen an 40 Ratten, denen 80 Silikonprothesen in die hinteren Gliedmassen implantiert wurden, wurden die Besonderheiten der Entstehung einer Hülle um das Implantat im Verlauf von einer bis zu zwölf Wochen erforscht. Dabei wurde festgestellt, dass sich um das Silikonimplantat eine Hülle mit glatter Wand zwischen dem Gewebe mit konzentrisch angeordneten Kollagenfasern und Fibroplasten bildet, ohne dass ein Epithel eines ähnlichen Bettes an der inneren Wandoberfläche entsteht. Die Stärke der Hüllenwand stabilisiert sich in der sechsten bis achten Woche und vergrössert sich nicht über die Grenze von 350—400 mkm Die Blutversorgung der Hüllenwand ergibt sich aus den konzentrisch anwachsenden Gefässen der Kapillarenrille. Das klinische Material enthält die Erfahrungen aus der Therapie von 15 Patienten (24 Fingern) mit veralteten Beschädigungen der Sehnen der Gelenke des zweiten bis fünften Fingers in der kritischen Zone. Es wurde eine neue Methode der Fixierung eines rotierenden Sehnentransplantats auf das Fingernagelglied angewendet, was gestattete, eine Unbeweglichmachung durch Gipsverband zu vermeiden, eine rechtzeitige Rehabilitierungskur zu beginnen und ausgezeichnete bis gute Ergebnisse bei 12 Patienten (80 %) (21 Fingern) binnen fünf bis sechs Wochen nach der zweiten Etappe der Plastik zu erzielen.

RESUMEN

La tenoplastia de dos etapas en el tratamiento de los pacientes con defectos viejos en los tendones de los flexores digitales

Divakov, M G, Ziryanov, S K, Osochuk, V S, Batovskiy, S. A.

Durante los experimentos con 40 ratas fueron implantadas 80 prótesis de silicon en las extremidades posteriores, se investigaban las circunstancias especiales del orígen de la cápsula alrededor del injerto implantado que aparece en el período de 1—12 semanas. Fué averiguado que alrededor del injerto de silicon implantado se forma una cápsula intertisular de pared lisa con la organización concéntrica de las fibras de colágeno y fibroblastos sin la formación del epitelio que tiene una estructura semejante; la cápsula aparece sobre la superficie interior de la pared. El espesor de la pared de la cápsula se estabiliza en la 6ª—8ª semana y no sobrepasa el límite de 350—400 μm. El abastecimiento de sangre de la pared de la cápsula está provista por los vasos concétricos de la ranura capilar. El material clínico contiene las experiencias del tratamiento de 15 enfermos (24 dedos) con los defectos viejos en los tendones de los flexores digitales del II⁰—V⁰ dedo en la zona crítica. Se empleó una nueva técnica de la fijación del colgajo rotario de tendón sobre la uña, lo que facilitó eliminar la inmovilización por yeso, empezar la rehabilitación temprana y de tal manera obtenir resultados excelentes y buenos en 12 pacientes (80 %) (21 dedos) dentro de 5—6 semanas después de la segunda etapa de la operación plástica.

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Dr. M. G. Divakov, CSc.,
Vitebsk Medical Institute,
210023, Frunze St. 27, Vitebsk, USSR

Institute of Cosmetic Care, Prague Municipal National
Committee, Prague (Czechoslovakia)

Department of Plastic Surgery
Head K. Fahoun, M. D. DrSc.

NASAL VESTIBULAR ATRESIA AND ITS SURGICAL PREVENTION

K. FAHOUN

The most common consequence of rhinoplasty is a reduction in the nasal vestibular space due to sinechiae and cicatricial tissue at the apex of the vestibular cupola. Some authors (3) claim conservatively that as many as 85 % of patients after rhinoplasty suffer from the reduction of the nasal vestibular space. Vestibular atresia is pathognomonic because of an excessively radical resection of the vestibular mucosa at the upper margin of the lower (alar) lateral cartilages occurring in rhinoplasty performed by means of cartilaginous incision. Similarly, excessive resection of the lower end of the upper lateral cartilages in nose reduction and excessive resection of the vestibular mucosa along the lower edge of the inferior lateral cartilages can both lead to atresia. Rhinoplasty with skeletal reduction always results in an excess of mucosa, whose retraction is to be taken into account beforehand. An excess of mucosa leads to its plication at the apex of the vestibular cupola, which eventually results in atresia. Equally, the remaining soft tissues, detritus, haematoma and a persistent swelling after surgery lead to the formation of cicatricious tissue, which adversely affects the line of the nasal ridge creating a ball-like bulge above the tip of the nose simultaneously reducing the nasal vestibular space.

Vestibular reduction can be divided into four degrees of atresia according to Sheen (Sheen, J. H., 1978), as indicated in Fig. 1.

The 1st degree includes atresias between 0 % and 15 %, when patients have no functional difficulties. The degree mostly applies to well-performed rhinoplasties.

The second-degree atresia refers to vestibular reduction from 15 % to 40 %, which leads to functional changes with potential epithelial metaplasia, crust formation, and occasional epistaxis.

The third-degree atresia reduces the vestibulum in the range from 40 % to 75 % leading to respiratory obstruction and mouth-breathing when in

creased air consumption is needed. This malfunction can be improved only by surgery.

The fourth-degree atresia exceeds 75 % of the vestibular capacity. This atresia is not common but when it does occur, it poses not only problems for the patient but also for the surgeon to repair. The patient suffers from anxiety mostly due to lack of air, must breathe through the mouth even at rest, which eads to a great number of clinical problems (2, 3).

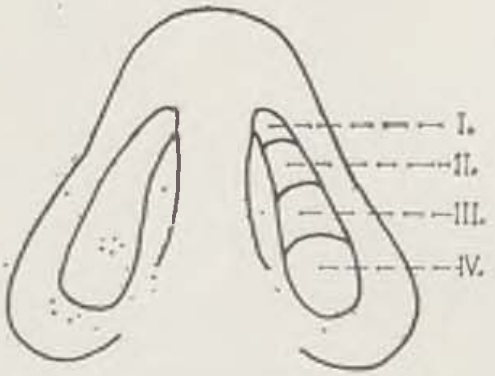

Fig. 1

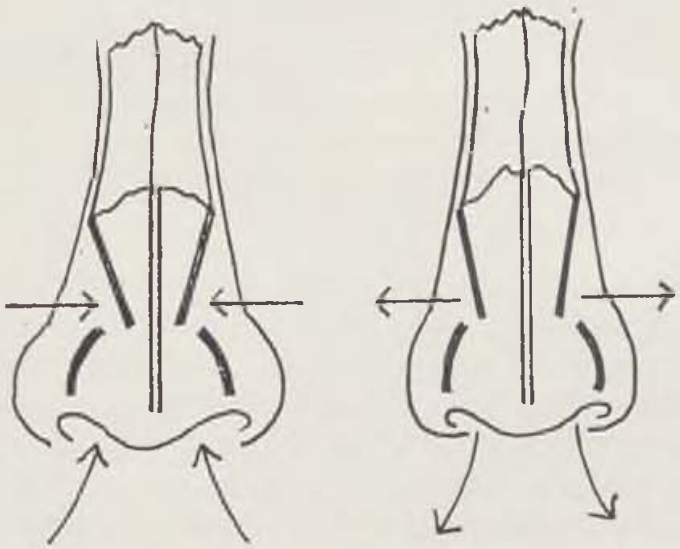

Fig. 2

If the cicatricious tissue bulges into the vestibulum, it can negatively affect also the function of the vestibular valve. The inner valve is formed by the lower free end of the upper lateral cartilage, septum and the nose base. During deep respiration, the nostrils are enlarged and the valve narrows due to the approximation of the free caudal ends of the upper lateral cartilages. In expiration, the nostrils narrow and the valve opening increases. The normal function of the air inlet control is shown in Fig. 2.

We perform surgical prevention of vestibular atresia in the following manner: for rhinoplasty we use the transcartilaginous method; after mobilization, we expose the upper part of the lower lateral cartilage separating it carefully from the mucosa. Then we model the cartilage reducing it to the shape required. According to the size of the reduction, we select the type of transcartilaginous incision — posterior, medial or anterior. Even if we apply the anterior intracartilaginous incision — needed for an extensive reduction

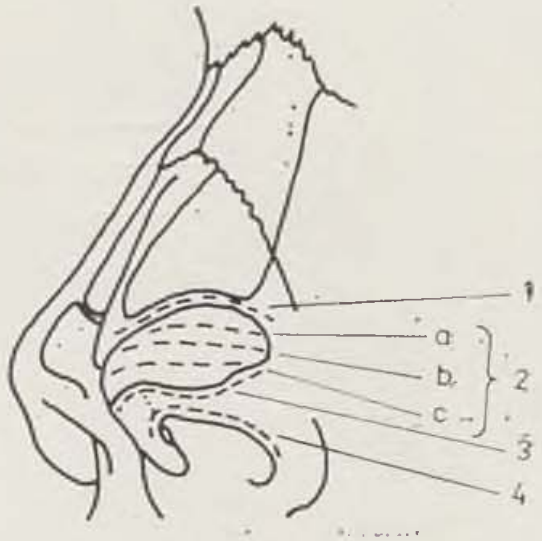

Fig. 3. Intranasal incisions
1 intercartilaginous; 2 transcartilaginous: a poaterior, b medial, c anterior; 3 infracartilaginous; 4 marginal.

of the lower lateral cartilage — we must always leave a 3 mm wide margin of the lower lateral cartilage, which forms the relief of the basal area of the nose. Total extirpation of the lower lateral cartilages is a serious mistake as it leads to an unbecoming drop of the tip of the nose and collapse of the nostrils, which is very difficult to repair. Surgical correction depends precisely on the implantation of the cartilage, which the primary rhinoplasty failed to remove. We use homotransplants taken from previous reduction rhinoplasties. Then we incise the mucosa at the apex of the vestibular cupola and carry out its conservative reduction as shown on Fig. 5.

At the end of the operation we carefully reconstruct and adapt the mucosa using fine catgut stitches. The incision of the vestibular cupola is left free, and is carefully adjusted with tamponade which is carried out with greased forceps directed from the inside and a modelling plaster-of-Paris splint from the outside.

Using the incision and conservative resection of the mucosa, we try to prevent plication at the vestibular apex. Postoperative haematoma is continuously drained into the vestibular tamponade. In this way, we prevent formation of persistent haematoma and cicatricious tissue in the soft part of

the nose. The tamponade is removed on the 3rd day after surgery. None of the operated patients showed signs of atresia found at clinical examination (unobstructed nasal airways during respiration) or in the subjective data obtained from the patients.

This surgical method has been successfully applied at our department for 15 years now.

Fig. 4

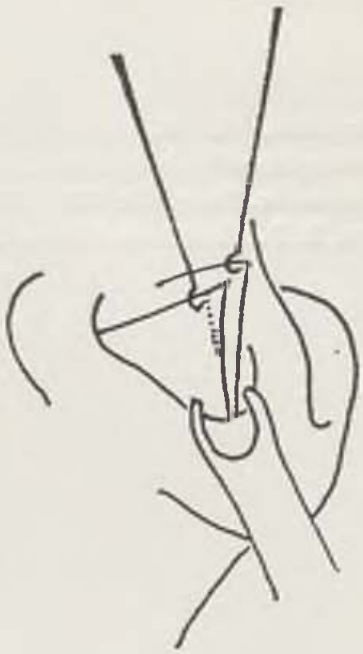

Fig. 5

SUMMARY

The author discusses his 15-year old experience of surgical prevention of vestibular atresia by means of incision of the mucosa at the apex of the nasal vestibular cupola.

RÉSUMÉ

Atrésie vestibulaire nasale et le mode de prévention opératoire

Fahoun, K.

L'Auteur présente ses expériences aquises au cours de 15 ans avec la prévention opératoire des atrésies vestibulaires. La méthode consiste en coupe des muqueuses au sommet de la coupole du vestibule nasal.

ZUSAMMENFASSUNG

Vestibuläre Atresie der Nase und Art der operativen Prävention

Fahoun, K.

Der Autor führt seine fünfzehnjährigen Erfahrungen mit der operativen Prävention vestibulärer Atresien durch Anschneiden der Schleimhaut im Scheitelpunkt der Kuppel des Nasenvestibuls an.

RESUMEN

La atresia vestibular nasal y su prevención operatoria

Fahoun, K.

El autor presenta sus experiencias de 15 años con la prevención operatoria de la atresias vestibulares con ayuda de la incisión de las mucosas en el ápice de la cupol vestibular nasal.

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Dr. K. Fahoun
85 Jeremenkova
140 00 Praha 4
Czechoslovakia

Medical Academy. Sofia, Bulgaria

Institute of Surgery

Head Prof. S. Baev, M. D. Dr. Sc.

Department of Plastic Reconstructive and Aesthetic Surgery

Head Prof. K. Anastasov, M. D., Ph. D.

BREAST RECONSTRUCTION FOLLOWING MASTECTOMY

P. TEPAVICHAROVA

BREAST RECONSTRUCTION FOLLOWING MASTECTOMY

There are three alternative methods for plastic reconstruction of the breast:

1. submuscular insertion of implants
2. arterialized myocutaneous flaps
3. free myocutaneous transplants

The choice of the type of reconstruction depends on factors, such as:

1. previous operation: subcutaneous mastectomy, modified radical mastectomy, mastectomy after Patey or Halsted
2. general condition of the patient and individual requirements
3. surgeon's experience

The use of submuscular implants for breast reconstruction is indicated in patients who have been subjected to modified radical mastectomy, leaving intact the pectoralis major, and eventually the pectoralis minor muscles.

Skin augmentation through flap transfer or free myocutaneous transplants is preferable mainly in the event of a small-size breast and extensive tumor excision with ensuing muscle defect.

Free transplants require special equipment-operating microscope, microsurgical instrumentation, experienced team. Here the operating time is also of crucial importance. Reconstruction by free transplants lasts about 6—7 hours, while reconstruction by arterialized myocutaneous flaps is completed usually in 2 1/2 to 3 hours only.

The latissimus dorsi and the transverse rectus abdominis musculo-cutaneous (TRAM) flaps are the two main flaps for breast reconstruction. The latissimus dorsi flap is especially useful for axillary fill after a radical mastectomy and requires mammary implants, while the TRAM flap provides for sufficient material, without using breast implants.

MATERIAL AND METHODS

In the Department of Plastic Reconstructive and Aesthetic Surgery — Sofia a total of 26 breast reconstructions were done over a three-year period. The patient's mean age was 40,5 years (range 26 to 48 years).

The patients were divided in groups according to timing of reconstruction and surgical technique employed (table 1). Delayed reconstructions were performed in twenty cases, and immedate in six.

Table 1. Time and method of reconstruction

Method / Time		Immediate	Delay	Total
Silastic implant post	modified radical mastectomy Patey Halsted	1		1
Expander post	modified radical mastectomy Patey Halsted		1	1
M. latissimus dorsi flap post	modified radical mastectomy Patey Halsted	5	7 10	22
M. rectus abd. post	modified radical mastectomy Patey Halsted		2	2
Total		6	20	26

Seven reconstructions were undertaken following radical modified mastectomy, seven-after Patey, and 12-after Halsted mastectomy.

In one patient submuscular implant was used; in one-expanders, bilateraly; in 22 arterialized myocutaneous latissimus dorsi flap; and in 2 patients m. rectus abdominis flap. In 7 patients the reconstruction was supplemented by areola-nipple repair.

To secure breast symmetry, the contralateral gland was reduced in one case, ptosis was corrected once, and implants were inserted in the micromastic opposite gland in two instances.

Ten patients had undergone postmastectomy irradiation. In five cases irradiation was performed after the reconstruction. In 5 patients ovarectomy was resorted to because of the hormonal positive type of tumor. Postoperative chemotherapy was applied in one patient because of the local recurrence following myocutaneous transfer.

OPERATIVE TECHNIQUE

Reconstruction was performed under general anaesthesia.

A. BREAST RECONSTRUCTION

The procedure consists in creating a total submuscular brassiere from sixth interspace to the clavicle, and from the sternal border to the midaxillary line, raising the pectoralis major, pectoralis minor and serratus anterior as a single muscle sheath, and placing a tissue expander, or permanent implant in cases of enough local tissue available. In the event of tissue deficiency m. latissimus dorsi was usually used. The orientation of the myocutaneous island relative to the muscle base were three-horizontal, vertical and oblique. The shape of the skin island was tailored in compliance with the shape of the defect resulting from mastectomy or scar excision in delayed cases. It was most often elliptical, triangular or diamond-shaped. In the two cases of rectus abdominis reconstruction, the flap was positioned vertically, taken simultaneously with the anterior rectus sheath. The implant may be introduced under the flap in the same operative session or within 2—3 months when areola-nipple reconstruction is performed.

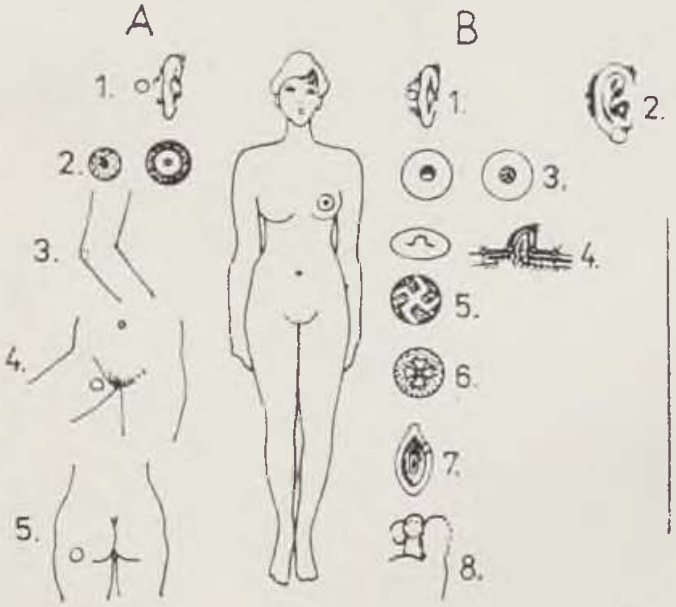

Fig. 1. Donors for:

A — **Areola reconstruction**
1. retroauricular skin
2. contralateral skin
3. elbow
4. groin
5. infragluteal fold

B — **nipple reconstruction**
1. Scapha 2. Lobulus
3. contralateral nipple
4. Hartrampf dermo-fat
5. Cohen — pin wheel
6. Maltese
7. Labia minora
8. Klatsky — toe pulp graft

B. AREOLA-NIPPLE RECONSTRUCTION

Areola-nipple reconstruction adds to the overall realism of the reconstructed breast, and enhances the breast symmetry impression.

Fig. 2a. 29 years old patient, after modified radical mastectomy.

Fig. 2b. The same patient after the operation with latissimus dorsi flap, insertion of silicon implants bilaterally, areolar reconstruction from the contralateral areola.

Numerous methods of areola-nipple reconstruction have been described (3, 4) and most of them involve the use of separate tissues for the areola and the nipple mound (fig. 1). Grafts from contralateral areola, groin, infragluteal fold, retroauricular skin have been suggested as possible sources. Thus for

nipple mound, the contralateral nipple, labia minora, earlobe, toe pulp graft and local flaps: pinwheel flap of Cohen, dermal-fat flap of Hartrampf, and the Maltese one were proposed.

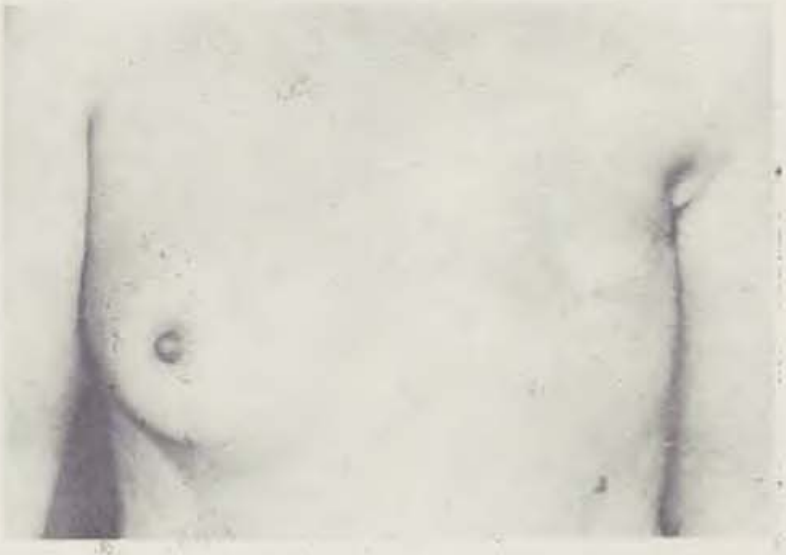

Fig. 3a. 41years old patient, after modified radical mastectomy.

Fig. 3b. The patient after latissimus dorsi transfer, insertion of silicon implant and reolar reconstruction from the groin.

In our material four of the areola reconstructions were effected by harvesting the contralateral areola, and in three cases a full-thickness skin graft from the groin was used. For nipple reconstruction, part of the contralateral nipple was utilized: twice the nipple was sectioned horizontally and in 4 cases vertically.

RESULTS

The symmetry and the consistency of the breast were the main criteria for assessment of the postoperative results in cases of inserting silicon or

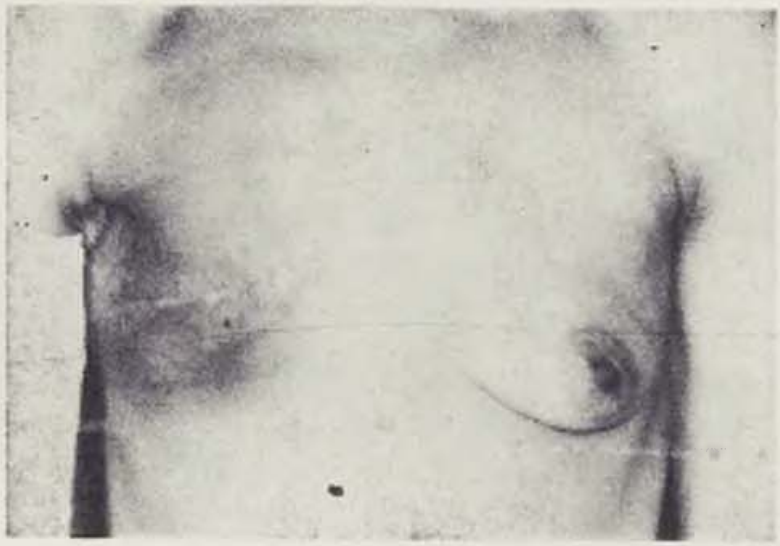

Fig. 4a. 35 years old patient following mastectomy after Patey.

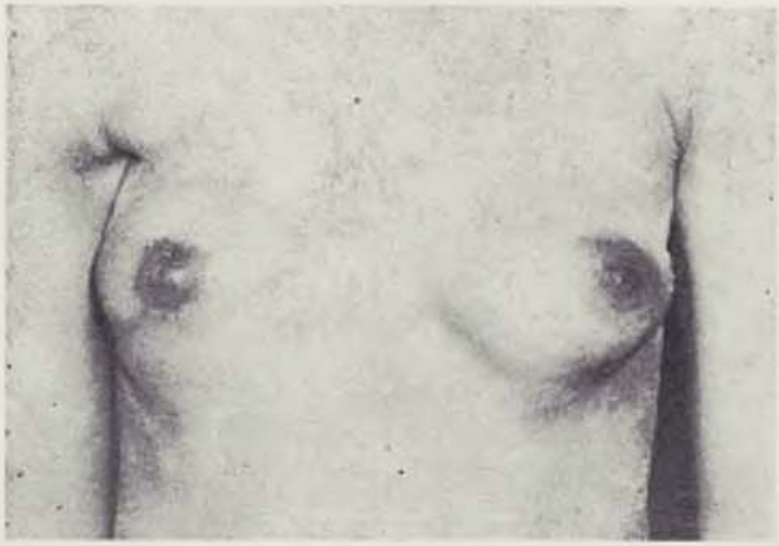

Fig. 4b. The patient after latissimus dorsi transfer, bilateral insertion of silicon implants, areolar reconstruction from the groin.

expander implants. When flap transfers were used the flap and areola-nipple grafts survival were considered as within aditional criteria. In the two patients with mammary implants the results were very good. Six months of reconstruction, capsular contracture (Baker — gr. 1) occured. Out of 24 reconstructions by myocutaneous flaps in 22 (92 per cent) flap survival was re-

corded, in one case a 50 per cent necrosis of the latissimus dorsi flap developed, necessitating secondary repair with a flap raised from m. rectus abdominis, and in one case reconstructed by m. rectus abdominis 20 per cent of the skin and fat island failed to survive. Five flap reconstructions were classified as good owing to the difference in pigmentation between flap and surrounding tissue.

Table 2. Results

Method \ Results	Very good	Good	Fair	Total
Expander + implant	2	0	0	2
Lat. dorsi flap	16	5	1	22
Rectus abd. flap	1	1	0	2
Nipple-areola reconstr.	6	1	0	7

In all cases of nipple-areola reconstruction the grafts took uneventually. In one patient depigmentation of an areolar graft, taken by shaving the contralateral areola, occurred (Fig. 2, 3, 4 /a, b/).

DISCUSSION

In breast reconstruction the surgeon faces three main problems, namely:
1. The timing of reconstruction.
2. Choice of the type of mammary reconstruction.
3. Choice of the type of nipple-areola reconstruction.

We agree with Little, Berrino and Petit (1988) according to which the immediate reconstruction has a number of advantages, e. g. enhanced aesthetic outcome, economy of time and finances, psychological advantages. In the opinion of Little (1988) nowadays nearly half of the breast reconstructions performed in the United States represent components of radical procedures.

The present follow up results are in agreement with these of Little (1988), who also emphasized that the immediate reconstruction does not interfere the adjuvant treatment. While in the US everyone who wants reconstruction can have it, we do this only in clinical stages $T_{1,2}$ N_1 M_0 patients, and when the tumor is located in the outer quadrants of the gland. In all other clinical stages, and when the cancer resides in the inner quadrants or between them, we give preference to late reconstruction — not earlier than the 12th post-mastectomy month.

Today, most plastic surgeons (Berrino, Bostwick, Bricout, Marshall, 1988), are in favour of the TRAM flap for breast reconstruction because it requires no implant insertion. We have greater experience with the latissimus

dorsi myocutaneous flap. The latter is prefered because of its wider indications It may be used in smokers, because smoking causes vasoconstriction, obesity patients post irradiation conditions, insulin-dependent diabetes all of which are contraindications for the TRAM flap. (Hartrampf, 1988). The post-operative complications are more frequent and more serious (abdominal herniation hazards, in particular) with TRAM, than with latissimus dorsi flap.

For nipple-areola reconstruction we prefer: harvesting the outer half of the contralateral areola, when it exceeds 4 cm. in width and a reduction mammaplasty of the contralateral breast is indicated. We do not recommended to shave the opposite areola (Wexler, 1973), because of the likelihood of graft depigmentation, as shown by our practice. When the contralateral areola is smaller than 4 cm we use full-thickness skin graft from the groin, or retroauricular skin consistent with the pigmentation degree.

We propose horizontal or vertical division of the contralateral nipple reconstruction. In our material there was no loss of nipple projection, as claimed by Hartrampf, 1984, Cohen and Ward, 1986.

SUMMARY

Immediate reconstruction contributing to prompt elimination of the postmastectomy phychologial sequelae, and not interfering with the post-operative adjuvant treatment, is recommended in clinical stages $T_{1, 2}N_1M_0$ patients. Delayed reconstruction is recommended in the other clinical stages, and in tumors located in the inner quadrants.

In case of limited peritumoral tissue excision the reconstruction is effected by simple techniques with expanders and implants. In case of extensive peritumoral tissue removal myocutaneous flaps have to be used. The methods of breast and nipple-areola reconstruction should be considered with a reference to the individual requirements of the patient and the experience of the surgeon.

RÉSUMÉ

Reconstruction mammaire après mastectomie

Tepavicharova, P.

Pour les patientes au stade clinique $I_{1, 2}N_1M_0$, nous recommendons exécuter une reconstruction immédiate qui contribue à l'élimination rapide des séquelles psychiques après mastectomie et qui n'est pas contradictoire à la thérapeutique de soutien post-opératoire. Quant à d'autres états cliniques, et même chez des tumeurs localisés dans les quadrants inférieurs, nous recommendons un sursis de reconstruction. Aux cas des excisions d'une qualité limitée du tissu péri-tumoral, la reconstruction est effectuée par une simple technique, en utilisant les expandeurs et les implants. Dans les cas de vastes excérèses des tissus péri-tumoraux, il faut appliquer un lambeau musculocutané. La méthode de reconstruction mammaire, de mamelon et d'aréole doit être choisie en considérant le désir individuel de la patiente et l'expérience du chirurgien.

ZUSAMMENFASSUNG

Die Rekonstruktion der Brüste nach einer Mastektomie

Tepavicharova, P.

Bei Patientinnen im klinischen Stadium $I_{1, 2}N_1M_0$ wird eine unverzügliche Rekonstruierung empfohlen, die zu einer raschen Eliminierung der psychologischen Folgen nach einer Mastektomie beiträgt und mit der Hilfstherapie nach der Operation nicht interferiert. Bei den sonstigen klinischen Zuständen auch bei Geschwulsten, die in den inneren Quadranten lokalisiert werden, empfiehlt sich ein Aufschub der Rekonstruierung. In Fällen einer Exzision einer begrenzten Menge peritumoralen Gewebes wird die Rekonstruierung mittels einfacher Technik unter Anwendung von Expandern und Implantaten ausgeführt. In Fällen einer ausgedehnten Exzision peritumoralen Gewebes muss man einen Haut-Muskel-Lappen verwenden. Die Methode der Rekonstruierung der Brust und der Brustwarze sowie des Hofs ist mit Berücksichtigung der individuellen Wünsche der Patientin sowie der Erfahrungen des Chirurgen zu erwägen.

RESUMEN

La reconstrucción de la mama después de la mastectomía

Tepavicharova, P.

En las enfermas en el estadio clínico $I_{1, 2}\,N_1\,M_0$ se se recomienda ejecutar una reconstrucción inmédiate, porque ésta contribuye a una eliminación rápida de las consecuencias psicológicas después de la mastectomía y no impide el tratamiento post-operatorio auxiliar. En el caso de los demás condiciones clínicas así como en el caso de los tumores localizados en los cuadrantes internos se recomienda aplazar la reconstrucción. En los casos de la excisión de una cantidad limitada del tejido peritumoral, la reconstrucción está ejecutada por medio de una técnica simple, i. e. con ayuda de los expandores y tejidos de implantación. En los casos de una excisión extensa de los tejidos peritumorales es necesario aplicar el lóbulo cutáneo-muscular. Hay que considerar la selección del método de reconstrucción de la mama, del pezón y la areola con respecto al deseo de la enferma y también a las experiencias del cirujano.

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Penka P. Tepavicharova, M. D., Ph. D.
Zona B-5, bl. 8 A, ap. 79
Sofia, 1303, Bulgaria

Affiliated Hospital of Jiamusi Medical College, Jiamusi (China)

Department of Plastic Surgery and Burns

REPAIR OF EXPERIMENTAL HIGH VOLTAGE ELECTRICAL INJURIES

ZHU ZHI-XIANG, WANG YIE, LIU XU-YUAN, MENG FAN-ZHI, WANG TIE-JUN, LIU ER-CHAI

INTRODUCTION

The incidence of electrical trauma has steadily been increasing in recent years and some techniques for the repair of such injuries as, for example, vessel transplantation and flap replantation have been used (1, 2). Yet the mutilation rate of these injured victims still remains high. the extremity amputation rate ranging from 30 % to 71.4 % with partial disability in all survivors (1, 3—7).

An effective method of treatment has not been developed yet. Similarly, there is still a difference of opinion as regards the possible repair, extent and debridement, choice of coverings and medicine application, mainly from the point of view of clinical experience (1, 2, 10). A thorough experimental investigation has been insufficient (4—8). A new system of early conservative debridement and flap rehabilitation was used in the electrical injury treatment in our hospital from 1984 and the results were satisfactory (9, 10). Meanwhile, an animal model of high voltage trauma was developed and its repair has been investigated.

MATERIALS AND METHODS

The circuit for high voltage experiments supplied by 220 V AC 50 Hertz was boosted to 1,600 V using a step-up transformer. Two circular copper--plate electrodes, 6 mm in diameter, were produced. Current values were registered with a pincerlike ammeter HioHi. Forty-six SHT white rats, each weighing 500 g were anaesthetized with ketamine (10 mg) mixed with 0.2 mg chlorpromazine/kg injected subcutaneously. The zones surrounding the head of the fibula were shaved, and a 15×30 mm flap, situated in the superior lateral area of the knee was raised from the muscular surface, and then the electrodes were put into the centre of each lesion. The duration of the shock was variable according to the experimental design.

Group 1. Six rats. The duration of the effect of the electrical current varied and depended on the achievement of identically serious reproducible lesion.

Group 2. Twenty rats. The standardized wounds (5 seconds) in both hind limbs were debrided conservatively, i. e. that only charred or necrotic soft tissues were removed while all devitalized tendons, nerves, vessels, bones, joints and slightly injured muscles were retained during the operation at post-injury hours 4, 8, 12, 24, 48 and 72th, and at post-injury days 5, 7, 9, and 11. Any site of bilateral limbs was randomly chosen as an experimental site and was covered with flaps and beneath the flap continuous irrigation was supplied for 48 hours to improve the flap survival (10). Opposite limbs serving as controls were to be grafted with free mesh-grafts. Two animals were used each time. The animals were kept under observation for 6 weeks after injury.

Group 3. Twenty rats. One side of the limbs was treated in the same way as the experimental site of group 2, and on the other side wounds were debrided thoroughly: all necrotising or damaged tissues were removed up to the point when marked muscular bleeding could be observed. The wounds were also covered with flaps at the same time as indicated above but there was no irrigation beneath the flap.

RESULTS

The average current intensity registered was 400 mA. Calculated tissue resistance was 4,000 Ohms. Current density averaged 1,111 mA/cm^2 under each electrode contact point, 260 mA/cm^2 was found near the cross section of the knee joint. The mean electrical field energy was not lower than 14,000 V/m, Joulean heat in unit time was not lower than 152.6 Cal/per second. The electric injuries in hind bilateral limbs were analogous.

Group 1. Within the first second the muscles showed pallid solidified necrosis under electrode contact zones and local small vessels were closed. Within two seconds, the pallid necrosis penetrated into the bone joints while bluish smoke appeared. In three seconds, the central lesion area was enlarged to the maximum diameter of 8 mm. Kneecap ligament and head of the fibula were partially charred. In five seconds the central necrosis measured 10 mm in diameter, a 6 mm wide pallid necrotic belt surrounded it, and about a 10mm wide extravasated blood zone outlined the peripheral area. Half fibula and knee joint space were charred and exposed. This trauma was very similar to the clinical conditions which were so serious that amputation was mostly necessary. Therefore, it was chosen as a standardized trauma for this study (photo 1). Within 7 seconds, the lesion appeared almost on the whole joint. After 9 seconds, a serious injury developed resulting immediately in the loss of the extremity.

Group 2 (photo 2)

Two rats died of bleeding from the wounds of the control sites at 7th and 9th day after injury. Although all the 18 remaining flaps in the experimental sites survived, the functions of the hind limbs differed greatly in various time intervals. Out of them, 10 limbs operated on before the 48th hour showed full recovery, two operated at the 72th post-injury hour showed

a slight disability and the remaining six surviving limbs treated at the 5th post-injury day lost practically all functions. In the control site the tissues beneath the graft necrotised progressively and total functions were lost spontaneously.

Fig. 1. The photo was taken immediately after injury and the bilateral wounds were comparable.

Fig. 2. A rat operated on at the 48th hour was photographed at the 10th post-injury day. The right limb treated with free skin necrotised and developed inflexibility.

Group 3 (photo 3. 4)

The results obtained from the experimental sites were the same as those from experimental sites of group 2. In the contralateral limb, the mutilation rate was directly related to the thorough debridement and the flap failure.

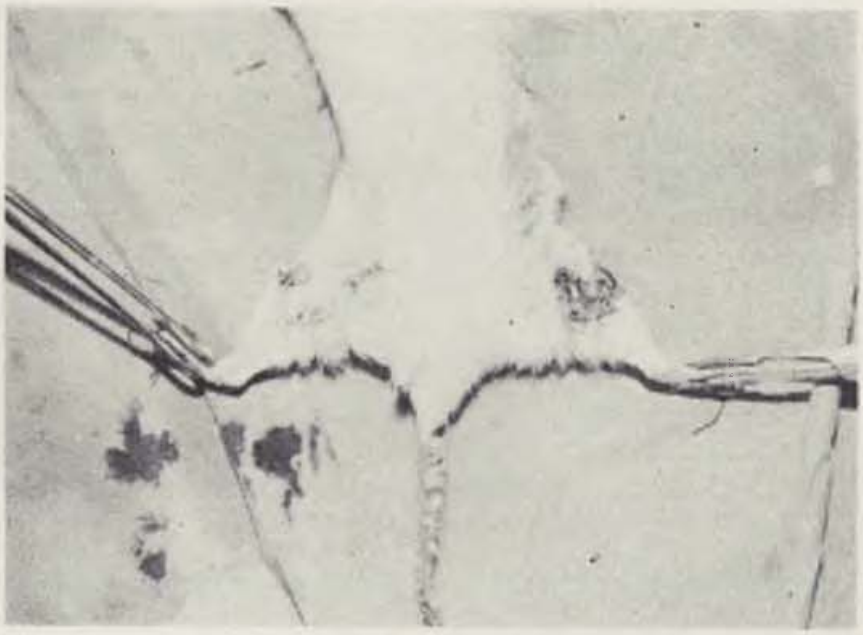

Fig. 3. The tenth post-injury day, experimental site wound (left) healed well, contralateral flap showed dry necrosis.

Fig. 4. Partial or full flaps with no irrigation beneath them were necrotising.

The functions of the first two rats operated on at the 4th post-injury hour did not suffer serious loss because the tissue loss during the debridement was slight and the flap did not lose as much as all others. In the rats operated on from the 8th up to 48th hour, the knee joint space exposed after parts of the anterior and posterios tibial muscles, the gastrocnemius, quadriceps, were removed, the limbs lost their functions and on the 5th post-operative day all the limbs were amputated.

DISCUSSION

There were two major deleterious factors in the electrical injuries: 1. Joulean heat which was produced by both low and high voltage indirectly inflicting injury to the tissue cells. 2. While the electrical fields reached point of intensity, large cells, for example muscular cells, showed breakdown or lysis. Generally speaking, the latter was characteristics of high voltage. Average field energy in the animal model was 14,000 V/m, analogous to the field intensity which is produced when an adult's hand gets in touch with 20,000 V electrified wire.

Based on the clinical findings of progressive muscular necrosis which would result in the necrosis of adjacent tissues in such injuries (9, 10), a direct muscle injury was chosen for this experimental model.

For the purpose of investigation, we divided the experimental trauma into four types according to clinical criteria at the moment of burn: 1. flesh wounds, partial muscular necrosis, vessels, nerves and bone joints may be injured and are not difficult to repair (1 second injury); 2. medium injuries: the trauma penetrated into vessels, bone and joint spaces; amputation and disability are difficult to avoid following conservative treatment (3 second injury); 3. serious trauma, extensive soft tissue necrosis and vital structures damaged seriously, more than half of the circulation of the hind limb closed. Amputation is frequently the consequence (5 second lesion). The two types above, the medium and the serious ones, accounted for 80 % of total losses of the extremities in the clinical patients (9). Such cases being the main problem, the serious type was chosen as a standardized experimental lesion; 4. extremely grave trauma, i. e. such that cannot be remedied nowadays, such as extremity charring or extensive soft tissue loss, etc. A higher mutilation rate of the traditionally conservative treatment of the electrical injuries was due to repeated debridement while skin grafting was difficult to avoid. In recent years, advantage has been seen in carrying out a thorough debridement and flap coverage within post-injury days 7 and 15, but unfortunately, this often results in the loss of functions. One reason for this was an extensive loss of soft tissues and vital structures due to thorough debridement. On the other hand, the completely devitalized bones, vessels, joints, nerves and slightly injured muscles were restored (the so-called conservative debridement) and the functions of the extremities could be saved. In theory, a certain extent of lesions of the tissues, for example muscular swelling, in

the macroscopic appearance is a reversible injury which would return to normal if good blood supply were restored.

It is well-known that deep tissue in the wounds continuously necrotise with time so that the term of the operation is very important. In the present paper, the 20 limbs repaired prior to 48th post-injury hour regained function and aesthetic results; however, others operated on after the 5th post-injury day showed a total loss of the functions. The results support the findings in the electrical injury patients who should be operated on before the 48th post-injury hour (9). Skin grafting in the zones debrided conservatively was of no use for this model but the skin flap coverage led to good results. However, the necrotic or devitalized tissues that were left beneath the flap endangered the flap with necrosis. This condition can be avoided by using a continuous irrigation beneath the flaps (9, 10). Finally, the results of this study suggested the following methods: 1. before the 48th post-injury hour — conservative debridement; 2. repair with the aid of flaps; 3. continuous irrigation beneath the flap is a reliable system for the electrical trauma treatment.

SUMMARY

Repair methods for high voltage electrical injury were studied in 46 rats submitted to symmetrical bilateral hind limb electrical injuries using 1,600 V AC. Out of 40 hind limbs of the 40 rats which were treated with conservative debridement and flap coverage, 20 limbs repaired prior to the 48th post-injury hour obtained a good appearance and functions, the rest operated after the 4th post-injury day showed partial or complete disability. Forty contralateral limbs served as controls, including 20 hind limbs grafted with mesh-grafts which recently necrotised and 20 of them debrided thoroughly resulting in substantial loss of tissue, showed disabling effects. The investigation suggested that a better appearance and functions in such injuries would be obtained if using the technique of immediate conservative debridement and flap coverage.

RÉSUMÉ

Réparation de traumatismes électriques expérimentaux à haut voltage

Zhu Zhi-xiang, Wang Yie, Liu Xu-yuan, Meng Fan-zhi, Wang Tie-Jun, Liu Er-chai

Les méthodes de traitement des traumatismes par courant électrique à haut voltage étaient étudiées chez 46 ratons qui ont subi des traumatismes électriques bilatéraux symétriques aux membres de derrière, à l'aide de 1600 volts AC. Sur 40 membres de derrière (chez 40 ratons) qui ont été traités expérimentalement par ablation conservative des tissus nécrosés avec recouvrement par un greffon vingt, traités de cette façon avant 48 h. après traumatisme, ont acquis de bons aspects et fonctions. Les autres, opérés après 4e jour suivant le traumatisme, présentaient la perte de fonction partielle ou totale. Chez 40 membres de contrôle contralatéraux (y compris 20 pattes avec des

lambeaux cutanés libres sous forme de filet, nécrotisés ultérieurement, et 20 plaies minutieusement nettoyées, ce qui amenait vers une perte considérable des tissus), on a observé un effet invalidisant. Les résultats démontrent qu'on puisse atteindre de meilleurs aspects et fonctions chez les traumatismes similaires, si la méthode de l'excision conservative immédiate avec le recouvrement par un greffon est appliquée.

ZUSAMMENFASSUNG

Die Wiedergutmachung experimentaler elektrischer Hochspannungsunfälle

Zhu Zhi-xiang, Wang Yie, Liu Xu-Yuan, Meng Fan-zhi, Wang Tie-Jun, Liu Er-chai

Die Methoden einer Behandlung durch elektrischen Hochspannungsstrom verursahter Unfälle wurde an 46 Ratten erprobt, denen mittels 1600 V Wechselstrom symmetrische bilaterale elektrische Verwundungen der hinteren Gliedmassen verursacht wurden. Von 40 hinteren Gliedmassen (von 40 Ratten), die durch konservative Beseiti gung der abgestorbenen Gewebe und Zudecken mit einem Transplantat experimentabehandelt wurden, wurden bei 20 derart behandelten Ratten, die man vor dem Ablauf von 48 Stunden nach dem Unfall so behandelte, ein gutes Aussehen und eine gute Funktion festgestellt, während man bei den anderen, die erst vier Tage nach dem Unfall operiert wurden, einen teilweisen oder völligen Funktionsverlust fand. An 40 kontrollierten kontralateralen Gliedmassen (einschliesslich 20 Füsse mit freien Hautlappen in Netzform, die später nekrotisierten, und 20 sorgfältig gesäuberten Wunden, was zu einem erheblichen Gewebeverlust führte) wurde ein invalidisierender Effekt beobachtet. Die Ergebnisse zeigen, dass man bei solchen Unfällen ein besseres Aussehen und eine bessere Funktion dann erzielt, wenn man die Methode einer unverzüglichen konservativen Exzision und Abdekkung mittels Transplantat anwendet.

RESUMEN

La reparación de los accidentes eléctricos experimentales causados por la alta tensión

Zhu Zhi-xiang, Wang Yie, Liu Xu-yuan, Meng Fan-zhi, Wang Tie-Jun, Liu Er-chai

Los métodos terapéuticos de los accidentes eléctricos causados por la alta tensión fueron sometidos a prueba en 46 ratas con las heridas eléctricas bilaterales simétricas infligidas a las extremidades posteriores por medio de 1600 voltios AC. Desde el número de 40 extremidades posteriores (40 ratas), que fueron tratados experimentalmente por el removimiento conservativo de los tejidos atrofiados y por la transplantación, 20 casos tratados de tal manera 48 horas después del accidente tuvieron la apariencia y función buenas; en los otros casos, que fueron operados hasta depués del 4º día después del accidente se observó la pérdida parcial o total de la función. Un efecto desfavorable fué observado en 40 extremidades contralaterales de control (incluyendo 20 patitas con lóbulos cutáneos libres en la forma de una red, los que más tarde se volvieron necróticos y 20 heridas desinfectadas cuidadosamente, lo que produjo una pérdida considerable de los tejidos). Los resultados muestran que en tales accidentes se puede obtenir mejo apariencia y función si se ejecutan inmédiatamente la excisión conservativa y la trasplantación.

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Dr. Zhu Zhi-xiang,
Department of Plastic Surgery
and Burns, Affiliated Hospital
of Jiamusi Medical College, Jiamusi,
China

Works Institute of Health Care, East Slovak Iron Works, Košice (Czechoslovakia)

Centre for Burn Treatment and Reconstructive Surgery

Head J. Bláha, M. D., CSc.

Department of Otorhinolaryngology

Head J. Lukán, M. D.

P. J. Šafařík University, Košice

Institute of Forensic Medecine

Head Prof. J. Lukáči, M. D.

THE IMPORTANCE OF FIBERBRONCHOSCOPY IN RESPIRATORY BURNS

N. LUKÁN, L. ŠÁNDOR, M. SZABO

Fiberoptic bronchoscopy brings a large number of advantages: a wider range of indications, reduced surgical hazards and decreased invasive effect. In patient of poor general condition, bronchoscopy using rigid tubules is contraindicated. Respiratory burns belong among such conditions. In such cases, rigid bronchoscopy cannot be employed due to considerable facial oedema, prominent trismus and great fragility of the thermally damaged mucosa accompanied by secondary trauma with all its consequences.

Despite medical progress, respiratory burns account for a high mortality rate even in the most advanced countries of the world. In this paper we want to consider the possibilities of endoscopic diagnosis in connection with respiratory burn treatment.

Respiratory burns are most frequently caused by explosions of combustibles and gas in enclosed spaces: in flats, workshops, means of transport. Depending on the type of the burning material and access of oxygen, the temperature inside an enclosed space rise up to several hundred degrees Celsius within seconds or minutes. In case of synthetic materials burning — those used in households — the temperature is 2.5 times as high as that of natural materials. Serious respiratory burns can also be caused by inhaling hot saturated steam whose thermic capacity is 4,000 higher than that of dry hot air. Hot dry air when inhaled cools down very quickly by means of the physiological activity of the mucous membranes of the upper parts of the respiratory system. In inhaling hot gases the reflexive closure of the rima glottidis prevents major damage to distal parts. For its high thermic capacity

and saturation with water, hot steam does not allow water to evaporate from the mucosal surface, thus preventing the cooling of the noxa which can penetrate into the pulmonary alveoli and burn them. At 145 °C the air transfers approx. 55 J of heat at a single inhalation, while water saturated steam of 100 °C and its absorption capacity transfers heat of at least cca 837 J at each single inhalation. Table 1 illustrates experimental heat absorption during insufflation of hot gases into the respiratory system (2).

At the Centre for Burns, Works Institute of Health Care, East Slovak Iron Works, Košice, from 1986—1988 were hospitalized 1417 patients. Out

Table 1. Experimental insufflation of hot gases

Substance	Temperature in °C	
	in larynx	in carina
Dry air	165	40
	300	50
	500	60—100
Steam	98	60—95

Fig. 1. Burned laryngeal vestibulum

of these 22 had respiratory burns. Compared to work statistics, the percentage of diagnosed respiratory burns is 3—5 % lower, i. e. 1,55 %. This figure may not be correct due to the error of small numbers, though we do think that many patients die before they are able to reach a specialized ward.

Our fiberoptic bronchoscopy of burned patients is based on criteria proposed by Stone (1). These are as follows:

1. burns caused by explosion or fire in enclosed spaces;
2. facial, nasal and oral burns;
3. semi-burned hair in the nasal vestibule, burns in the nose, mouth or charred particles found in the nasal and pharyngeal mucosa.

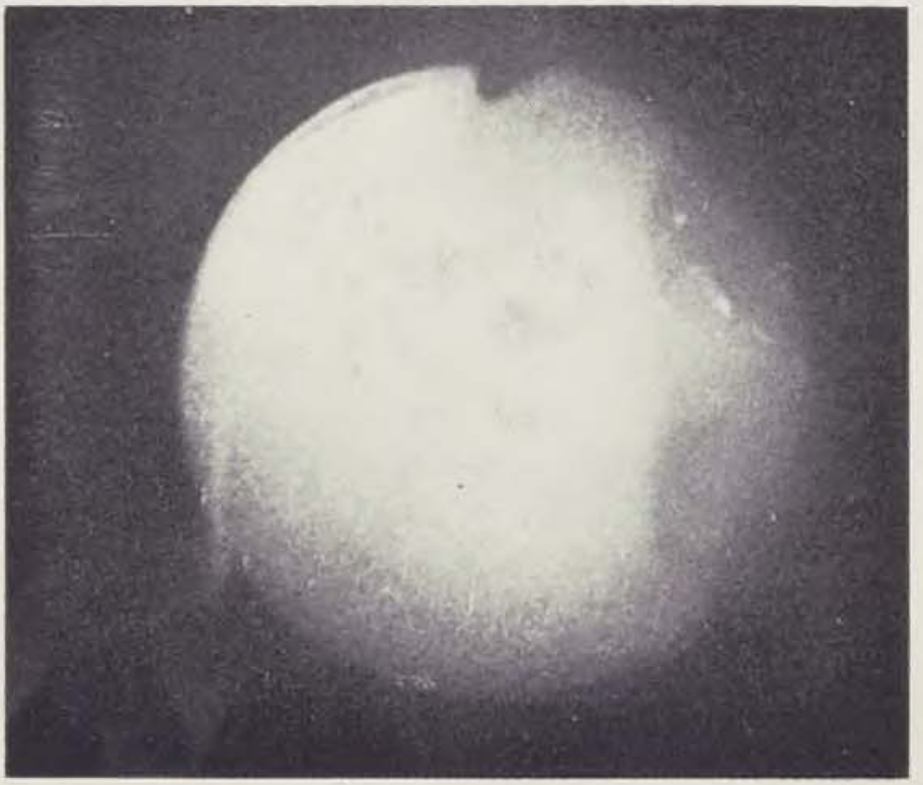

Fig. 2. Changes in the inferior part of the trachea

If the patient is conscious, dysphonia will suggest potential damage caused to respiratory organs. Breathlesness requires urgent fibroscopy using intubation or tracheotomy performed with utmost care. If a respiratory burn is suspected, fiberbronchoscopy plays a very important role in the determination of its extent, in monitoring it, and, last but not least, in the application of local therapy (3). It must be preceded by a general ENT examination which should yield information about the extent of the damage caused to the respiratory organs, and help to determine the next procedure. However, in serious burns, this general examination may pose difficulties. Before direct examination of the epipharynx, larynx and tracheobronchial tree, the patient

is given pre-medication. according to common practice 30 minutes prior to surgery, in emergency cases intravenously. The operation is usually performed under superficial anaesthesia of the mucous membrane. General anaesthesia, which we employed only in rare cases, has little effect as it impedes the examination of the larynx and the proximal part of the trachea with the inserted tube. Some of the latest techniques using respiratory devices under anaesthesia are not available to us. If the local defect permits it, we use spray for nasal, laryngeal and hypopharyngeal mucosa. For the purpose of anaesthetizing the larynx and the inferior parts of the respiratory system, we had good results with the application of anaesthetics under visual control using fibro-

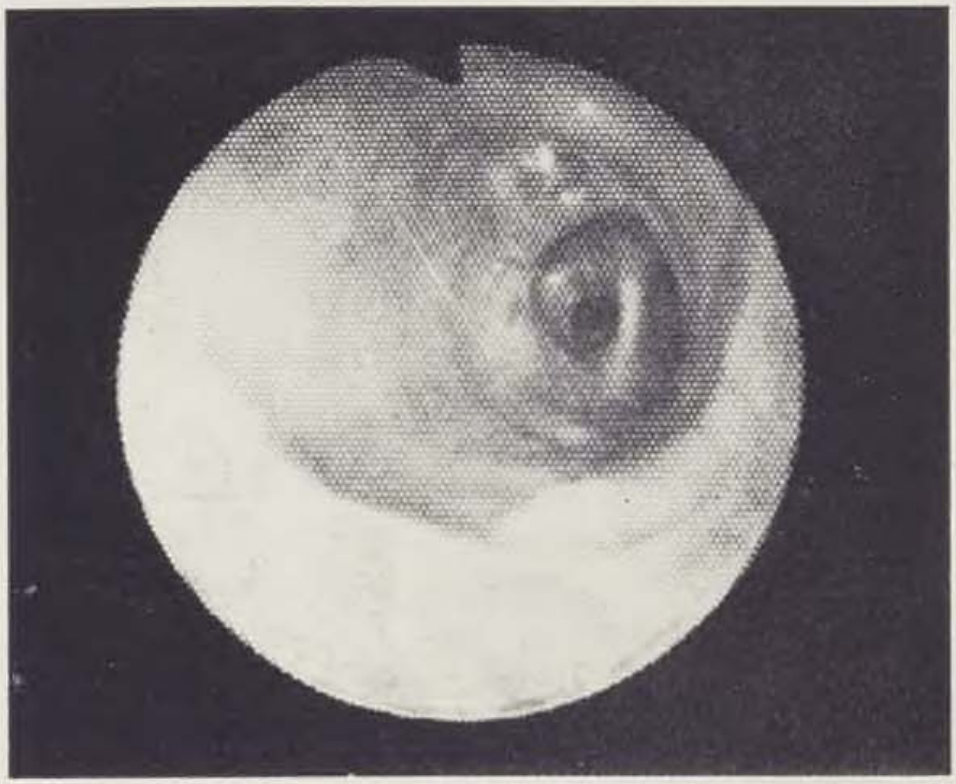

Fig. 3. Burned bifurcation and the left principal bronchus

scopic tube which is easy to introduce through the nose. Thus we can avoid painful irritation of the burned lips, mouth, tongue, and, sometimes, overcome difficulties in assessing the severity of the trismus which is usually of great extent. In case of unremovable nasal obstructions, this procedure cannot be employed. Continual aspiration is a great advantage there.

There are supraglottic and subglottic types of respiratory burns. In the most serious cases, changes are also seen in the most distal parts of the respiratory organs up to the alveoli. unaccessible even to fiberoptic examination. Such damage is caused not only by the high temperature of the gases, which is partially absorbed by the mucosa of the proximal zones but by the thermo-

-chemical reaction of toxic products with the parenchyma, a condition called inhalation injury by some authors (4).

Our group (Tab. 3) consisted of 22 patients hospitalized from 1986 to 1988. All patients who died at our department had an inhalation injury confirmed by autopsy. Mortality due to inhalation injury is very high, in our group — 59.1 %. According to world statistics, the figure is 50—80 %. In case of supraglottic burns, mortality reaches 25 % whereas in subglottic burns it is almost 79 %. Up to now it has not been possible to assess the ratio of inhalation burns in relation to the extent of body surface damage or to metabolic breakdown. Code numbers have been proposed for respiratory burns assessment, including anatomical localization, the degree and extent of the body surface burned (5).

Table 2. Correlation of inhalation burns to the total number of burned patients

	1986	1987	1988	Total
Total number of burned patients	512	473	432	1417
Respiratory tract burns	6	7	9	22
%	1.17	1.48	2.08	1.55

Table 3. Mortality due to inhalation injury correlated with the extent of respiratory tract damage

		1986	1987	1988	Total %
Respiratory tract burns	number	6	7	9	22
	deaths	4	4	5	13 (59.09 %)
Supraglottic region	number	2	3	3	8
	deaths	1	1	0	2 (25 %)
Subglottic region	number	4	4	6	14
	deaths	3	3	5	11 (78.57 %)

The organism has only a limited number of possible reactions to cope with damage. The spectrum of the pathological changes in the respiratory system depends on the degree of burn ranging from erythema, through oedema up to necrosis (6) (photo enclosure).

Even in cases of such seriousness, the considerate nature of fiberbronchoscopic examination enables us to collect the required material for cultivation, repeated therapeutical operations, such as aspiration, lavage and local application of antibiotics and cortisonoids. In one of our patients fiberbronchoscopy was rep ated 10 times without any adverse effect.

With the development of specialized care of burn patients, fiberbronchoscopy has a prominent role to play in diagnostics and therapy. Accordingly, our future efforts will be channelled to attaining this objective and we believe that the acquired experience will improve the unfavourable prognosis of these grave injuries.

SUMMARY

Respiratory burns worsen considerably the prognosis of the patients. Fiberoptic endoscopy facilitated the examination of respiratory burns and determined the degree and extent of mucosal damage. At the same time, aspiration and lavage of the affected bronchi can be advantageously used in therapy. 22 patients with respiratory burns were hospitalized at the Burn Centre, Works Institute of Health Care, East Slovak Iron Works, Košice (Czechoslovakia); 13 of them died, i. e. 59.1 %. The paper analyzes fiberbronchoscopy applied to respiratory burns, anaesthetic technique and intubation, and the results are compared with post mortem findings. Some clinical findings are demonstrated, too.

RÉSUMÉ

Intérêt de fibrobronchoscopie dans les brûlures d'organes respiratoires

Lukán, N., Šándor, L., Szabo, M.

Les brûlures des organes respiratoires aggravent considérablement le pronostic des brûlés. Ce n'était qu'avec la fibrobronchoscopie que l'on a pu examiner le système respiratoire brûlé et désigner le degré et l'étendue d'endommagement des muqueuses. Simultanément, elle offre de bonnes possibilités d'interventions curatives, comme l'aspiration et le lavage des bronches atteintes. Néanmoins, la mortalité de ces traumatismes est grande. Dans les années 1986—88, au Centre pour le traitement des brûlures de l'Institut de la santé publique des Usines sidérurgiques de l'Est-Slovaquie, on a hospitalisé 22 patients pour les brûlures du système respiratoire, dont 13 sont décédés, c'est-à-dire 59,1 %. Le travail analyse les indications de fibrobronchoscopie des organes respiratoires brûlés, technique de l'anesthésie, de l'intubation et les résultats cliniques sont comparés avec les constats d'autopsie. On démontre quelques examens cliniques.

ZUSSAMMENFASSUNG

Die Bedeutung der Fibrobronchoskopie bei Verbrennungen der Atemorgane

Lukán, N., Šándor, L., Szabo, M.

Verbrennungen des Atmungssystems verschlechtern ganz ausgeprägt die Prognose bei den verbrannten Personen. Erst die fibroskopische Bronchoskopie ermöglichte die Untersuchung des verbrannten Atmungssystems und die Bestimmung der Stufe und des Umfangs der Beschädigung der Schleimhäute. Gleichzeitig gibt es die gute Möglichkeit von Behandlungseingriffen mittels Absaugen und Auswaschen der betroffenen Bronchien. Jedoch trotzdem ist die Mortalität bei solchen Unfällen eine hohe. Im Zentrum zur Behandlung von Verbrennungen im Volksgesundheitsinstitut in Košice wurden 9186 bis 1988 22 Patienten mit Verbrennungen des Atmungssystems hospitalisiert

von denen 13 starben, d. h. 59,1 %. Die Arbeit befasst sich mit der Indikation der Bronchofibroskopie verbrannter Atmungsorgane, mit der Technik der Anästhesie, mit der Intubation, und die Befunde werden mit den Sektionsbefunden konfrontiert. Es werden einige klinische Befunde demonstriert.

RESUMEN

La importancia de la fiberobroncoscopia en las quemaduras respiratorias

Lukán, N., Šándor, L., Szabo, M.

Las quemaduras respiratorias agravan considerablemente la prognosis de los que mados. Sólo la broncoscopia fiberoscópica hizo posible la examinación del sistema respiratorio y la determinación del grado y extensión del defecto de las membranas mucosas. Al mismo tiempo hay una buena posibilidad de ejecutar las intervenciones terapéuticas con ayuda de la aspiración y lavado de los bronquios afectados. En la seección de quemados, del Instituto Nacional de Salud Pública (perteneciento al Establecimiento Siderúrgico, Eslovaquia oriental), en los años desde 1986 hasta 1988, fueron hospitalizados 22 pacientes con las quemaduras respiratoris; desde este número 13 personas murieron, i. e. 59,1 %. El papel analiza las indicaciones de la broncofiberoscopia en relación con los órganos respiratorios quemados, la técnica de anestesia, la intubación y los hallazgos se comparan con los hallazgos seccionales. Pues se demuestran algunos hallazgos clínicos.

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Dr. Norbert Lukán
Svätoplukova 23
040 01 Košice
Czechoslovakia

Masaryk University, Brno (Czechoslovakia)

Medical Faculty, Department of Plastic Surgery and IIIrd Department of Medicine

Heads Prof. L. Bařinka, M. D. DrSc., Ass. Prof. P. Přikryl, M. D. DrSc.

SYSTEMIC CONSEQUENCES OF NON-HEALING SKIN WOUNDS: ANAEMIA OF CHRONIC DISEASE

J. POSPÍŠILOVÁ, E. DUNGELOVÁ, M. KLOBÁSOVÁ

The healing process is one of the principal regeneration phenomena of the living organisms. In mammals, the post-injury period consists in the epithelial, endothelial and connective tissue regeneration. Functionally specialized tissues are mostly replaced by connective tissue. Wound healing is a process which begins with tissue damage and lasts up to scar formation. According to the extent of the damaged tissue, the healing process is classified as primary, when wound edges join spontaneously or surgically, or as secondary, after an extensive tissue damage with contused, infected or otherwise separated edges of the wound.

The extent healing by second intention helps to distinguish individual stages of the healing process. Under physiological conditions, in the healthy organism there are three stages of damaged skin replacement, their duration overlapping each other. They are: inflammatory, proliferative and tissue reorganization stages. After injury, the first healing stage involves changes in the chemical structure of the tissue which is mostly governed by endogenous factors. These are released from the damaged tissue and blood cells. They mostly contain prostanoids, which affect the capillary bed thus participating in the dynamic process of the inflammatory healing stage. The local tissue reactions can be modulated by hormones acting either as stimulation or inhibition of anabolism or catabolism. The cells with a key role to play in the inflammatory healing stage are macrophages (monocytic phagocytizing MPS system), which remove the damaged tissue with the aid of the other phagocytizing polymorphonuclear leucocytes of released lytic enzymes remove. The macrophages excrete products of phagocytosis into the extracellular space, where these can serve as the basic building material for the growth of new tissue. Another function of macrophages is to activate fibroblasts (chondroblasts, osteoblasts), which divide and synthesize the principal intercellular matrix during the second healing stage. This stage is marked by the division and synthetic activity of fibroblasts. These synthesize collagen and glycosaminoglycans mostly in such a form as to ensure a rapid refill of

the skin defect. This is due to type III collagen which because of its structural homogeneity (3 identical alpha chains) depends less on the genetic code than the definitive type I collagen (2 types of alpha chains). The latter can better meet the functional and mechanical demands of subcutaneous tissue. Newly synthesized glycosaminoglycans are not sulphated. During the second healing stage, a new capillary system is formed at the damaged site, and epithelialization of the wound surface begins. During the third healing stage there is a gradual exchange of collagen types, reduction in vascularization, and eventually the fibrous tissue is reconstructed into the corio-adipose tissue. The healing stages can overlap; their duration, under physiological conditions, depends on the extent of injury and on the general reactivity of the organism.

Some well-known healing disorders were reported on in preliminary papers (Pospíšilová 1980 and 1984) In this study we will be concerned with systemic disorders occurring during a long-term treatment of non-healing skin wounds.

CASE REPORT

The orthopaedic department of a regional hospital referred to our department of plastic surgery a female patient, J P., 23 years old, with a non-healing wound in the right lower and upper extremities. The wounds had developed gradually and despite their treatment at different specialized clinics, they had remained unhealed for over two years. The anamnesia did not show any congenital healing disorder. The patient had a normal development but from early childhood underwent gymnastic training and took part in contests. Her earlier injuries had healed normally. She only referred to joint trouble commonly found in most gymnasts. The first of her persisting wounds had occurred when she was 20.

On admission, the general patient's condition was as follows: general asthenia (height — 168 cm, weight — 48 kg), skin — dry and pale without subcutaneous fat, mucous membranes — pale, well-developed muscles; thyroid gland slightly enlarged; head, chest and abdomen without pathological changes, BP 130/80, pulse 80, regular. The acral parts of the extremities were notably colder. On the back of the right hand there was a deep open wound in the cicatricial block of subcutaneous connective tissue, thickly coated (Fig. 1), the distal third of the arm was swollen; on the inner side of the right knee there was a coated wound of 3.5×9 cm in size (Fig. 2) and a deep wound on the external side of the right leg (Fig. 3) with pale granulations and secreta of 7×4 cm in size. At our department, the patient had an accident resulting in a rupture of the old wound on her right elbow, which did not heal per primam either (Fig. 4).

We examined the patient meticulously using all means available. We found no disorder of hormonal, immunological or collagenotic character. However, the results of hematological examination showed hypochromic normocytic anaemia (Hb 89 g/l, Ery 3.7×10^{-2}/l), low serum Fe level, decreased transferrin saturation, increased Fe bonding capacity and increased

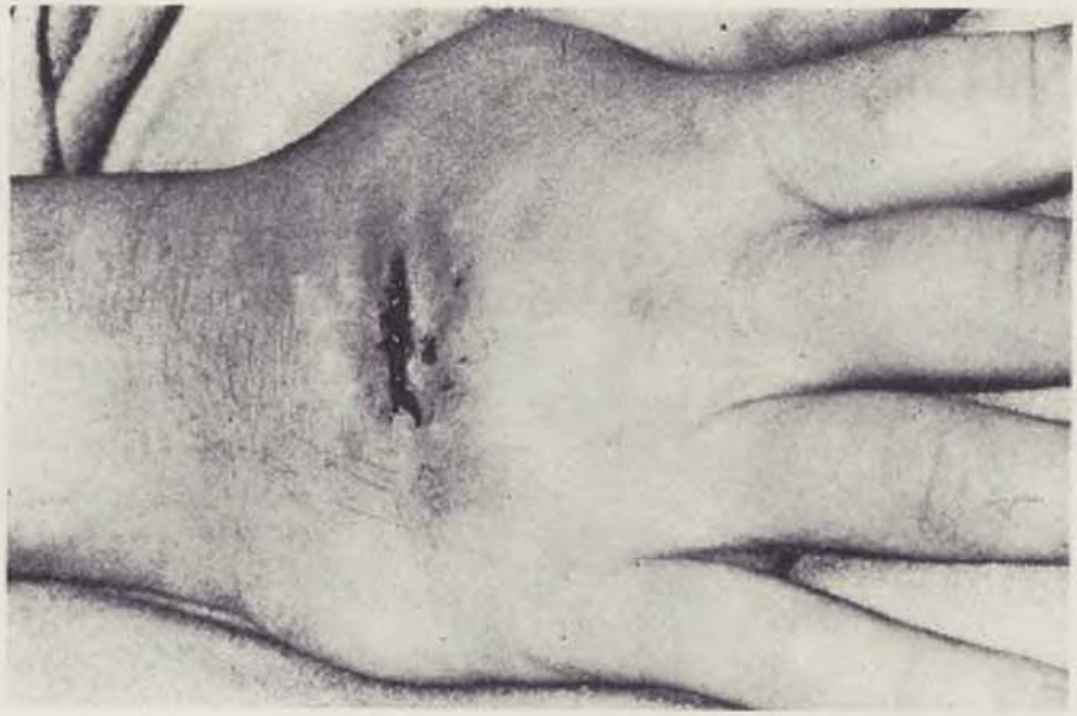


Fig. 1. Non-healed deep wound on the dorsum of the right wrist induced by exploratory excision at the site of the persisting oedema 2 years prior to the patient's admission to the department of plastic surgery.

Fig. 2. Almost two-year old non-healed wound on the inner side of the right knee after operation for meniscus.

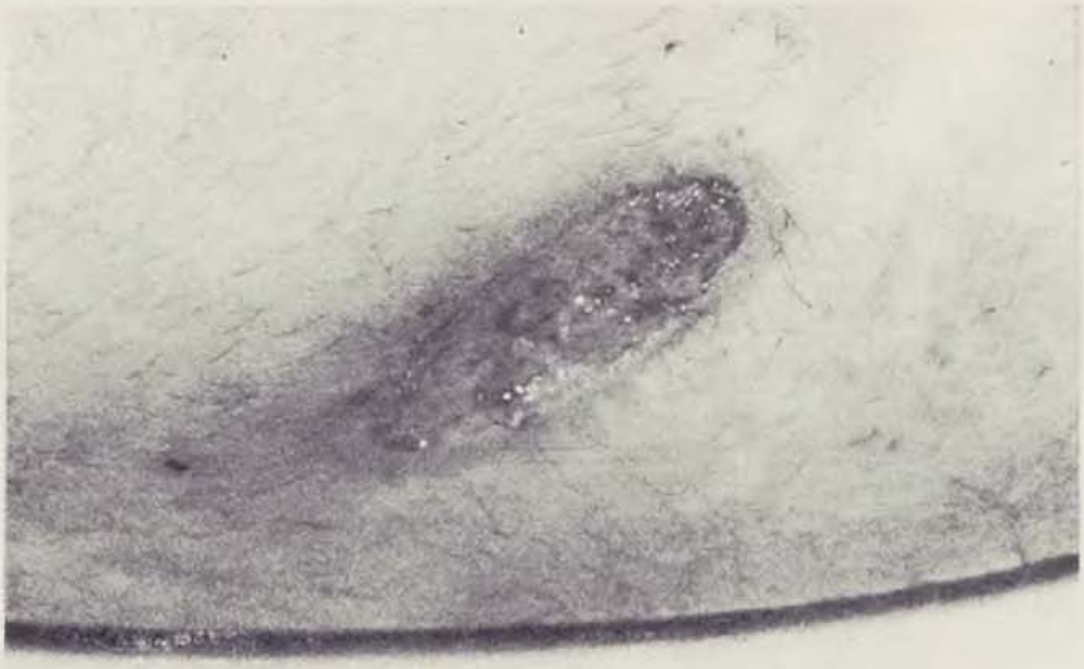


Fig. 3. A deep wound on the external side of the right leg caused by an alleged knife attack (approx. 3 years before).

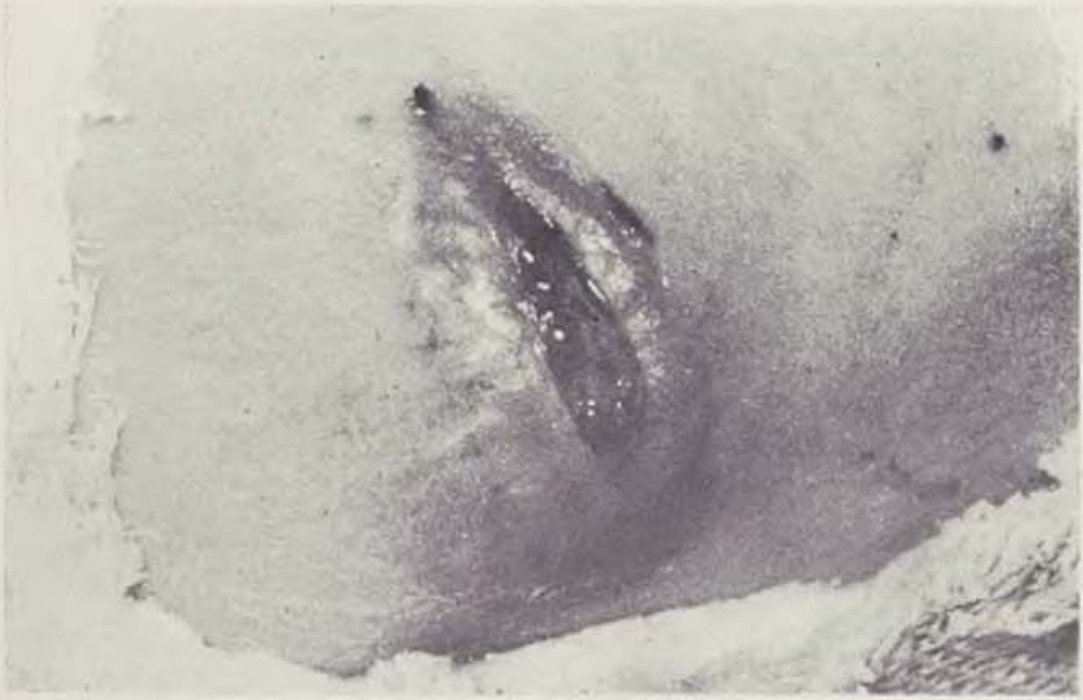


Fig. 4. An older scar on the right forearm lacerated due to a fall during the patient's hospitalization in our department; the laceration failed to heal after suture (the patient was undernourished in the presence of anaemia).

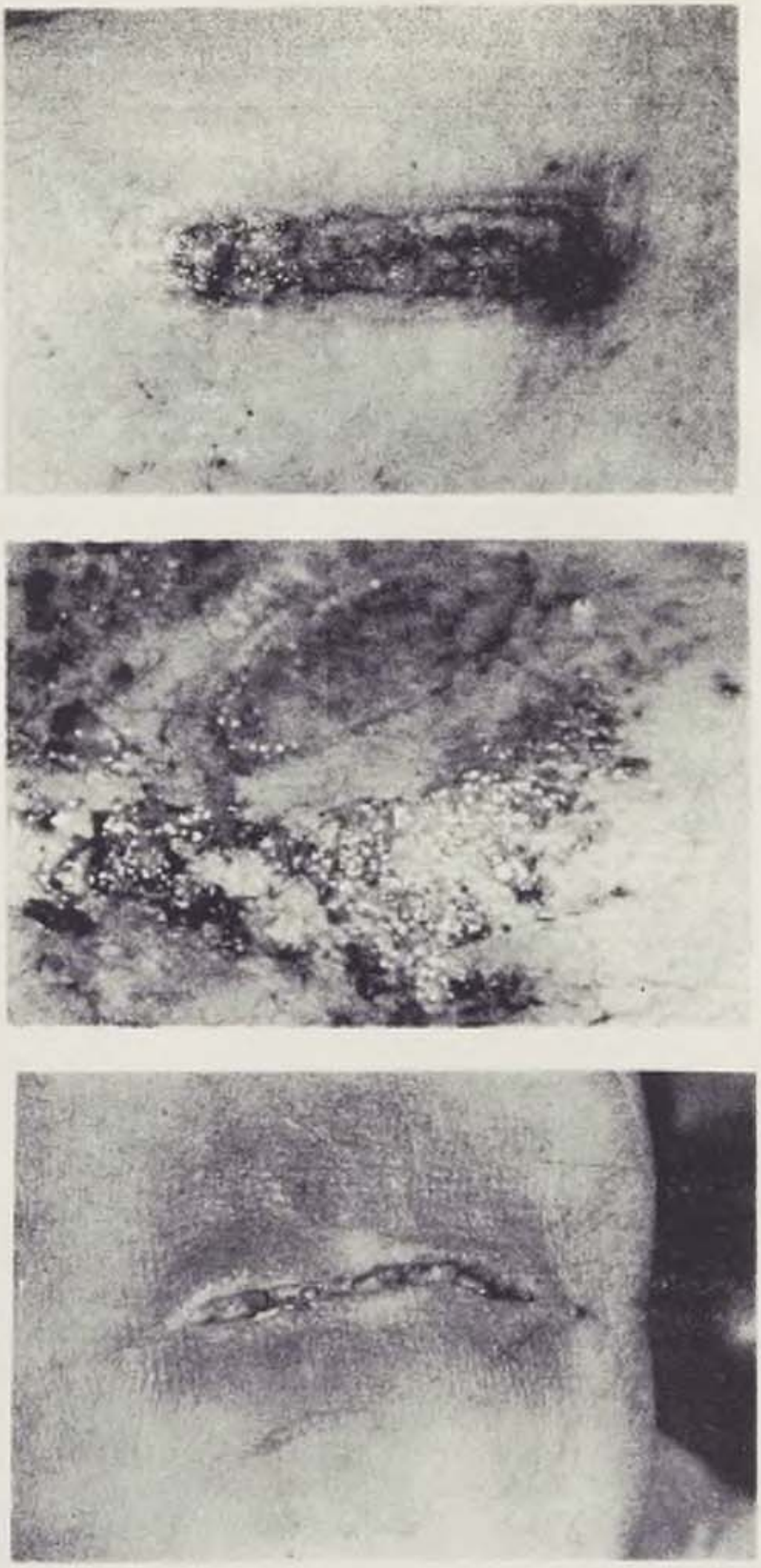
B. S. R. (17/40). During her stay at the department, the patient was persistently subfebrile. Despite careful surgical and conservative treatment, the wounds remained unchanged (Figs. 5, 6, 7). It was obvious that the patient was undergoing further healing stages but still within the first inflammatory phase. Anaemia of chronic disease (ACD) described in detail by G.R. Lee (1983) was suspected. This type of anaemia is found in long-lasting inflammatory or neoplastic processes appearing in persistent skin wounds. Some of the typical signs of this disease are as follows:

1. normocytic and normochromic anaemia, often hypochromic, sometimes microcytic
2. decreased serum Fe level
3. increased lactoferrin level
4. decreased transferrin saturation
5. increased sedimentation due to dysproteinemia
6. subfebrile condition.

Laboratory findings confirmed this diagnosis. In cooperation with internists we started with general treatment. Apart from local therapy and rehabilitation of the extremities, we launched a course of intensive anti-anaemic treatment including minor fresh blood transfusion, employing anabolics, vitamins, roborant and non-steroid anti-phlogistic agents with the aim to inhibit prostaglandin production — the principal mediators of the inflammatory healing phases. This comprehensive therapy introduced, the general condition of the patient improved, her blood count normalized, blood sedimentation values decreased, serum Fe levels increased and subfebrile state disappeared. Better haematological and biochemical values also helped to improve the clinical picture of the underlying disease as well as the function of both affected extremities (Figs. 8, 9, 10). However, the patient's psychic condition showed no improvement. During the course of the whole treatment the patient was under psychological and psychiatric control. The main cause of the injuries of long duration and unclear origin seemed to be the patient's psychological condition.

PSYCHOLOGICAL EXAMINATION

History of the health disorders: the patient's health complaints dated back to the autumn 1984 when she was treated for suspected tendonitis of the wrist at the surgical department of a regional hospital. After removing the plaster-of-Paris, the right hand oedema persisted for a long time. The patient was examined at the orthopaedic department of the regional hospital; it resulted in finding only a borderline hypoplasia of lymphatic vessels in the right axilla. Her condition was diagnosed as lymphedema of the right forearm and hand of neurogenic or psychogenic etiology. No organic cause or automutilation were found. From the summer 1985 until the autumn 1987 the patient was treated both in out-patient and in-patient facilities for a number of lacerated and incised wounds and dehiniscence of old scars, most of which were sustained under obscure or rather improbable accident cir-



Figs. 5, 6, 7. The wounds were treated locally every day, the condition remained unchanged. Surgical interventions failed to succeed despite the plaster-of-Paris fixation.

Figs. 8, 9, 10. The somatic state improved, the wounds healed almost completely. The figures show the patient's condition before her first discharge from the department

cumstances. In 1986, due to dyspeptic disorders, the patient was hospitalized at the psychiatric department and diagnosed as an imbalanced personality suffering from a neurasthenic syndrome with anorexia. She had problems with adjustment at the department, she did not consider the psychiatric treatment adequate in view of her complaints. Nor did further psychotherapeutic treatment succeed in motivating the patient to cooperate better. In May 1987 she was granted disability pension. In autumn 1987 the patient was transferred to the department of plastic surgery.

The patient underwent a psychological examination aimed at evaluating the effect of the psychogenic component on the whole therapeutical treatment and at giving a psychotherapeutical support to it. In the initial phase, the patient tended to play down her complaints in expectation of rapid healing. She regarded her illness as a state that she herself was unable to influence and that was limiting her activities in life. Gradually, she had the tendency to ascribe her health condition to the physicians (actually, the great amount of auxiliary examinations added to the patient's impression of the physicians' diagnostic uncertainty). During hospitalization she suffered from temporary crises manifested by withdrawal, indifference to therapy, dietetic and sleep disorders. These states were accompanied by her inner tension which, as it appeared later, was neutralized by auto-aggressive practices. The patient was unable to realize the relationship between her mental and physical state. Apart from psychosocial signs of immaturity (egocentrism, reduced control of impulses, opposition tendencies, family attachment, etc.), here crises were due to insufficiently integrated affective emotions which the patient failed to comprehend. Although her psychopathological picture lacked variety and distinction (initially her crises were ascribed to hospitalization), it was found that the major etiopathogenetic factor consisted in a deeper personality disorder conditioned by disharmonious development. The effect of eliminated psycho-traumatic experiences was also considered. However, a mere empathic approach failed to succeed in releasing the patient's massive inhibition. Therefore, the authors aimed the course of psychotherapy at provoking a more responsible attitude toward the disease so as to develop an alliance between the patient and medical personnel. The outcome of these efforts varied — the patient's increased egocentrism led to a rapid weakening of the contact and, eventually, to her passive resistance. Despite the patient's poor cooperation, her skin injuries healed and by the end of February 1988 she was discharged from the department. After her adaptation to home environment, a recommendation was made to discontinue her disability pension.

In the course of the following year, for repeated deterioration of her injuries of the extremities, the patient was hospitalized for 4 more times at the department of plastic surgery. During her last hospitalization, the patient made deliberate efforts to delay her discharge so as to avoid being declared fit for work. For this reason, she was given a systematic, analytically aimed psychotherapy, which in her case the authors consider a causal treatment.

DISCUSSION AND CONCLUSION

The patient, J. P., due to her impaired psychic regulation, practised automutilation leading to a serious systemic disorder which is highly resistant to therapy. Her general condition was grave and raised fears. Her somatic disorders were caused by a substance which is released from the activated macrophages, the leucocytic endogenic mediator LEM (Fig. 11). The whole

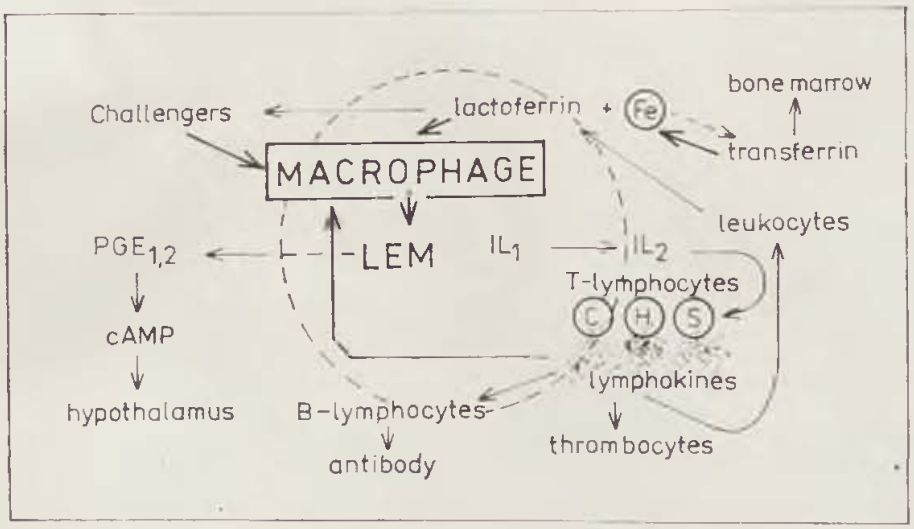


Fig. 11. Healing disorder caused by long-lasting local tissue irritation.

process begins with skin damage and macrophage activation, which is due to the so called phagocytic challengers. These involve antigens, endotoxins, cutaneous staphylococci and other agents. When irritated excessively, the LEM factor of interleucine-1 (IL-1) is released. This factor induces the release of E chain prostaglandin out of the cell membranes of arterial walls, decreases the zinc level in the plasma and changes into interleucine-2 (IL-2). The IL-2 activates T-lymphocytes. Then follows proliferation of cytotoxic helpers as well as of suppressing lymphocytes, out of which especially the helpers release a substance called lymphokine which activates them to produce proliferation of macrophages (the whole MPS system), B-lymphocytes, polymorphonuclear leucocytes (PMN) and thrombocytes. During phagocytosis, PMN releases lactoferrin. The MPS system activation results in a vicious circle, for the whole process is repeated and multiplied. Instead of waging a purposeful fight against the antigenous challengers, this process produces a strong local inflammatory reaction which continuously repeats and intensifies. This inevitably leads to an auto-aggressive attack by some of its own cells, for example erythrocytes. The ensuing anaemia is accompanied by the above symptoms.

ACD Anaemia produces:

1. decreased serum Fe level. The macrophages take up iron and some Fe-dependent antigens. Lactoferrin released from the activated PMN leuco-

cytes participates in the Fe decrease. Lactoferrin transfers Fe to the macrophages and to some bacteria. At a lower pH value (inflammatory tissue), it has a higher affinity to Fe than transferrin, which transfers Fe to the erythropoetic cells. Due to these reasons, the Fe therapy does not help to eliminate anaemia, rather it tends to preserve the inflammation.

2. Decreased erythrocyte viability (Fe insufficiency);

3. increased absorption of blood cells through the MPS system.

Dysproteinemia is induced by synthetic activation of the MPS and PMN systems, primarily by B-lymphocytes. Subfebrile state is due to the effect of E type prostaglandin (PGE_1 and PGS_2) on CAMP production (cyclic adenosine monophosphate) in the brain which irritates the thermoregulatory centres in the anterior hypothalamus.

It can be presumed that the other prostanoids, hormones and factors of non-specific immune reaction of the complementation series take a very active part in the pathological process. However, there are still many unknown factors as regards the damaged tissue chemical processes and their complicated regulations which still await clarification.

SUMMARY

The paper describes a case of skin wounds inflicted by automutilation in a young woman with psychic regulation disorder. Repeated local irritation and infection produced a complicated systemic disorder leading to hypochromic anaemia which failed to respond to Fe treatment. The paper discusses the mechanism of this type of anaemia which appears in literature under the heading of anaemia of chronic disease (ACD).

RÉSUMÉ

Séquelles de système de plaies cutanées malcurables. Anĕmie de maladies chroniques

Pospíšilová, J., Dungelová, E., Klobásová, M.

Description d'un cas d'automutilation consistant en traumatismes cutanés d'une jeune femme avec des troubles de la régulation psychique. Les irritations locales répétées et l'infection ont provoqué des troubles compliqués qui amenaient vers l'anémie hypochrome qui ne s'améliorait pas après la simple thérapeutique martiale. On discute le méchanisme de l'anémie survenue, appelée dans la littérature Anémie des maladies chroniques (ACD).

ZUSAMMENFASSUNG

Systemfolgen sich nicht heilender Hautverwundungen. Die Anämie chronischer Erkrankungen

Pospíšilová, J., Dungelová, E., Klobásová, M.

Es wurde ein Fall einer Automutulation beschrieben, der durch Hautverletzungen bei einer jungen Frau unter Störung der psychischen Regulierung hervorgerufen worden

war. Die wiederholten lokalen Reizungen und Infektionen verursachten eine komplizierte Systemstörung, die zu einer hypochromen Anämie führte, die sich dann auch bei einer Behandlung mit Eisen nicht besserte. Es wird der Mechanismus der entstandenen Anämie diskutiert, die in der Literatur „Anämie chronischer Erkrankungen (ACD)" genannt wird.

RESUMEN

Las consecuencias sistémicas de las heridas cutáneas difíciles de curar. Anemia de la enfermedad crónica

Pospíšilová, J., Dungelová, E., Klobásová, M.

Se describe un caso con las heridas cutáneas causadas por la automutilación en una mujer jóven con el trastorno de la regulación psíquica. Las irritaciones locales repetidas y las infecciones causadas por un desarreglo sistémico complicado, lo que resultó en la anemia hipocrómica, que no se mejoraba por la terapia por hierro. En el papel se discute el mecanismo de la anemia que aparece en la literatura bajo el título la anemia de la enfermedad crónica.

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J. Pospíšilová, M. D., CSc.
Regional Institute of Health Care
Teaching Hospital with Polyclinic
Department of Plastic Surgery
34—38 Berkova, 612 00 Brno-Král.Pole,
Czechoslovakia

REVIEW

J. Moserová, E. Houšková: **The Healing and Treatment of Skin Defects,** S. KARGER, P. O. Box CH-4009 Basel (Switzerland), 1989, 163 pages.

In surgery we very often come across skin defects of either mechanical (scalping, decubitus, décollement) or of thermal origin (burns, frostbite). Although medium-sized defects do not endang r the life of an otherwise healthy person, they can disqualify him for work and exclude him from family life. Unsuitable treatment can result in life-long functional disorders causing disability, which in most cases can be avoided given proper surgical treatment.

For this reason, medical literature has always been concerned with the subject of skin losses and their cover. This is important not only for plastic surgeons and physicians interested in burn treatment but also for general surgeons and general practitioners at out-patient departments who treat these injuries often regarded as insignificant. The same holds true for war and emergency situations.

The authors, J. Moserová and E. Houšková, research workers at the laboratory for burn research, the Department of Plastic Surgery, Medical Faculty of Hygiene, Charles University, Prague, publish in the Karger series the monograph — The Healing and Treatment of Skin Defects. In an abridged version, this monograph has already been published twice in Czech, which shows the amount of interest in this topic. The authors are in close day-to-day contact with clinical problems and therapeutical practice which they can first test experimentally, and then, pass on the results obtained experimentally to the clinicians for further testing. It was exactly this close clinical and experimental cooperation that suggested a range of suitable research problems. In this publications, the authors' aim was to share their findings and results obtained in many years'research focused on local therapy of skin defects, thus widening the range of options for a suitable therapy. From this viewpoint, this monograph is highly relevant. In the first place, it presents results of contemporary research into local changes in those skin losses that do not lead to general alteration of the organism; in the second place, this monograph may well serve as a valuable source for contemporary surgical practice.

Laboratory pigs were monitored for histopathological changes and for repair processes occurring both in superficial defects (mechanical as well as thermal ones), and in mechanical full-thickness skin defects. A brilliant histological documentation illustrates the results. The authors were concerned with the development of early infection which poses major problems in burn treatment and with its management using means of local therapy. Further, the monograph analyzes various experimentally tested methods of how to prepare the defects for covering (tangential excision, enzyme necrolysis) with histological check-up.

The monograph also includes a restrospective study drawing on the past case histories of a group of patients whose skin burns did not exceed 15 % of the body surface with early or delayed necrectomy performed, and compared them with a control group hospitalized at the Burn Centre, Department of Plastic Surgery, 30 years ago when necrosis was not excised and left to heal spontaneously. The results clearly show the advantage of early necrectomy. As soon as the surgeon decides to excise the necrotic skin, he should choose the quickest technique leading to definitive

covering of the defect with an autotransplant.

The next chapter, clinically the most valuable, suggests a range of options for covering skin defects. It shows the purpose of temporary covers, advantages of biological covers as distinct from synthetic ones, especially xenotransplants, tested in animal experiments, the results of which are relevant for clinical practice. So far only the autotransplant has been used for definitive cover.

The book has 163 pages and contains 76 photographs, mostly of histological sections, and 30 tables. It is well-arranged and corresponds to up-to-date standards. The monograph is concluded with abundant bibliography consisting of 193 references. It may be said that the authors' aim to cover this subject to the fullest possible extent has been generally met. The book is an accurate piece of study which significantly contributes to the pool of knowledge of skin losses and their replacement. It can also be considered a suitable reference material for all surgeons treating this defect.

Dr. Ladislav Vykouřil, CSc.
Regional Institute of Public Health
Teaching Hospital
IInd Department of Surgery
500 00 Hradec Králové
Czechoslovakia

IIIrd CONGRESS OF THE EUROPEAN BURNS ASSOCIATION

The IIIrd Congress of the European Burns Association (EBA) was held in Prague on October 4—7, 1989. The event was marked by an unusually friendly, informal atmosphere both at working sessions and on social occasions. 391 specialists from 29 countries took part. The scientific programme included 130 lectures and 21 visual presentations (video and posters) from all over Europe. Burns specialists from Australia, the US and from the continent of Africa took part as guests. The main themes of the Congress were problems of anaesthesia and resuscitation, metabolism, skin cover replacement, psychosocial problems, infection and experimental research monitoring. A special symposium was devoted to the management of mass disaster situations. This symposium presided over by the well-known Swedish burns specialist, Gosta Arturson of Uppsala, Sweden, was addressed by specialists of our own denomination as well as by guest surgeons who had experienced situations of a mass incidence of burns where, in terms of professional training, personnel and instrumentarium, they found themselves unprepared for handling the treatment of large numbers of thermal injuries. Their experience was found particularly valuable. For the first time ever, the programme of the Congress included the "Rudi Hermans" lecture in honour of the founder of the European Burns Association. Professor Bent Sorensen of Denmark, a top specialist who had been invited to present the lecture, aired his views on the widely discussed and still moot question of treating those whose injuries are truly incompatible with life. His was a wise lecture based on realistic thinking and profound humanism. Indeed, profound humanism was the hallmark of the attitude of those who presented their lectures or comments in discussions. There is nothing surprising about that as the problem of burns is, indeed, addressed by people capable of self-sacrifice, people with a fine relationship to their neighbours, people with great ethical demands on themselves, and, at the same time, with admirable tolerance to the others.

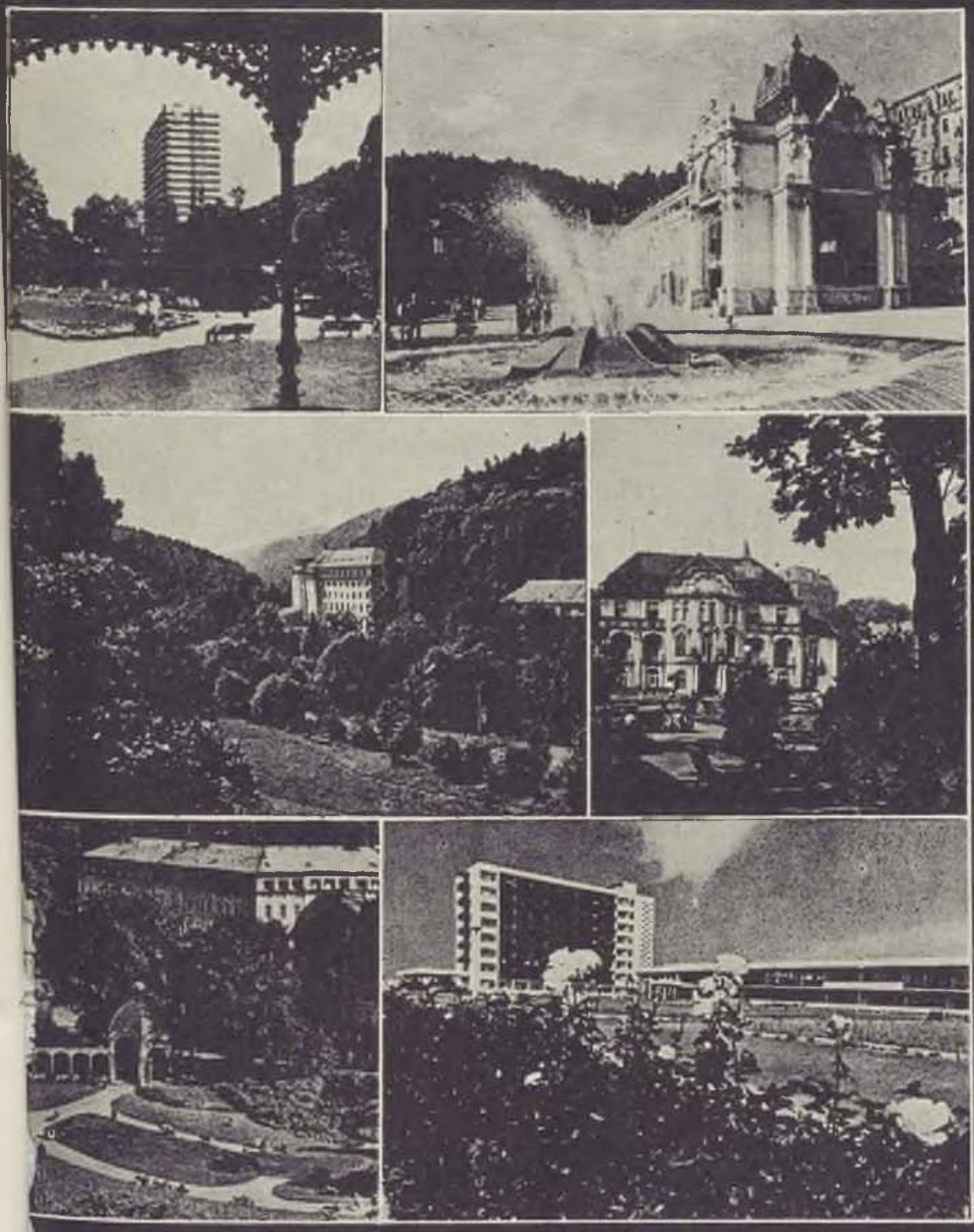
For the first time ever, the Congress was attended by specialists from all over Europe; for the first time, there were specialists from Eastern and Central Europe in considerably large numbers, many of them getting the first opportunity to see for themselves personalities known to them from literature only. Many new friendships were established there, the up and coming generation was given a chance of personal contact, which seems to have been the most valuable aspect of the event.

If, as we hear from the participants' letters, the Congress was such a success, the credit should go not only to the organizing committee in Prague but to all those who had arrived in Prague to take an active or passive part in the event. It was thanks to them that an atmosphere of friendship and understanding prevailed in the international hotel overlooking the river Vltava in those October days 1989. They helped to make a model of a friendly, co-operative Europe, full of respect for diversity of opinion, full of desire for peace, good health and genuine humanism, for justice and truth in science and in civic life.

The Organizing Committee wishes to thank all those who contributed to the success of the IIIrd Congress of the European Burns Association, especially to all the chairmen of the scientific workshops.

CONTENTS

The key to your health Czechoslovak spas



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