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TREATMENT OF FACIAL PARALYSIS BY IMPLANTATION OF A PHRENIC NERVE

B. A. SAMOTOKIN, V. I. GREBENYUK

The treatment of facial muscle palsy is one of the complicated problems of plastic surgery (Alexeyeva, Burdenko, Duel). Not long ago, surgical tactics in the treatment of chronic facial palsy were decided upon from a professional approach. The tremendous clinical experience accumulated up to date, however, permits elaboration of definite tactics regarding important practical questions such as the indication and choice of method, the duration of conservative and the right time for surgical treatment, etc. From this it follows that the treatment of a palsy resulting from injury to the facial nerve caused by an accident or during an operation on the ear, should start with surgery on the nerve. A palsy which has developed as a result of a fracture of the pars petrosa of the temporal bone (in a closed fracture of the base of the skull) must be treated conservatively in the beginning. Three to six months after the accident, when the general condition of the patient has improved, the sequelae of brain contusion have disappeared and the actual damage to the facial nerve, (i.e. whether the nerve trunk had been severed or whether it had only been temporarily compressed by the haematoma in the bone canal), has become evident, surgical treatment of the nerve should be undertaken.

Facial muscle palsy of infectious origin should be treated conservatively for three to six months, but if, in spite of systematic treatment, the reaction of the paretic muscles to faradic stimuli deteriorates, the palsy ought to be regarded as chronic and surgical treatment on the nerve itself should be decided upon.

The duration of conservative treatment is known with sufficient accuracy to test its efficacy and define the tendency to development in order to avoid losing further time in which the paretic muscles might still be capable of restoring their contracting power. These periods should be regarded as optimal if early neuroplasty leads to restoration of the function of all paretic muscles, including the frontal belly of the epicranium muscle.

In order to define the indication for an operation on the trunk of the facial nerve, we considered many factors: the reaction of the muscles to electric stimuli,

the degree of atrophy the soft parts of the cheek, the age and stature of the patient, etc.

Experience shows that the indication for neuroplasty is palsy of three years' duration. The cases in which neuroplasty, performed later, has achieved satisfactory results, do not reflect the typical features. They are but exceptions and, therefore, cannot serve as the rule for the plan of treatment; the more so, because we do not discuss partial repair of the deficiency, but the possibility of full restoration.

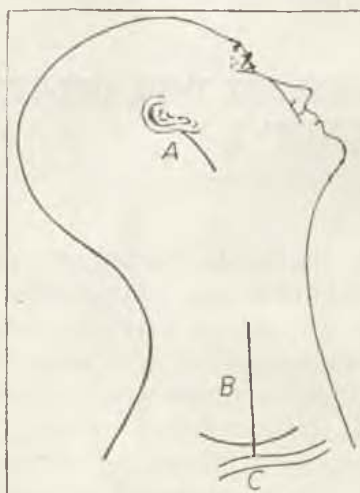


Fig. 1.

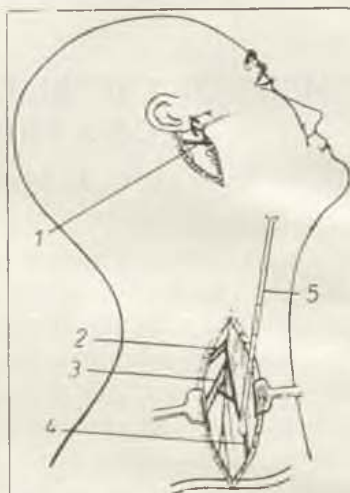


Fig. 2.

Fig. 1. Diagram of incisions for dissection of facial (a) and phrenic (b), nerves c — clavicle. — Fig. 2. Dissection of facial (1) and phrenic (4) nerves; 2—4th cervical nerve; 3—5th cervical nerve; 5—mobilizer of phrenic nerve.

When the paretic muscles show irreversible degenerative changes, i.e. electrical tests prove degeneration, and if the palsy has been of long duration, myoplasty and various corrective operations are indicated.

During the last ten years we have studied a new method of treatment of chronic facial muscle palsy which was suggested by the Russian surgeons Khitrov and Poyemny, in 1949 and which consists in the implantation of the phrenic nerve into the facial nerve. Khitrov performed six such operations and achieved good results. Eight years later, Hardy, Perret and Meyers described another five cases in which they had sutured the phrenic nerve to the facial nerve. In one patient the operation was concluded successfully, because the freed trunk of the phrenic nerve proved too short, so that suturing it to the facial nerve became impracticable.

Since 1951, we have performed 145 implantations of the phrenic nerve into the facial nerve in patients with chronic facial muscle palsy. There were 85 women and 60 men; with regard to age groups, there were 129 up to the age

of 30 and 16 over 30. As to the etiology of the palsy, 83 cases were of infectious origin, 54 of traumatic and in eight the cause of the disease could not be established.

The post-infectious cases were sequelae of influenza in 55 patients, common cold in 8, inflammation of the ear in 8, poliomyelitis in 4, diphtheria in 2, meningitis in 4, parotitis in 1, cellulitis of the cheek in 1 and scarlet fever in 1. The causes of traumatic palsy were: fracture of the base of the skull (involving the pars petrosa of the temporal bone) in 32 patients, operation on

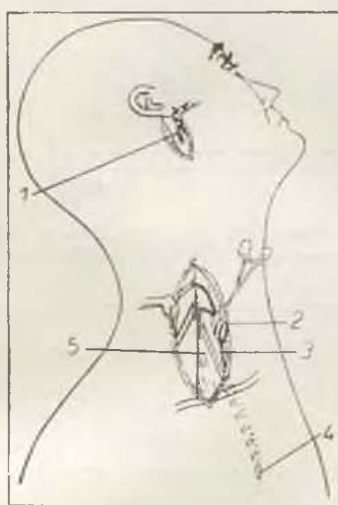


Fig. 3.



Fig. 4.

Fig. 3. Mobilization of facial (1) and phrenic (3) nerves; 2 — cotton wool pad and clamp holding the nerve; 4 — head of mobilizer within the thoracic cavity; 5 — scalenus anterior. — Fig. 4. Nerve suture: 1 — site of suture; 2 — position of phrenic nerve.

the ear in 16, injury to the face in 3, radical removal of an acoustic nerve tumour in 2, extirpation of lymphatic nodes in 1. The right side was affected in 80 patients, the left in 60. One patient had a bilateral palsy. In three patients the muscles innervated by the upper branch of the facial nerve were paralyzed, in one patient those innervated by the lower branch.

With regard to the duration of the palsy the patients could be divided into the following groups: up to 2 years — 43, between 2 and 6 years — 71, between 6 and 10 years — 16, over 10 years — 15.

In all patients the phrenic nerve was implanted into the facial nerve. We slightly changed the technique of the operation as described by Khitrov. The last modification consists in the following (Fig. 1—4):

First stage: dissection of the facial nerve. An incision, 5 cm. long, is made in the retromandibular groove and the trunk of the facial nerve is exposed in the space between the parotid gland and the mastoid process, freed from its

surrounding tissue and severed at the level of the stylo-mastoid foramen. The stumps are usually 0.5—1.2 cm. long which is quite sufficient for the insertion of epineural stitches.

Second stage: Dissection of the phrenic nerve. A transverse incision, 5—6 cm. long, is made 1—2 cm. above the clavicle. The nerve is exposed on the anterior aspect of the scalenus anterior and is freed from the surrounding tissue up to the branching-off of the 4th and 5th cervical nerves, and down to the subclavian

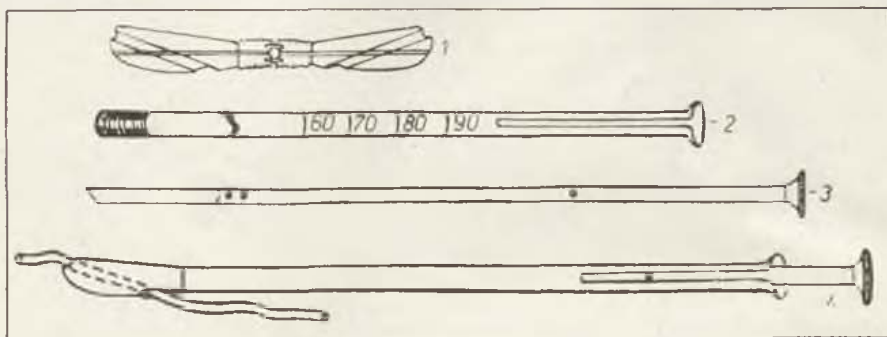


Fig. 5. Mobilizer of phrenic nerve: 1 — head; 2 — tube; 3 — rod with knife; 4 — mobilizer assembled.

vessels. The distance between the origin of the phrenic nerve and the trunk of the facial nerve varies between 9 and 12 cm. In order to suture the two nerves without any tension, it is, therefore, necessary to make the central stump of the phrenic nerve long enough to preserve its full viability. Severing of the phrenic nerve at the level of the 3rd to 4th rib is impracticable without special instruments. For this purpose we use a new instrument which we called "mobilizer of the phrenic nerve". It consists of three parts: a two-piece head, a guide tube and a rod furnished with a knife (Fig. 5). Through the head leads an oblique canal for the nerve and a vertical slot for the knife. The guide tube is screwed onto the head and has a scale with marks 20 mm. apart. The knife has an oblique cutting edge and is fixed to the rod ("Mobilizer" by V. I. Grebenyuk).

During the operation the mobilizer is used as follows: After exposing the phrenic nerve, one half of the head is placed under it so that the nerve comes to lie in the groove. Then the other half is applied and the guide tube firmly screwed on. Now the nerve trunk is slightly stretched by holding it over a pad of moist cotton wool, and the mobilizer pushed downwards along the nerve.

After sliding the instrument into the thoracic cavity down to the markings 6 or 8 cm. (from the upper margin of the clavicle), the rod with the knife is introduced into the guiding tube and pushed down to the stop thus severing the nerve. By this method, injury to the surrounding tissue is avoided, since neurotomy is effected within the head of the instrument. With the aid of this mobilizer it was possible to get a central stump of the phrenic nerve 16—17 cm. sometimes even 19—20 cm. in length. This length (16 cm.) fully suffices not

only for suturing the central stump of the phrenic nerve to the peripheral stump of the facial nerve without tension in the groove behind the mandible, but even with its upper branch in the region of the zygomatic arch.

At this stage of the operation, complications may arise on account of anatomical variations in the subclavian region [Barbaruk], i.e. possible injury to the subclavian vessels or the pleura.

In 145 operations we only met with four cases of injury to the pleura. The resulting pneumothorax was, however, not accompanied by severe symptoms, so that the operation could be concluded according to plan.

In two patients the causes of this complication were injuries and other affections of the lungs sustained prior to the operation.

Third stage: suture of the central stump of the phrenic nerve to the peripheral stump of the facial nerve. For this the phrenic nerve is led through a tunnel (above or underneath the sternocleidomastoid muscle) and out of the upper incision behind the mandible and is there sutured end-to-end to the facial nerve by one or two epineural stitches. We used silk No. 000 or kapron No. 00000 as suture material.

In order to safeguard the neuro-anastomosis from postoperative scar formation, the site of the nerve suture was protected with a fibrin film. For twenty-four hours after operation rubber drains were left in the wound.

In the postoperative period no complications were observed arising from phrenicotomy, neither was respiration affected in any way.

Although successful suture of the nerves is the basic step of the given method of treatment it does not in itself create ideal conditions for the smooth progress of regeneration in the implanted nerve and still less for the final restoration of the function of the mimic muscles. In order to create better conditions for the regeneration of the implanted nerve and as prevention of further atrophy of the denervated muscles, we used iontophoresis of the scars, support of the sagging cheek with adhesive plaster and remedial exercises. Experience has shown that it is not enough to restore the innervation of muscles and their contracting power, but that it is necessary to teach the patient how to use these muscles. Even if the operation has been carried out successfully, functional restoration of the facial muscles without timely and properly (from a physiological point of view) executed remedial exercises will be slow and incomplete. The remedial exercises, which we use, consist of three stages: 1. assisting the regeneration of the implanted nerve; 2. development of facial movements associated with breathing; 3. teaching of voluntary movements; 4. development of stereotypes and restoration of emotional mimic movements.

Three to five months after operation the majority of patients showed characteristic paraesthesiae and increased muscle tonus on the paralytic side. Then the first movements associated with breathing appeared which were characterized by involuntary contractions of the muscles on the paralytic side on deep inspiration. At first, movements in the muscles lifting the corner of the mouth, were observed, later also movements in the orbicular muscle of the eye. Observations showed that there is a complete parallelism between the degree of damage

to the neuromuscular system prior to operation and the time of restoration of the contracting power in the paretic facial muscles after the nerve fibres have grown into them.

It was also shown that if the movements associated with breathing did not develop properly, i.e. if the previously paralytic muscles did not contract well on inspiration, no voluntary movements appeared in them up to the commencement of treatment with remedial exercises. After 10—14 days training good

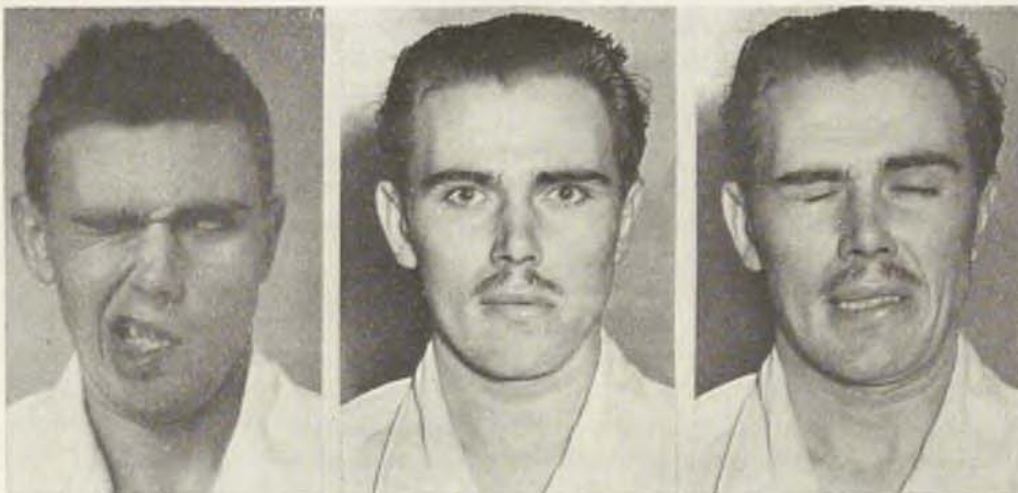


Fig. 6. Patient Kh. prior to and 18 months after operation.

voluntary movements developed and afterwards the associated contractions were suppressed. The most difficult stage of the treatment proved to be the restoration of emotional mimic movements. This is a complicated and time-consuming process. It requires training for a long time, great persistence and attention. An important part was played by psychotherapy, because the slightest disappointment or doubt in the success of the treatment distinctly impaired the elaboration of conditioned reflexes. After 3—4 weeks' hard training we succeeded in elaborating automation of some movements and symmetry of contractions in the muscles on both sides of the face. The patients were able to close their eyes, show their teeth, and maintain the symmetry of the face when reading, speaking or smiling. When breaking into sudden laughter, however, the affected side lagged behind the healthy and the face became temporarily asymmetrical. After a year or more of regular remedial exercise, however, the patients developed good emotional mimic movements.

The late results could be checked up in 115 patients [out of a total of 145 operated on]. In 22 patients the results could not be regarded as definite up to the time of writing and contact could not be established with 8 patients. Excellent results were registered in 22 patients, good in 68, satisfactory in 17 and unsatisfactory in 8.

In the 22 patients with excellent late results the condition was as follows. The face was symmetrical at rest and during function, epiphora was absent. Emotional mimic movements were good. The time elapsed since operation was up to seven years. All patients of this group were young (between 14 and 35) and the palsy was of comparatively short duration (between 6 weeks and 2 years). As to the etiology of the affection, traumatic origin prevailed in this group of patients (16); postinfectious palsy was found only in six.



Fig. 7. Patient G. prior to and 20 months after operation.

In the 68 patients with good results complete cosmetic and adequate functional restoration had been achieved. In this group the face was symmetrical only at rest. The muscle tonus had risen on the affected side, the palpebral fissures were equal in width on either side and the corners of the mouth were on the same level. Voluntary movements were present on the affected side, contractions of facial muscles associated with breathing, were absent. Epiphora and retention of food in the buccal pockets had stopped. On emotion (such as smiling, laughing, etc.), however, asymmetry of the face became quite evident; the contractions of facial muscles were stronger on the healthy side than on the affected. The emotional movements of these patients had been badly restored. In this group of patients palsy had been of longer standing; up to seven years.

In the 17 patients with satisfactory results only partial cosmetic and functional restoration had been achieved. The face had become less asymmetrical, epiphora had greatly decreased, retention of food in the buccal pockets and stopped. Associated movements appeared on deep inspiration and manifested themselves by a pull at the corner of the mouth and a slight narrowing of the palpebral fissure. Voluntary movements were weak.

The group with unsatisfactory results consisted of eight patients, although some of them did show slight movements associated with breathing in isolated muscles 12 to 18 months after operation. In the patients of this group the palsy

had lasted for a considerable period, atrophy of the paralytic side had been marked and reaction of the muscle to electric stimuli was absent. As further treatment myoplastic operations were performed in these patients.

Three cases are demonstrated below for illustration:

Case I: Patient Kh. (Fig. 6), aged 22, was admitted with a left facial palsy which had developed as a result of a suppurating inflammation of the ear. The palsy was of two-year duration. In 1956 implantation of the phrenic nerve



Fig. 8. Patient P. prior to and 2 years after operation.

to the facial nerve was performed on the left side. Six months after operation, the first associated movements appeared. On deep inspiration the corner of the mouth was pulled up and the lower lid lifted. Two and a half years after operation the patient was admitted for the second time for treatment by remedial exercises. In the course of three weeks he was trained three to four hours a day and the result was the elaboration of good voluntary movements and mimic stereotypes. On smiling and laughing the nasolabial groove reappeared and the corner of the mouth was pulled upwards. Movements associated with breathing were entirely suppressed. Breathing was unaffected. The patient is employed in a co-operative farm and performs physical labour. He has been elected deputy to the village soviet.

Case II: Patient G: (Fig. 7), aged 16, musician, 18 months prior to admission he sustained a fracture of the base of the skull with injury to the right facial nerve. In December, 1955, implantation of the phrenic into the facial nerve was performed on the right side. Five weeks after the operation tonus of the paralytic muscles had risen, epiphora had stopped and feeble contraction appeared in the affected cheek. After another week, movement associated with breathing became quite marked. Twenty months later the patient was admitted for the second time. With the aid of remedial exercises good voluntary movements

were elaborated, associated contractions suppressed and the mimic stereotypes firmly established. On fluoroscopy both halves of the diaphragm were on the same level. On forced respiration the right half lagged somewhat behind. The patient had again started to play the trumpet, since the previously paralyzed cheek could now retain the air quite well.

C a s e I I I : Patient P. (Fig. 8), aged 25, laboratory worker, who three years prior to admission, contracted influenza, complicated by a neuritis of the right facial nerve. In June, 1955, implantation of the phrenic into the facial nerve was performed on the right side. Four months later, epiphora had diminished and retention of food in the buccal pockets ceased, but only after a further month movements of the right half of the face associated with breathing became apparent. On second admission, in 1957, associated contractions were strong and voluntary movements absent. After a week of remedial exercises, voluntary movements were elaborated. The associated movements stopped three days later. The mimic stereotypes were elaborated with the aid of exercises and psychotherapy (hypnosis). As result of this, the nasolabial groove reappeared on the affected side on laughing. From correspondence it became known that emotional mimic movements had further improved in the course of the following year.

Although we did not observe in our patients any respiratory disorder after phrenicotomy, we, nevertheless, studied the function of the diaphragm by means of X-ray kymography. Investigations were carried out in 13 patients prior to, a few days after the operation and 5 to 20 months afterwards. The data thus obtained, permit us to assert that, unlike phrenicexeresis, severing of the trunk of the phrenic nerve does not lead to any great functional disturbances of the diaphragm. We did not observe any patient in whom the affected half of the diaphragm remained paralyzed after this operation; only paresis was always present. However, the paresis became less apparent with time and the function of the diaphragm was to a great extent restored. This is effected by the anastomoses between the two phrenic nerves and their connections with the ninth, tenth and eleventh intercostal nerves (Yevdokimov).

The accumulated experience with the treatment of chronic facial muscle palsy by implantation of the phrenic into the facial nerve combined with subsequent remedial exercises permits this method to be considered better than neuroplastic operations where other motor nerves are transposed. The use of the phrenic nerve for this purpose does not cause any respiratory disorder, the movements associated with breathing can easily be suppressed and, if the operation is performed in recent cases, it is even possible to achieve the emotional play of the facial muscles.

S U M M A R Y

In the treatment of facial muscle palsy, the authors adhere to therapeutic tactics which provide for a sequence of conservative and surgical methods in accordance with the etiology and the duration of the disorder. Thus in injuries to the facial nerve, the treatment should start with neuroplasty. A palsy, resulting from a closed fracture of the pars petrosa of the temporal bone or from an

infectious neuritis, should be treated conservatively for three to six months (with the exception of nerve compression), afterwards neuroplastic operations may follow and only after those, myoplastic or other corrective surgery should be undertaken. Special attention is paid to the analysis of the authors' own experience in the treatment of chronic facial palsy by the implantation of the phrenic into the facial nerve. In the course of ten years they performed 145 such operations.

The technique of the original operation is described in detail. The authors used a new instrument which they called "mobilizer of the phrenic nerve" (produced by the medical equipment industry of the U.S.S.R.).

Great importance is ascribed to special remedial exercises aimed at preventing the paralytic facial muscles from atrophying, at recovering their contracting power after the in-growing nerve fibres of the implanted nerve have reached them, chiefly, however, at the restoration of volutary and emotional movements of the previously paralytic musculature. The late results were checked up in 115 patients (excellent in 22, good in 68, satisfactory in 17 and unsatisfactory in 8).

Notice is taken of the circumstance that phrenicotomy, unlike phrenic-exeresis, is not accompanied by any gross functional disorder of the diaphragm. X-ray kymography in 13 patients proved that the paresis of one half of the diaphragm, which follows phrenicotomy, had diminished in the course of one year and the function of the diaphragm had been greatly restored due to the anastomoses with the intact nerve of the other side.

The authors consider implantation of the phrenic into the facial nerve as the operation of choice if neuroplasty is to be undertaken, because it does not give rise to any clinical respiratory disorders. The movements of facial muscles associated with breathing are easily suppressed. The chief advantage of this method, however, is that it makes it possible to restore the emotional play of the facial muscles.

R É S U M É

Le traitement de la paralysie faciale par greffe d'un nerf phrénique

B. A. Samotokin, V. I. Grebenyuk

En ce qui concerne le traitement de la paralysie musculaire faciale, les auteurs sont partisans d'une tactique thérapeutique où les méthodes conservatrices et chirurgicales seraient appliquées les unes et les autres, selon l'étiologie et la durée du trouble. En présence d'une lésion du nerf facial, le traitement devrait débiter par une plastie nerveuse. Si la paralysie a pris naissance à partir d'une fracture fermée de la pars petrosa de l'os temporal ou d'une névrite infectieuse, elle devrait être traitée de manière conservatrice pendant une période de trois à six mois (sauf s'il y a compression du nerf), puis une opération neuroplastique peut être effectuée et ce n'est qu'après celle-ci que la greffe musculaire ou d'autres mesures de réparation devraient être entreprises. On insiste spécialement sur les expériences faites par les auteurs eux-mêmes par rapport à la thérapie des paralysies faciales chroniques à l'aide d'une greffe du phrénique, pratiquée sur le nerf facial. Au cours des dix dernières années, les auteurs ont effectué 145 interventions de ce genre.

La technique du mode opératoire original est décrite en détail. Les auteurs utilisent un instrument nouveau qu'ils ont dénommé „préparateur un nerf phrénique“ (fabriqué par l'industrie de l'équipement médical de l'URSS).

On attache beaucoup d'importance aux exercices de rééducation pour empêcher l'atrophie du muscle facial paralysé et pour lui permettre de récupérer ses facultés de contraction, lorsque les fibres nerveuses en voie de prolifération dans l'implant vont atteindre ce dernier, mais surtout pour rétablir les mouvements volontaires et émotionnels de la musculature paralysée auparavant. Les résultats tardifs ont pu être contrôlés sur 115 malades (résultats excellents en 22 cas, bons en 68, satisfaisants en 17 et pas satisfaisants et 8 cas).

Il faut noter que la phrénicotomie, au contraire de ce qui se passe pour l'exérèse du phrénique, n'est accompagnée d'aucun trouble important du diaphragme. Les radio-kymogrammes enregistrés sur 13 malades ont prouvé que la paralysie de la moitié du diaphragme, qui se produit à la suite de la phrénicotomie, diminue au cours d'une année et que la fonction du diaphragme s'est rétablie dans une mesure considérable, grâce aux anastomoses qui se sont produites avec les nerfs du côté opposé.

Les auteurs considèrent que l'implantation du phrénique dans le nerf facial représente la méthode de choix, si une intervention neuroplastique doit être effectuée, étant donné qu'elle ne provoque aucun trouble respiratoire clinique. Les mouvements des muscles faciaux, associés à la respiration, sont facilement supprimés. Mais l'avantage le plus important de cette méthode, c'est qu'elle permet de rétablir le jeu émotionnel des muscles faciaux.

ZUSAMMENFASSUNG

Die Behandlung von Facialislähmungen mittels der Implantation des N. phrenicus in der Gesichtschirurgie

B. A. Samotokin, W. I. Grebenjuk

Bei der Behandlung von Gesichtsmuskellähmungen empfehlen die Verfasser eine therapeutische Taktik, die eine Folge einander abwechselnder konservativer und aktiver Methoden je nach der Aetiologie und der Dauer der Erkrankung vorsieht. Bei Verletzung des N. facialis muss die Behandlung mit einer Neuroplastik beginnen. Lähmungen, denen eine Fraktur der Pyramide des Schläfenbeins oder eine infektiöse Neuritis zu Grunde liegt, werden konservativ während 3 bis 6 Monaten behandelt (mit Ausnahme von Nervenkompressionen); sodann werden neuroplastische Operationen und erst danach Myoplastik und korrigierende Eingriffe vorgenommen. Besondere Sorgfalt widmen die Verfasser der Analyse ihrer eigenen Ergebnisse, die sie bei der Behandlung dauernder Facialislähmungen durch Implantation des N. phrenicus in den N. facialis erzielten. Innerhalb 10 Jahren führten die Verfasser 145 derartige Operationen durch.

Eingehend wird die Technik einer originellen Operation beschrieben, wobei ein neues Instrument zur Verwendung gelangt, das von den Verfassern „Mobilisator des N. phrenicus“ genannt und von der medizinisch-technischen Industrie der Sowjetunion erzeugt wird.

Grosses Gewicht wird auf eine spezielle Heilgymnastik gelegt, deren Aufgabe darin besteht, einer Atrophie der denervierten Gesichtsmuskulatur vorzubeugen, den gelähmten Gesichtsmuskeln nach ihrer Versorgung mit dem implantierten N. phrenicus die Kontraktionsfähigkeit wiederzuverleihen, und vor allem die willkürlichen und die emotionellen Bewegungen der vordem gelähmten Muskulatur wieder herzustellen. Die Spätresultate wurden bei 115 Personen überprüft, sie waren sehr gut bei 22 Patienten, gut bei 68, zufriedenstellend bei 17 und ungenügend bei 8 Kranken.

Es wird auf den Umstand hingewiesen, dass die Phrenicotomie im Gegensatz zur Phrenicoexhaeresis keine gröbere Störung der Zwerchfellfunktion bewirkt. Bei 13 Patienten wurde röntgenkymographisch nachgewiesen, dass die nach der Phrenicotomie auftretende Parese der Zwerchfellkuppel sich nach einem Jahr verringert und dass die Zwerchfellfunktion infolge der Ausbildung von Anastomosen in bedeutendem Masse wiederkehrt.

Die Implantation des N. phrenicus in den N. facialis bezeichnen die Verfasser als Methode der Wahl in der Neuroplastik, da der Eingriff am N. phrenicus keine klinischen Atemstörungen verursacht; die an die Atmung gekoppelten Bewegungen der Gesichtsmuskulatur sind leicht zu beseitigen, vor allem aber besteht die Möglichkeit, die Wiederherstellung des emotionellen Spieles der Gesichtsmuskeln zu erreichen.

RESUMEN

El tratamiento de la parálisis facial por la injertación de un nervio frénico

B. A. Samotokin, V. I. Grebenyuk

En el tratamiento de la parálisis facial de músculo los autores emplean tácticas terapéuticas que procuran toda una serie de los métodos conservativos y quirúrgicos en conformidad con la etiología y la duración del desorden. En caso de un defecto del nervio facial, el tratamiento debería empezar con neuroplastia. Una parálisis, que resulta de una fractura cerrada de la pars petrosa del hueso temporal o de una neuritis infecciosa, debería ser tratada de manera conservativa tres hasta seis meses [excepto la compresión de nervio], luego las operaciones neuroplásticas pueden tener lugar y solamente después de todo esto la cirugía mioplástica o otra forma de la cirugía correctiva se deberían emplear. Una atención especial está dedicada al análisis de la propia experiencia de los autores en cuanto al tratamiento de la parálisis facial crónica por la injertación del nervio frénico hacia el interior del nervio facial. Durante el período de diez años los autores llevaron a cabo 145 operaciones de este tipo.

La técnica de la operación original está descrita en detalle. Los autores emplearon un nuevo instrumento lo que llamaron un „instrumento movilizante del nervio frénico“ [producido por la industria medical de equipos de la U. R. S. S.].

Una gran importancia se atribuye a los ejercicios terapéuticos especiales que tienen que prevenir la atrofia de los músculos faciales paráliticos, restablecer su poder contratante después de que las fibras cicatrizantes de nervios del nervio plantado los han logrado, pero ante todo tienen que renovar los movimientos voluntarios y emocionantes de la musculatura parálitica. Los resultados tardíos fueron controlado en 115 enfermos [sobresalientes en 22 casos, buenos en 68 enfermos, satisfactorios 17 y poco satisfactorios en 8 pacientes].

Los autores llaman la atención al hecho que la frenicotomia, a diferencia de la frenicexeresis, no está acompañada de un gran desorden funcional del diafragma. El medir de las ondas de oscilación por radioscopía comprobó en 13 pacientes que la paresia de una mitad del diafragma, que viene después de la frenicotomia, había disminuido dentro de un año y la función del diafragma había sido restaurado considerablemente debido a la anastomosis con el nervio intacto de la otra parte.

Los autores consideran la injertación del nervio frénico hacia el interior del nervio facial como una operación de elección si la neuroplastia tiene que ser ejecutada, porque todo esto no causa desórdenes respiratorios clínicos. Los movimientos de los músculos faciales asociados con la respiración pueden ser suprimidos fácilmente. Pero la ventaja más importante de este método consiste en el hecho que él hace posible la restauración del movimiento emocional de los músculos faciales.

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RHINOPLASTY WITH FREE AURICLE TRANSPLANT

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One of the methods of covering a partial defect of the cartilagenous part of the nose is the transplantation of a section of the helix. This operation was first performed by Suslov at the end of 1897.

Four years later, in 1902, König reported about his transplanting of a section of the auricle to cover a defect of one ala nasi caused by lupus. The auricle graft was fixed so that the protruding edges of the cartilage were pushed underneath the edge of the defect and came to lie deeper than the suture line. Later, König made a statistical analysis of his 47 cases of free auricle grafts and found that about half of them (25) had taken.

The knowledge of the above results and also the publications of some other surgeons, e.g. Burak who reported the taking of the grafts only in two out of 12 cases, have supported the opinion as to the high percentage of failures after this operation.

In their search for a more promising method some surgeons have made attempts to transplant the auricle on a nutritive pedicle. For this purpose they made use of the skin of one cheek (Perimov), the scalp (Brown), one finger (Ivanissevich) and also of a Filatov flap (Vechtomov, Limberg and others). Because of the time they consume and the trauma they cause, these methods did not achieve wider usage.

Many surgeons, who practise free transplantation of the auricle have endeavoured to provide wider contact for the wound surface. For this purpose, they made a broader wound bed by mobilizing the edges of the defect and turning them upwards (Abrazhanov, Zhakov, Joseph and others). Employing this method, Zausayev used the skin of the inner surface of the graft for reconstructing the missing parts of the columella nasi.

Rabinovich shaped the edges of the defect into a wedge which he inserted into a groove cut into the graft. The same method was employed by Duvenport and Bernard with the only difference that the latter used part of the ear lobe for transplantation.

When excising the scars along the edge of the defect, some surgeons form a small pocket to retain the cartilage of the graft. Limberg, Obukhova and others employing this method achieved a very high percentage of good results.

Frankenberg suggests taking the transplant with a surplus and fixing the cartilage of the graft with a mattress suture in the pocket made along the edge of the defect. We have used this method with some modifications for the last three years and are convinced that it is promising.

In the following, an analysis is made of the cases of free transplantation of the auricle carried out for partial defects of the nose at the surgical department of the Institute of Medical Cosmetics during the period 1959—1961. We

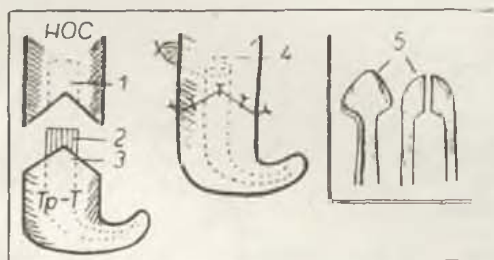


Fig. 1. Method of suturing the auricle transplant to the defect in the nose: 1. pocket for the retention of the graft; 2. protruding edge of the transplant cartilage; 3. wedge-shaped skin flap of transplant; 4. pi-shaped suture for the fixation of cartilage; 5. end of special forceps for holding the auricle graft while suturing.

operated on 30 patients, 21 women and 9 men, their age ranging between 19 and 50 years.

The defects originated from injury in 15 patients, from bites in 10, as a result of lupus, measles and other inflammatory processes in 5. Most defects of the distal parts of the nose were found in the region of the alae (in 25 patients), in one woman that defect was bilateral. The middle part of the ala was affected in 12 patients, in four of whom the remaining base of the ala was displaced upwards by the pull of a scar. In 10 patients not only one ala but also part of the tip of the nose and the columella were missing and in five even the base of the ala was absent. Defects of the tip of the nose were present in three patients.

In accordance with the opinion that during the first days the graft lives on its own nutritives (Kyandsky) and assuming that artificial hyperaemia might well increase their concentration in the graft, we rubbed the auricle with alcohol until it flushed, prior to excising the transplant.

In all patients, the operation was carried out under local anaesthesia with 1% novocain with no adrenalin, but with 200,000 u Penicillin added to it.

SURGICAL TECHNIQUE

A narrow strip of the scar is excised along the entire circumference of the defect and the wound edges are mobilized so that a pocket 4—5 mm. deep is formed. At the same stage a small piece of skin is excised from the free margin of the alar remnant in the shape of a wedge to receive one corner of the trans-

plant which is later to be fitted into it. (Fig. 1). Then the transplant is cut out of the auricle at the most suitable site. A surplus of skin in the shape of a wedge is taken from the edge of the helix as is shown in Fig. 1. The size of the transplant must exceed the area of the defect by 2—3 mm. along the entire circumference.

The skin of the transplant is carefully mobilized from the cartilage on both sides to a depth of 3—4 mm. making the cartilage margin well visible.

After transfer of the graft to the defect three u-shaped hair sutures are

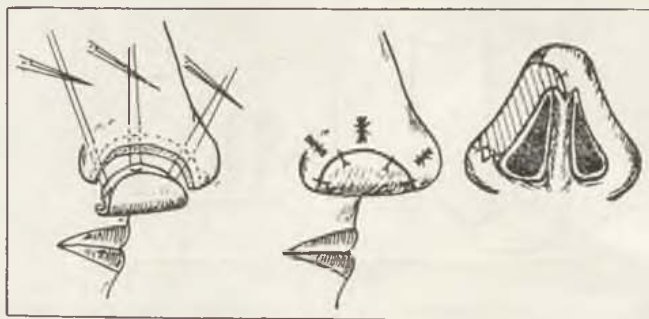


Fig. 2a.

Fig. 2b.

Fig. 2c.

Fig. 2a. Fixation of auricle transplant with pi-shaped stitches. — Fig. 2b. Appearance of transplant after completion of suture. — Fig. 2c. Wedge-shaped skin inlay of the transplant sutured into place.

inserted in the three basic directions through the protruding cartilage edge of the graft. The sutures are led out through the skin from inside the pockets of the defect, 10—12 mm. from the wound edge and temporarily secured by clamps (Fig. 2a). Afterwards the transplant is turned over with its inner surface facing upwards and the skin of this surface is sutured to the mucous lining of the nose by a few thin catgut stitches. Then, by tying the u-shaped sutures the graft is eased into its bed. The hair sutures are knotted from outside over small gauze pads (Fig. 2b), but the catgut sutures are tied from within the nasal cavity. Thus the graft appears firmly fixed to its bed and, at the same time, a broad contact area of wound surfaces has been achieved. Finally, the skin wound is sutured with wide-spaced hair sutures thus obtaining good approximation of the wound edges.

Since holding the graft by hand obviously hampers the movements of the surgeon on suturing, we use a special forceps for the purpose. The graft, held in place by the assistant with this forceps, becomes easily accessible for inspection and manipulation by the surgeon. The forceps designed for holding an auricle transplant has a broad triangular end with a projection making it possible to get round the edge of the groove (see Fig. 1).

During the first three to five days after operation the patients have cooling applied to the skull and cheeks. Conley, Balon and others reported on the

favourable effect of hypothermia, particularly after transplantation of auricle grafts.

With regard to the situation of the defect, the operation of transplanting part of the auricle has some special features. In the repair of an alar defect reaching the tip of the nose it is particularly important to achieve a smooth transition of the tissue of the ala onto that of the columella. For this, the incision must be extended onto the columella in accordance with the fold on the healthy

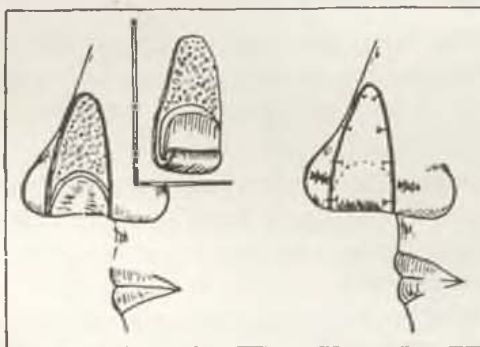


Fig. 3. Plastic repair of ala nasi with a full-thickness auricle transplant plus an additional skin flap. In the frame see shape of transplant.

side, and the skin of the graft previously taken with a surplus wedge which bends over smoothly, can then be sutured into the wound of the columella [see Fig. 2c].

Apart from the defect in one of the alae nasi sometimes also the upper part of the columella and that of the tip of the nose are missing. In these cases the tip of the nose becomes displaced towards the affected side. The loss of tissue in these patients is, in fact, considerably greater than appears at first sight. In such cases it is necessary to free the tip and replace it into its proper position.

The missing part of the columella is reconstructed from local tissue using a folded flap of mucosa which is taken from the mucous membrane remnants of the nostril. The nutritive pedicle of such a flap becomes an extension of the mucous lining of the septum nasi. The resulting through-and-through defect of the ala nasi and partly also of the tip of the nose has to be repaired with an auricle graft.

In cases where the base of the ala nasi has been displaced, the scars are severed and the ala replaced to its normal position. The actual tissue defect made apparent by this manoeuvre determines the size and shape of the graft required.

For the repair of defects at the base of the ala nasi the graft is preferably taken from the upper-posterior part of the contralateral auricle. The convexity of the auricle at this site permits the reconstruction of the base of the ala to an almost natural shape.

In one patient, apart from a full-thickness auricle graft, we had to take an additional section of skin from the posterior aspect of the ear. Because the details of this operation may be of interest the following paragraph deals with the case history.

Patient T, aged 28, came to the Institute of Medical Cosmetics on May 28, 1961, requesting repair of a defect in the left ala nasi resulting from an injury six months previously. The general condition of the patient was satisfactory, no pathological changes were found in the internal organs.

The left ala nasi had been destroyed to an extent measuring 12×15 mm. in area. The rest of the ala was turned inwards and slightly pulled upwards. Above the defect, on the dorsum and the side of the nose, a coarse scar extended over an area of 20 × 15 mm.

On April 7, 1961, under local anaesthesia, the scar was excised along the margin of the defect, the ala nasi mobilized by a deep incision and lowered to its natural position; then the scar on the dorsum nasi was also excised. A skin defect on the dorsum nasi and a hole in the region of the ala leading into the nasal cavity was the result of this stage. The wound edges were then mobilized to form a pocket. The transplant, 35 mm. in length and 15 mm. wide, was taken from the upper-posterior section of the left auricle, its shape corresponding to that of the pattern of the defect, cut for the purpose. In its peripheral part, including a section of the helix, the transplant consisted of all layers of the auricle, but in addition to this a skin flap was excised proximally to cover the skin defect on the dorsum nasi. The skin edges of the transplant were mobilized, too, and the protruding margin of the cartilage was introduced into the pocket formed along the edge of the defect and there fixed by two u-shaped sutures, tied over gauze pads. The wound was then closed with hair and catgut sutures; the defect in the auricle closed by a silk suture (Fig. 3).

The stitches were removed on the tenth day, when the graft had taken completely. The shape of the nose was fully satisfactory. In Fig. 4a and b patient T. is shown before and after operation.

The above case confirms that it is possible to use a fullthickness auricle graft with, if necessary, an additional skin flap.

We performed a total of 31 operations in 30 patients. In one patient, with a deformed margin of the right ala nasi a plasty was performed with a spindle-shaped graft taken from the central parts of the auricle according to Lexer. Twenty nine grafts of the 31 transplanted took well. In two, the skin edges sloughed off. However, the wound even in these two patients stretched after healing and the ultimate result proved quite satisfactory.

Most transplants — disregarding their shape — were measured in two directions, i. e. the length and the width, with a special caliper recommended by Niiyekhai. The dimensions of the grafts ranged between 10 and 20 mm. in width and 15 and 35 mm. in length.

No dependence of the quality of take on the size of the transplant could be observed. The marginal skin necrosis of the two patients described above

occurred in grafts of medium size and we assume that this was probably due to the surrounding scar not having been excised completely. Among the other complications a difference in colour (cyanotic) of the transplanted graft ought to be pointed out. We observed this in four patients even 12 to 18 months after operation. In another two patients a keloid scar developed along the line joining the transplant with the local tissue which was treated with good effect by two series of soft X-ray treatment (Bucky).

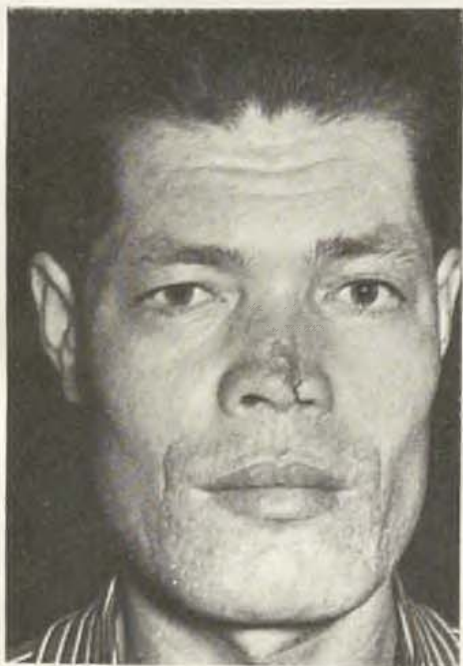


Fig. 4a. Patient T: defect of one ala and a scar on the dorsum nasi following injury.



Fig. 4b. Patient T: one year after transplantation of an auricle graft.

In the literature, almost no mention is made of corrective operations after transplantation of auricle grafts, although in a number of cases these operations seem inevitable. Corrective operations can only be performed several months after the primary operation. Among these operations the most typical are: removal of the protruding bend at the edge of the reconstructed ala nasi or liberation of the retracted scar along the joining line between the transplant and the local tissue. In order to avoid retraction of the scar, we have recently shaped the skin of the graft into a wedge on primary operation. Limberg recommended for this purpose the use of Z shaped skin flaps. In a number of cases the transplanted auricle graft looks flat. For correction of this shortcoming a V-shaped incision is made on the tip of the nose and, depending on the degree of flattening, the peripheral parts of the cartilage are removed or, in order to facilitate molding to the required convexity, incisions are made into

this cartilage. The nasal cavity is packed from within and a collodium dressing is applied from outside which permits the molding of the tip of the nose into the required shape.

In conclusion, it appears necessary to touch upon the problem of the fate of the auricle which the graft has been taken from. In the overwhelming majority of cases the shape of the ear undergoes but little change after the excision of a comparatively small section and subsequent suture. After excision of bigger transplants, however, it becomes impossible to close the defect by a simple suture. In such a case K'yansky suggests the excision and transplantation of a piece from the contralateral auricle, half the size of the defect.

We practice covering of the defect in the auricle with a pedicle flap graft taken from the retroauricular region. The shape can be improved upon by an additional corrective operation. This method was described by Brown in 1946 and was also used by Polliciari in 1949, who also used part of the ear lobe as a free transplant for the repair of the defects in the tip of the nose and the columella, and points to the favourable qualities of the lobe as plastic material.

For the reconstruction of the auricle after excision of a large graft one may thus choose between a pedicle flap plasty from the retroauricular region and the transplantation of a small graft taken from the other ear.

S U M M A R Y

1. The repair of partial defects of the cartilaginous parts of the nose with a free auricle transplant gives good results and can, therefore, be recommended as the method of choice.

2. Making of a special pocket at the edge of the defect for the insertion of the graft and the fixation of the cartilage with mattress sutures creates better conditions for the take of the transplant.

3. Larger defects of the auricle left after excision of the transplant are best repaired with a pedicle flap skin graft from the retroauricular region.

R É S U M É

Rhinoplastie par greffe auriculaire libre

G. V. Kruchinsky

1. La réparation des déféctuosités partielles de la partie cartilagineuse du nez à l'aide d'un greffon auriculaire libre donne de bons résultats et peut être recommandée comme méthode de choix.

2. La construction d'une poche spéciale au bord de la déféctuosité qui sert à l'insertion du greffon et à la fixation du cartilage, à l'aide d'une suture en capiton, va créer des conditions plus favorables à l'adhérence de l'implant.

3. Des déféctuosités plus importantes, produites dans le pavillon de l'oreille par l'excision du greffon, peuvent être réparées le mieux à l'aide d'un greffon cutané en lambeau pédiculé, en provenance de la région rétroauriculaire.

ZUSAMMENFASSUNG

Rhinoplastik mittels freier Übertragung von Ohrmuschelteilen

G. W. Krutschinski j

1. Die Korrektur partieller Defekte des Nasenskorpelskelets mittels freier Übertragung von Ohrmuschelteilen ergibt günstige Resultate und kann als Methode der Wahl empfohlen werden.

2. Die Bildung einer speziellen Tasche am Defektrande für das Transplantat und die Fixierung seines Knorpels mit Hilfe einer Matratzennaht bietet bessere Bedingungen für das Anheilen.

3. Grosse Defekte der Ohrmuschel nach Entnahme des Transplantats werden zweckmässig durch einen gestielten Hautlappen aus dem retroaurikulären Gebiet ersetzt.

RESUMEN

La rinoplastia con la transplatación de la aurícula libre

G. V. Kruchinsky

1. La reparación de los defectos parciales de las partes cartilaginosas de la nariz por medio de la transplatación de la aurícula libre ofrece buenos resultados y así puede ser recomendada como uno de los métodos existentes.

2. La formación de un bolsillo especial al margen del defecto para insertar allí el injerto de piel y para la fijación del cartílago con las suturas de colchón prepara mejores condiciones para la ejecución del injerto de piel.

3. Defectos más grandes de la aurícula dejados después de la excisión del injerto de piel pueden ser reparados lo más ventajosamente con el injerto de piel del lóbulo de pedículo desde la región retroauricular.

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FLAP OPERATIONS FOR UNILATERAL HARE-LIP

Š. DEMJÉN

Many methods have been, and still are, suggested and tried for correcting hare-lip, with the aim of achieving a normal functional and aesthetic result. Most of these operations, which are known by different names, can be divided into V excisions and flap operations.

In V excisions, the edges are simply excised by straight cuts in the shape of an inverted V, or by curved cuts in the form of an oval excision, and are sutured. In flap operations, flaps are obtained by various techniques from the immediate vicinity and are inserted into an incision on one side of the cleft.

Operations in which the edges of the cleft are cut linearly or slightly curved usually have undesirable consequences. The scar contracts and the edge of the vermilion is drawn up. This deficiency has long been a sore point and many authors have attempted to elaborate different flap operations giving a broken instead of a linear scar [5]. This was not the only unsatisfactory feature of the above operation. After suture, the lower half of the lip is usually narrow and in profile the shape of the lip is unnatural, being straight from the base of the nose to the edge of the vermilion and sometimes actually turned inwards, while the lower half of the normal lip curves outwards. If only small amounts of tissue are excised from the vermilion at the edge of the cleft, in an attempt to preserve the width of the lip, the residue of the vermilion leaves a deformity of the type of a coloboma. A wide V excision, on the other hand, gives a long, straight, narrow lip.

In an attempt to avoid these standard deficiencies of V excisions, various flap operations have been suggested, including right-angled, rounded and triangular flaps, flaps from the medial side of the cleft, flaps from the lateral side or from both sides, flaps of varying heights, at the dividing line between the skin and the vermilion of the lip, below the ala and the columella, in the middle of the lip (lengthwise) and at the top and bottom of the lip.

The results of any method depend primarily on how it conforms to the principles of reparative surgery which apply under the given circumstances. In reconstruction of hare-lip, the aim is to obtain the best possible results, 1. with the minimum loss of tissue and 2. by utilizing the material available to the greatest possible advantage.

The material available in this case is both defectively developed and displaced. The lip is usually shortened vertically on both sides of the cleft, but usually more on the medial side. The columella is also usually shorter on the side of the cleft, as well as being displaced (11). The Cupid's bow is complete, but is divided by the cleft and is displaced upwards on the medial side of the

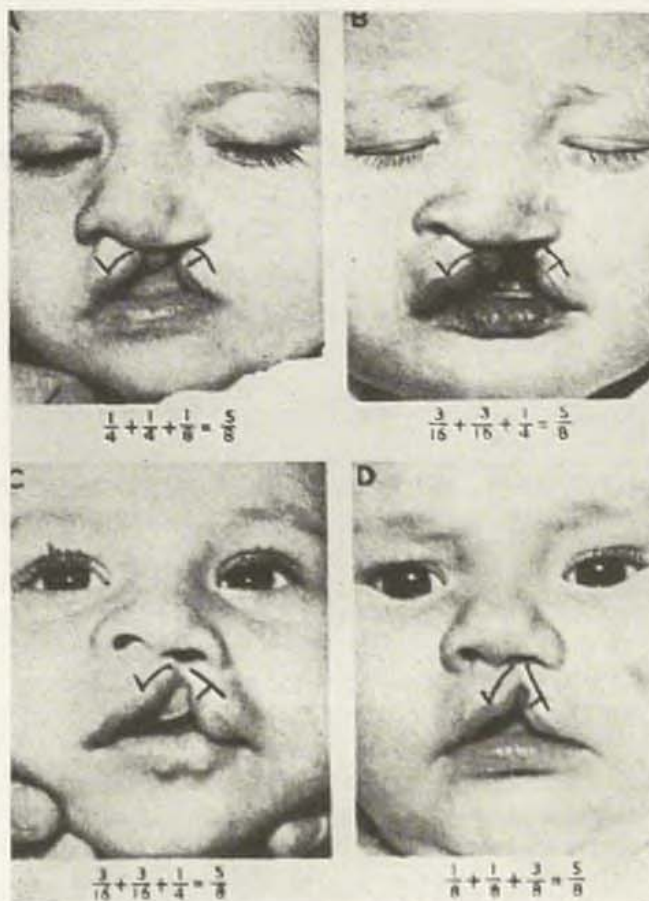


Fig. 1a. Diagram of operation according to Le Mesurier.

cleft (10). The edge of the filtrum is also clearly marked on the side of the cleft, but is shorter than on the normal side, or else the whole lip between the cleft and the centre of the filtrum is less developed than on the normal side.

The aims of flap repair are as follows: 1. to restore the displaced parts of the lip to their normal position, 2. to keep them in place by proper distribution of the tissue.

The way in which these aims are achieved varies with different methods. The first in this series of methods was Blair and Brown's modification (1930) of Murault's principle and the modification by Brown and McDowell (1945).

In 1949, Le Mesurier published the results of his 14 years' experience with the right-angled flap, which was a modification of the principle suggested by Hagedorn [1884]. In the same year Steffensen published his experiences with this method, followed in 1953 by Breuer, who also modified it. Le Mesurier's method, as modified by Steffensen and Breuer, was definitely an advance on V

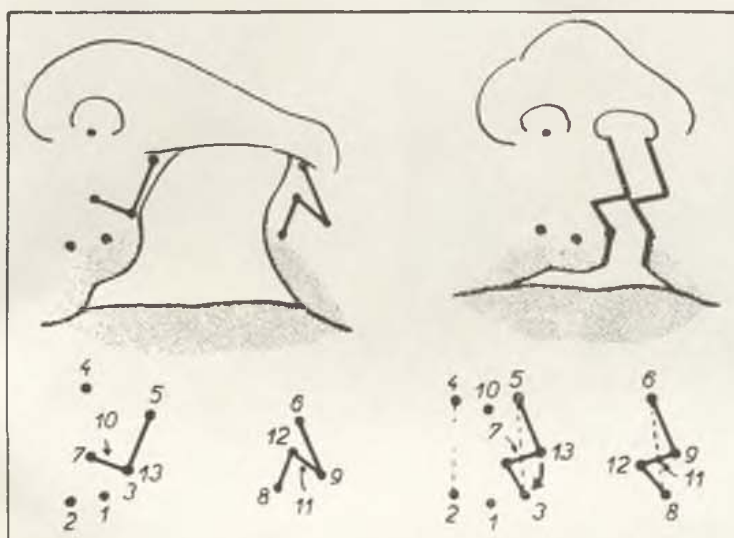


Fig. 1b. Diagram of operation according to Tennison.

excision. It has been used in the author's clinic since 1956 in cases of complete and incomplete unilateral hare-lip and for secondary correction and has also been tried in bilateral hare-lip.

In 1952, Tennison published the principle and technique of the triangular flap. Because of its simplicity and good cosmetic results it was adopted by Cardoso [1952], Marcks et al. [1953], Hagerty [1958], Breuer [1959], Randall [1959] and Wang [1960], who supplemented it and whose results convinced many others, including the author, that it had distinct advantages over Le Mesurier's principle. Since the beginning of 1959 it has been used in the author's clinic as the method of choice.

Before describing his experiences with the right-angled and the triangular flap, the author would like to mention another principle, of which, as yet, he has no personal experience, but which he definitely intends to try. In 1958, Millard [one of Gillies' pupils] published the results of a new method of his own, which he described as rotation + advancement. From the description and evidence, this method undoubtedly represents yet a further advance. It involves less loss of tissue than any of the other methods put forward. The Cupid's bow is preserved intact and the displaced elements are returned to their proper position by rotating the medial segment and advancing the lateral segment. Tissue loss is



Fig. 2a.



Fig. 2b.



Fig. 2c.



Fig. 2d.

Procedure at operation according to Tennison.

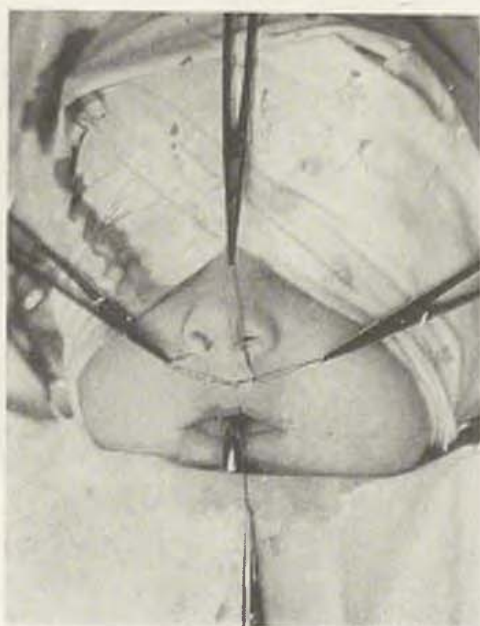


Fig. 2e.



Fig. 3a.



Fig. 3b.

Triangula. flap according to Tennison.

minimal; the lower half of the scar imitates the edge of the filtrum and the upper half is hidden by the nose. The great progress made in the correction of unilateral hare-lip during the past ten years has been due to the recognition and observance of the following principles:

1. V Excision produces a short lip with a narrow lower end of the lip



Fig. 4a.



Fig. 4b.



Fig. 4c.

Quadrangular flap according to Le Mesurier. Central part, Cupid's bow, without notch.



Fig. 5a.



Fig. 5b.

and with a disfiguring scar, which, after contracting, often draws the vermillion up into a point.

2. If the amount of tissue in the lower part of the medial segment is inadequate, it can be supplemented from the lateral segment.

3. The Cupid's bow is fully developed, but is displaced. The operation should keep it intact and return it to its proper position, not destroy it.

4. The operation should reconstruct the lip so that the lower third curves outwards, so that the lip is sufficiently wide horizontally and is of the same length on both sides and so that the Cupid's bow is symmetrical.

These features should be maintained in changes in facial expression and during growth.

Flexible schemes have been elaborated for Le Mesurier's and Tennison's operations. The basis of measurement is the height of the normal half of the lip and individual distances are related to fixed anatomical boundaries. In the case of Le Mesurier's principle the author adhered to the suggestions of Steffensen and Breuer and in Tennison's principle to those of Marcks, Hagerty and Randall. When planning the operation a pen and compass are at first essential, but when sufficient experience has been obtained the compass can be dispensed with. Details of how to plan the operation are given in the diagrams.

COMPARISON OF THE TWO OPERATIONS

In Le Mesurier's operation, a right-angled flap is formed on the lateral side of the cleft. This is rotated medially and is sutured on the medial side to the Cupid's bow.



Fig. 6a.



Fig. 6b.



Fig. 6c.

Fig. 5, 6. Result after Tennison's operation. Central part of Cupid's bow preserved.



Fig. 7a.



Fig. 7b.

Total cleft operated according to Tennison.



Fig. 8a.



Fig. 8b.

Total cleft operated according to Tennison, lateral view.



Fig. 9a.



Fig. 9b.

Fig. 9. Total unilateral cleft operated according to Tennison.

In Tennison's operation, a triangular flap is formed on the lateral side of the cleft and is sutured into an incision on the normal side. Thanks to Cardoso and Marcks and, independently of these, to Millard, surgeons realized that the whole medial segment of the Cupid's bow is always developed and that a complete Cupid's bow can be reconstructed. In V excision of the type of Mirault's, Brown's and McDowell's operation and in operations of the Le Mesurier type, half the medial segment is destroyed, while in Tennison's operation, as modified by Marcks, Hagerty and Randall, and in Millard's operation it is preserved and is used in the reconstruction of a complete Cupid's bow with two points and a central groove.

With Le Mesurier's technique, the lower vertical suture is in the middle of the lip, where it cuts across the groove between the two points of the medial part of the Cupid's bow. The whole half of the medial segment of the Cupid's bow on the side the cleft should be reconstructed so as to make it symmetrical with the normal side. Theoretically, this can be achieved by altering the width of the base of the right-angled flap, but in actual fact it is difficult to achieve and maintain. Tennison's operation preserves what Le Mesurier's operation tries to reconstruct.

Another important difference is that tissue losses in Le Mesurier's operation are greater on both sides than in Tennison's operation, i. e. after the operation the lip is shorter horizontally than after Tennison's operation. Since the cleft lies lateral to the midline, it is more logical to keep the operation lateral rather than to shift the flap into the midline. Since the defect formed by the incision in the medial part of the cleft is triangular in both operations, it is more logical to use a triangular flap rather than a right-angled flap.

Tennison's operation is simple and ingeniously applies the basic principles for the given possibilities. The cleft half of the lip is shortened vertically and the vermillion is displaced upwards. The shortness on the medial side of the cleft is corrected by an incision in the filtrum, permitting replacement of the displaced

vermilion and lengthening the lip. The Cupid's bow is preserved, since the incision starts from a point at exactly the same distance from the middle of the groove as on the normal side. The resultant triangular defect is filled in with a triangular flap from the lateral element, thus making good use of the very tissue which is sacrificed in Le Mesurier's method and in V excision. On the lateral side of the cleft the lip also develops vertically, as a result of incisions which finally produce a Z-shaped, not a linear, scar.

THE AUTHOR'S OWN EXPERIENCES

The author has so far performed 140 flap operations for incomplete and complete unilateral hare-lip.

The results of V excision were not satisfactory and from the end of 1956 Le Mesurier's operation was used for unilateral hare-lip. The results were decidedly better than those of V excision. The lower third of the lip was wider and curved outwards and the step-shaped scar did not hypertrophy or draw up the vermilion. This operation was performed on 60 patients.

Detailed study of Tennison's principle, as modified by Marcks, Hagerty and Randall, showed that it represented yet another step forward. On giving it a trial in 1958, the author found that it had other advantages in addition to greater technical simplicity. It keeps lateral to the midline, the triangular defect is filled in with a triangular flap, tissue losses on both sides are smaller and — most important of all — the valuable piece of vermilion lateral to the centre of the groove in the middle segment of the Cupid's bow, which is sacrificed in Le Mesurier's operation, is preserved. The lower edge of the lip is wider than after Le Mesurier's operation, the lip curves outwards and the middle segment of the Cupid's bow remains intact, i. e. with two points and grooves.

This operation has so far been performed on 80 patients. Le Mesurier's method has been reserved for secondary correction of V excisions, in which half the middle segment of the Cupid's bow is usually destroyed on the side with the cleft. In these cases an attempt to achieve symmetry is made by making the base of the right-angled flap slightly narrower than the free end. This also gives a symmetrical Cupid's bow, but the symmetry may be spoilt by contraction of the scars and hypertrophy of the right-angled flap, which is rotated from an almost vertical position into a horizontal position and is drawn over to the midline, and whose pedicle is narrower than its free end.

SUMMARY

On the basis of 140 flap operations for complete and incomplete unilateral hare-lip, in 60 of which Le Mesurier's operation and in 80 Tennison's operation was performed, the method of choice in the author's clinic today is Tennison's operation. Le Mesurier's operation is reserved for secondary correction of V excisions.

R É S U M É

Opération de la fissure unilatérale de la voûte palatine, à l'aide d'un lambeau

Š. Demjén

Après des expériences faites à l'occasion de 140 opérations de fissures unilatérales de la voûte palatine, totales ou partielles, dont 60 ont été exécutées d'après la méthode de Le Mesurier et 80 d'après celle de Tennison, nous préférons aujourd'hui, dans notre service, celle de Tennison. La méthode d'après Le Mesurier est réservée aux corrections secondaires dans l'excision.

Z U S A M M E N F A S S U N G

Lappenoperationen bei einseitiger Lippenspalte

Š. Demjén

Auf Grund der Erfahrungen mit 140 Lappenoperationen einseitiger unvollständiger sowie vollständiger Lippenspalten, von denen 60 nach der Methode Le Mesuriers und 80 nach der Methode Tennisons operiert worden waren, ist an der Klinik des Verfassers das Vorgehen nach Tennison die Methode der Wahl geworden. Das Vorgehen nach Le Mesurier wird für sekundäre Korrekturen mittels der V-Exzision vorbehalten.

R E S U M E N

Las operaciones de lóbulo de la fisura del labio unilateral

Š. Demjén

A base de las experiencias con 140 operaciones de lóbulo de las fisuras unilaterales completas desde cuales 60 pacientes fueron operados según el método de Le Mesurier y 80 según el método de Tennison nuestro lugar de trabajo ha decidido de emplear el método de Tennison. El método de Le Mesurier se emplea en las correcciones secundarias de las V excisiones.

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EXPERIMENTS WITH TRANSPLANTATION OF SKIN AND SMALL-INTESTINE GRAFTS

Y. V. BERINGER, A. A. ZYKOV, L. S. PRIYEZHEVA

A great many studies have been dedicated to the problems of the temporary coverage of large burned surfaces with skin homotransplants. The efficacy of this method in the prevention of shock due to the loss of plasma and of infection has been confirmed by many clinical observations (Petrov, Yablonsky, Ginzburg, Vilyavin and others). The wider application of homoplastic methods in the treatment of burns has, nevertheless, been hampered due to the technical difficulties in procuring sufficient skin from human cadavers. This gave the impetus to a search for new full-value substitutes of homogenous skin. The use of skin or other tissue from animals seemed the simplest solution of the problem. Experiments with transplantation of heterogenous skin have been known for a long time but have not led to wider usage because the results were too unsatisfactory. Due to the tissue incompatibility between the donor and the recipient the transplanted skin did not take and, up to the present, the problem of changing the immunological properties of tissues and of lowering their antigenic qualities has remained unsolved. This is why only few papers deal with heterotransplantation of skin, among them those of Mordovsky dealing with homo- and heterotransplantation of skin in rabbits and Chernomordik who used conserved skin from cow udders and skin from horned cattle for the treatment of trophic ulcers on the lower extremities. As is known from the literature, tissues of human and bovine embryos possess but slight antigenic properties in the first months of intrauterine life. This was the reason for research into their defensive properties first in experiments, later also clinically. In 1951, Rogers employed skin of bovine embryos for the treatment of burns. According to this author, the transplant was absorbed after two weeks, but by that time the wound was already covered with healthy granulations, and at the wound edges active epithelization could be observed. Later, Rogers, Converse and Silvetti published good results with the treatment of burns after transplantation of heterogenous foetal skin. Evidence of sensitization was not found in these patients.

The suggestion of using other tissues for substituting homogenous skin, are of clinical interest. These include conserved peritoneum of horned cattle (Kuz-

netsov, Khokhlov and Shilayeva) and tissue from the small intestine of human cadavers. The possibility of these tissues being used for the coverage of large wound surfaces was studied first in experiments, and later also clinically (Beringer and Zykov).

The authors' interest was awakened by the possibility of obtaining large amounts of human intestinal tissue and foetal skin of horned cattle. Intestinal tissue actually proved useful and can be taken from the majority of cadavers. From one corpse 3,500 to 4,000 cm² of tissue can be obtained which represents about 25% of the body surface of man. The supply of foetal skin should, also meet with no great difficulties considering the mass slaughter of cattle.

The authors decided to verify the results obtained hitherto by experiments with rabbits and test these tissues, i.e. the foetal skin of horned cattle, skin and small intestine of human cadavers, with regard to their providing an effective coverage for large wound surfaces. For comparison additional experiments were carried out covering defects with the skin of dogs. Both fresh and conserved grafts were used. A total of 60 experiments were completed.

METHOD

Pieces of shaven skin are taken aseptically from the bodies of dogs one to two hours after death; the subcutaneous tissue of the transplant is removed afterwards. The skin of bovine embryos is taken in the following way: the amniotic sac is painted twice with tincture of iodine where the incision is to be made, after opening the sac the embryo is extracted and the skin of its back and belly removed aseptically. The small-intestine grafts are taken from human cadavers not later than six hours after death and then processed by the authors' own method.**

The grafts are stored in the following solutions: No 1 (recommended by Beringer and Zykov), 31-E and 31-Zh (Belyakov) for 6 to 14 weeks.

Under local anaesthesia with 0.25% novocain solution a piece of skin corresponding in size to 25% of body surface, was excised from the back of rabbit and the defect covered by a conserved heterotransplant fixed by an interrupted suture. The graft was then covered with a dressing containing a streptocidal ointment.

At the end of the first week after implantation of the skin heterotransplant, signs of desiccation, loss of elasticity and a change in colour, were observed. The transplant turned dark and the edges began to wrinkle.

It must be noted that the heterotransplant lay close to the wound surface and did not provoke any inflammatory reaction in the surrounding tissue. The gradual desiccation of the graft then caused its wrinkling and separation from the bed of the wound. For the duration of four to five weeks, however, the graft provided good protection for the wound surface. Loss of plasma was never observed and infection developed only in rare cases. During the first week the general condition of the rabbits did not show any particular change. Later, however, the rabbits began to take food badly, lost a great deal of weight, and

**] Vestnik Khirurgii imeni Grekova V. 4, 1961.

Tab. 1. Results of Complement-fixation. Reactions between the Sera of Experimental Animals and the Extracts of Transplanted Tissues.

Number of animals	Material used for transplantation		Prior to transplantation	Weeks after transplantation			
				1	2	3	4
				Titre of antibodies at which complete complement-fixation took place			
3	Canine skin	non-conserved	—	1:16—1:64	1:16—1:64	1:64	1:16—1:64
1		conserved in solution 31-E for 6 weeks	—	1:16	1:16	1:64	1:128
1		lyophilized	—	1:4	1:4	1:128	1:128
3	Bovine foetal skin	non-conserved	—	1:4—1:64	1:64—1:256	1:16—1:64	1:16
2		conserved in solution 31-E for 15 weeks	—	1:16	1:16—1:128	1:16—1:128	
2		conserved in solution BZ-1 for 12 weeks	—		1:128	1:64	1:64
3	Human intestine	non-conserved	—	1:64—1:128	1:128	1:64—1:128	1:16—1:64
4		conserved in solution 31-E for 10—60 days	—	1:32	1:32—1:64	1:32	1:32—1:64
5	Human skin	conserved in solution 31-E for 6—32 weeks	—	1:64—1:128	1:32—1:128	1:32—1:64	1:64—1:256
5	Controls with Blood sera of	man	—	—	—	—	—
5		dog	—	—	—	—	—
7		horned cattle	—	—	—	—	—

their fur fell out over a large area, particularly around the wound. In most rabbits these changes progressed, causing death in half of them. In the surviving rabbits the grafts separated first at the edges, later even in the centre. At that time the wounds had grown considerably smaller, were covered with healthy granulations, and were gradually replaced by a scar.

The experiments with skin of bovine embryos were carried out by the same method. The appearance of the grafts did not change much during the first week. They preserved their elasticity and firmness and remained in close contact with the wound surface. At the beginning of the second week gradual desiccation, darkening and wrinkling could be noticed. For three to four weeks the transplants well fulfilled their protective function; after that time elimination started.

The rabbits did not show any marked allergic reaction to the skin of bovine embryos which could be registered by loss of hair, a marked loss of weight and progressive cachexia as when using dog skin and which frequently led to the death of the rabbit. Although also registered, these changes were much milder with the exception of two rabbits which showed evident sensitization. Only one of the ten rabbits died. The further course of healing proceeded in the same way as had been observed after transplantation of dog skin. In two rabbits (No 7 and 21) the transplant did not separate, but underwent colliquation at an earlier stage, i. e. within two weeks.

Summing up the results of their experiments with transplantation of bovine foetal skin, the authors came to the conclusion that the allergic reaction in rabbits was evidently smaller here than after transplantation of canine skin. Foetal skin, however, is not totally void of antigenic properties.

The small-intestine grafts were applied with the serosa towards the wound and fixed there by sutures. Suppuration and other local inflammatory signs were not noted. Desiccation started after 10 to 15 days, but separation began at the end of the fourth week and both desiccation and marginal wrinkling facilitated diminution of the wound surface.

It must be stressed that in these rabbits no loss of weight could be observed. They took food well, did not lose hair, nor did they show any other signs of an allergic reaction.

All the above data are concerned with the transplantation of conserved grafts. Freshly prepared skin grafts of whatever specific source, underwent moist necrosis on the first days after transplantation leading to gradual colliquation which provoked severe signs of intoxication eventually causing death of the animal.

In the second part of this work the authors studied the immunological reactions of experimental animals to the transplanted tissues, because this problem has not yet been sufficiently elucidated in the literature.

The only paper in this direction seems to be the study of Kucherenko (1935) dealing with the changes of immunological properties in the serum of the recipient after heterotransplantation of skin, using the complement-fixation reaction. This author ascertained that after transplantation of the skin of man, mouse or guinea pig to rabbits, specific antibodies can be detected in their blood. The drop in the specific fixation titre coincides with the clinical signs of necrosis of the transplant. The antibody titre was comparatively low, 1:10 to 1:40. Simultaneously the authors studied the influence of conservation on the antigenic properties of tissues.

The data on the influence of conservation on the antigenic properties of tissues, as referred to in the literature, are controversial. Khvorostukhin (1958), Golovin (1956) and Krakovsky (1959) maintain that conserving decreases or even destroys the antigenic properties of tissues. Other authors point out that vessels preserve their antigenic properties after lyophilization (Bilenko, Kapichnikov 1957). According to Priyezzheva (1957, 1959, 1961) the antigenic properties of skin lyophilized by deep freezing at -183°C and stored at -25°C are preserved for 16 months; when stored in a fluid medium (solution 31-E, 31-Zh) even up to 17 months.

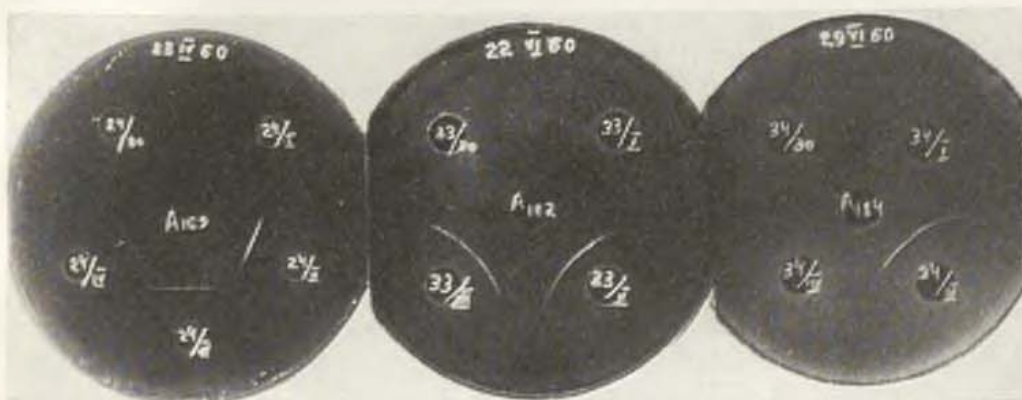


Fig. 1a.

Fig. 1b.

Fig. 1c.

Fig. 1 a, b, c. Counterdiffusion reaction in agar. The reaction periods of precipitation testify to the fact that towards the second week after transplantation of heterogenous tissues, antibodies appear in the serum of animals. — Fig. 1a. 24/p-serum of rabbit No 24 prior to operation; 24/I, II, III, IV-sera of the same rabbit one, two, three and four weeks after transplantation of bovine foetal skin conserved in Beringer-Zykov solution No 1 for three months; 169 A-extract from transplanted skin. — Fig. 1b. 33/p-serum of rabbit No 33 prior to operation; 33/I, II, III, IV-sera of the same rabbit one, two, three and four weeks after transplantation of human skin conserved in solution 31-E for ten days; 182 A-extract from transplanted skin. — Fig. 1c. 34/p-serum of rabbit No 34 prior to operation; 34/I, II, III, IV-sera of the same rabbit one, two, three and four weeks after transplantation of intestinal tissue conserved for 32 weeks; 184 A-extract from transplanted tissue.

To study immunological processes, the authors transplanted both freshly prepared and conserved skin grafts (of a single donor) to rabbits, the size of which corresponded to 12–15% of the recipient's body surface: The immunological reactions after transplantation of human, canine and bovine foetal skin and of conserved intestine taken from human cadavers, were studied.

The sera of rabbits, in which heterotransplantation had been performed, were studied with the aid of the complement-fixation reaction and immunoprecipitation in agar. The sera of the experimental animals taken prior to and 7, 14, 21, 28 and 35 days after transplantation served as antisera. Water-salt extracts from tissues used for the transplantation and human, bovine and canine sera, served as antigens. These sera were used as non-specific antigens and

only for the complement-fixation reaction. The water-salt extracts were prepared aseptically with physiological saline in a ratio of 1:5.

Immunoprecipitation was tested with 1.5% agar solution prepared with a phosphate buffer of a ion concentration of 0.1 and pH of 7.5.

Experimental method: a 1 cm. layer of agar is poured on the floor of a Petri dish and after setting, holes are made in it and two drops of fluid agar, antigen and antiserum inserted.

As a result of this investigation, antibody complement-fixation reactions against all tissues used for transplantation, were detected (see Table). At the same time, it was found that conserved tissues evoked a reaction corresponding to the formation of complement-fixation antibodies, at first somewhat less intensive than that of non-conserved tissue; towards the second week, however, the titre of antibodies reached the same level as when fresh tissues were used. This apparently explains why conserved tissues behave rather inertly as opposed to fresh, living tissue, but they later act as a sort of antibody deposit.

It was found that the most marked immunological reaction in rabbits was provoked with conserved human intestine; in this case the titre of antibodies reached 1:256. It may be assumed that the method of conservation of intestinal tissue in potent antiseptics deprives the tissue of its toxic properties by killing the microbes, but that the antigenic properties of bacteria are preserved, and these, as additional irritants, intensify the formation of antibodies.

That the detected antibodies are specific was verified by the negative results of the complement-fixation reaction where human, canine and bovine sera were used as antibodies, and the serum of rabbits to which tissue of man, dog and horned cattle had been transplanted, served respectively as antiserum. Apart from this, the titre of the complement fixing antibodies rose and dropped gradually. In all instances precipitins were detected (Fig. 1a, b, c). They also manifest themselves in the reaction against the donor sera. Precipitins, as a rule, appeared towards the second week after transplantation and disappeared towards the fourth or fifth week.

The authors are of the opinion that the problem as to whether the use of bovine foetal skin is, at all admissible, deserves special attention. In the above experiments both conserved and non-conserved skin of horned cattle embryos produced sensitization of the recipient. This fact is of special importance since in surgical practice it happens that large defects (e.g. after burns) are covered with skin grafts, while, at the same time, large quantities of plasma substituting solutions prepared from heterogenous blood are infused.

The author's observations do not yet give an answer to the question about the intensity and duration of the state of sensitization of the recipient. This requires further investigation which is at present being carried out in the Lenin-grad Institute of Blood Transfusion.

CONCLUSION

1. As a result of the above experiments the authors ascertained that transplantation of intestinal tissue is to be preferred to any other here used tissues

because it provides a good temporary cover of large wound surfaces and does not produce any marked allergic changes.

2. Immunological investigations showed that all grafts used provoked sensitization of the experimental animals.

3. Heterogenous skin, even that of bovine embryos, should be used with caution in clinical practice because of the possible sensitization of the patient, and, therefore, homogenous tissue is to be preferred.

SUMMARY

In experiments in rabbits, the authors studied the efficacy of transplants both freshly prepared and conserved in various fluid media for the temporary coverage of large wound surfaces. They used skin and small-intestine grafts of human cadavers, horned cattle embryos and dogs. At the same time the immunological reaction of the experimental animals to the transplanted grafts were verified.

It is the authors' opinion that all tissues used in these experiments provoked sensitization of the animals, but allergic signs after the use of intestinal grafts are less marked.

RÉSUMÉ

Expériences faites avec la transplantation de greffons cutanés et de l'intestin grêle

Y. V. Beringer, A. A. Zykov, L. S. Prijezzheva

Par des expériences faites sur des lapins, les auteurs ont étudié l'efficacité des implants, aussi bien à l'état frais que conservés dans de divers liquides, pour la couverture temporaire de plaies d'une surface étendue. Ils ont utilisé des greffons cutanés et de l'intestin grêle, de provenance de cadavres humains et d'embryons de bêtes à cornes ou de chiens. En même temps, les réactions immunologiques des animaux d'expérience vis-à-vis ces greffons implantés ont été vérifiées.

D'après l'avis des auteurs, tous les tissus utilisés dans ces expériences provoquent une sensibilisation des animaux, mais les symptômes allergiques étaient les moins marqués après application de greffons intestinaux.

ZUSAMMENFASSUNG

Die Übertragung von Haut- und Dünndarmheterotransplantaten im Experiment

Ju. W. Beringer, A. A. Sykow, L. S. Prijessheva

1. Die Resultate der durchgeführten Versuche ergaben, dass die Übertragung von Darmtransplantaten der Transplantation anderer Gewebe überlegen war, was auf einen wirksamen Schutz grosser Wundflächen für eine bestimmte Zeitspanne und auf das Fehlen markanter allergischer Phänomene zurückzuführen ist.

2. Die immunologischen Untersuchungen erwiesen, dass alle von den Verfassern verwendeten Transplantate eine Sensibilisierung der Versuchstiere hervorriefen.

3. Hautheterotransplantate einschliesslich der Haut von Rinderembryonen sind in der klinischen Praxis mit Vorsicht zu verwenden, da eine Sensibilisierung des Patienten auftreten kann, weshalb der Verwendung von Homotransplantaten der Vorrang zu geben ist.

RESUMEN

Los experimentos con la transplatación de la piel y de los pequeños injertos de piel intestinales

Y. V. Beringer, A. A. Zykov, L. S. Priyetzheva

Durante los experimentos con los conejos los autores estudiaban la eficacia de los transplantates recién preparados tanto como los trasplantes conservados en diferentes medios líquidos designados para cubrir provisoriamente extensas superficies heridas. Ellos usaban los injertos de piel y los de pequeños intestinos tomados de los cadáveres humanos, de los embriones de cuernos del ganado y los de los perros. Simultáneamente la reacción inmunológica de los animales experimentales en relación con los injertos transplantados fue verificada.

Los autores suponen que todos los tejidos empleados en estos experimentos provocaron la sensibilización de los animales pero los síntomas alérgicos después del empleo de los injertos intestinales no están tan acentuados.

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ELECTRICAL PROPERTIES OF SKIN IN PATIENTS WITH BURNS

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Electrodiagnosis of pathological skin conditions in burns is a method in its very beginnings. This report is intended to give a summary of the knowledge collected so far and to point out further possibilities for research in the biophysical properties of the skin. The authors base their experience mainly on the results obtained in their own laboratory, because hitherto relatively little work has been done on these lines (Dennis, Telfer 1958).

Electrodiagnosis of the skin offers roughly the following possibilities: 1. to assess the damage to the epidermis both qualitatively and quantitatively, even if it is only submicroscopic or functional; 2. to assess the irritability, and thus also the viability of preserved or regenerating epidermal cells; 3. to find the criterion of the metabolic function of normal, undamaged epidermis; 4. from the experience obtained so far it is not possible to ascertain the condition of the deeper layers, i.e. the dermis and subcutis.

The biophysical basis of these features lies in the epidermis functioning as a barrier. The epidermis is a typical example of a biological barrier to the transport of substances, energy and also of information. It was mainly due to research in the electrophysical properties of the skin (Suchi 1955) that we obtained more accurate information about the localization of this barrier. It consists of a 10 μ thick layer within the deepest parts of the *stratum corneum*, i.e. on the border between the still viable and already cornified epidermal cells. The exact character of this layer still remains to be determined, but its role as electric insulator and barrier to the transport of particles, electrolytes or non-electrolytes, water, liposoluble substances, and as energy barrier, has been documented unanimously by a number of authors. From this it follows that in the case of damage to the epidermis, electrical measurements, in particular, will enable us to detect the damage, characterize its quantity and follow up its repair.

For this purpose the authors have elaborated a method called phoreography based on the measurement of the electrical properties of the tissue, i.e. its ohmic resistance, capacity, character of conductivity, electrical irritability, the direct current potential difference and the hysteresis of conduction. All these qualities are in relationship to the barrier function of the epidermis whose detailed interpretation has been the subject of another report (Kryšpín 1962).

Measurements are carried out in the following way: several pairs of non-polarizable electrodes are connected either with pathologically altered or normal skin by a conductive paste and fixed there with adhesive tape. Almost every time, bipolar electrodes 2 cm. apart are used. The electrode pairs are placed either on corresponding skin areas or, if the irritability of the epidermis is to be registered, two pairs are applied close to each other. For measuring, the "Prema" phoreometer is used making automatic registration of a number of functions possible. The irritability of the epidermis can be ascertained either from the parameters of the phoreogram — or through mechanical irritation caused by the peeling-off of five epidermal layers with the help of adhesive cellophane tape. This forcible stripping, carried out within 10 to 15 seconds, causes irritation of the epidermis which has a characteristic course in time and space.

RESULTS

1. Normal values: The human epidermis can be characterized by a number of parameters. The absolute values of ohmic resistance depend on a large number of factors (thickness of epidermis, age, hydration of skin, skin temperature, etc.) and is, therefore, not decisive by itself for the appraisal of normality. As will be shown below, the absolute values can be the same in normal and in pathologically altered skin. The normal skin, however, is also characterized by the values of electrical and mechanical irritability, the type of conduction, the hysteresis and the reactance.

2. In skin damaged by heat, several types of changes can be found:

a) In erythema and oedema of the skin without damage to the epidermis, a decrease in resistance values and an almost linear type of conductivity can be observed.

b) With the development of blisters the continuity of the epidermal barrier is for the most part already disrupted and the ohmic resistance drops sharply; the type of conductivity is linear and hysteresis has disappeared. In spite of this, however, it is possible that some kind of blisters remain covered by an absolutely intact barrier with high ohmic resistance. These conditions require further study.

c) Unexpected findings were made in the healthy skin of patients with burns. During the period in which the general condition of the patients was still unbalanced, the authors studied epidermal irritability by peeling-off the epidermal layers according to Wolf. In most patients an interesting deviation was found: Contrary to expectation, the ohmic resistance of the skin after stripping, instead of falling, rose, sometimes even quite considerably (Table 1).

In the following, the first parameters of the above method of investigating the skin irritability in normal and pathological conditions are given. The values of changes after this type of irritation are summarized in table 1. which is mainly concerned with the magnitude of relative changes at the site of stripping and its surroundings and with the time characterization of these changes. Based on these results the authors point out that normal epidermis and epidermis spontaneously regenerated after burns predominantly reacts with a drop in ohmic

Tab. 1.

Current $1 \mu A$	Initial resistance $\cdot 10^6 \text{ Ohm}$	Relative changes					
		at rest		of stripped site		of sites in surroundings	
		%	half-time min.	%	half-time min.	%	half-time min.
Normal skin $n = 10$	1.066 (0.434—2.908)	+14.0(4) —41.0(5)	16.3 13.8	+21.5(2) —57.8(5)	1.5 1.4	+3.5(2) —16.6(7)	5.9
Spont. epithelized sites after burns $n = 6$	1.170 (0.360—2.120)	+20.3(3) —15.7(3)	10.5 12.9	—91.0(6)	1.2	—13.5(6)	4.2
Skin change following X-ray irradiation $n = 4$	1.293 (0.150—2.507)	+15.6(3) —15.0(1)	7.8 22.5	+174.0(1) —66.0(3)	2.3	+19.0(3) —69.0(1)	3.8
Acne $n = 1$	0.162	+73.0	27.5	+527.0	1.0	+32.0	3.0

Mean values of ohmic resistance of skin in megaohms per cm^2 are given in column 1. Figures in brackets are the highest and lowest values measured. Normal and pathologically altered skin was measured at 5 sites in each subject (n = number of subjects). Column 2 (relative change at rest) shows the change in resistance in percent of initial value up to attainment of steady state. Column 3 shows half-time of this change. Column 4 shows relative change after stripping off 5 epidermal layers in percent of steady-state value [figure in bracket represents number of patients in whom this change was observed]. Values plus (+) and minus (—) represent average of all relative values of increase or decrease.

resistance which spreads into the surroundings of the irritated site, whereas epidermis under pathological conditions reacts, in a number of cases, with a steep rise in ohmic resistance which also spreads into the surroundings, but with a somewhat shorter half-time than in normal skin.

DISCUSSION

In explanation of these findings it can be said at present that two main factors play a part in effecting the changes in ohmic resistance and other electrical properties of the skin: 1. The first is the change in geometrical relations (thinning of epidermis, mechanical tears, etc.). 2. The second are changes in the mobility of electric current carriers within the tissue which the authors assume to depend on a metabolic supply of energy. Where it is possible to control and eliminate the first factor, the change in the electrical properties of the skin can only be the expression of a metabolically conditioned

change in the energy situation within the tissue. In some pathological conditions where the ohmic resistance was found to rise, it may be assumed that the impulse, which usually evokes a drop in resistance spreading into the surroundings, causes under pathological conditions a further relative shortage of energy needed for the transport processes within the tissue, manifesting itself by a rise in resistance. This rise, too, spreads into the surrounding tissue which bears witness to the fact that in both instances other metabolic or humoral factors which are capable of propagation into tissue not itself directly irritated play their part. This finding is, for the time being, unique in the pathophysiology of the skin (Rothman 1954) and points to the probable mechanism of a number of pathological processes in the skin, particularly when damaged by trauma.

These findings do not belong to the group of the so-called axon reflexes, because the vascular changes evoked by this irritation, which are usually taken for manifestations of an axon reflex, show a different course in quality and time, as was demonstrated in a previous paper (Kryšpín, Skála, Paleček 1960).

S U M M A R Y

Electrophysiology of the skin is a reliable diagnostic method which permits quantitative evaluation not only of the macroscopic changes in the burned skin, but also of the metabolic disorders occurring in the apparently quite normal skin of patients with burns. Up to the present the authors have only attempted to indicate some values which have been verified in a sufficiently large number of controls and patients. Basically these studies were only carried out in order to investigate the course which research of pathophysiology of the skin following injury by burns, should take. The authors are concentrating their attention on the interpretation of the rise in ohmic resistance following irritation under pathological conditions, including conditions following injury by burns, because they assume this rise to be a metabolically conditioned change whose elucidation will contribute not only to an improvement in diagnosis but also in the treatment of burns sickness.

R É S U M É

Les qualités électriques de la peau des brûlés

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L'électrophysiologie de la peau est une méthode diagnostique de confiance, permettant non seulement l'estimation quantitative des changements macroscopiques de la peau brûlée, mais de même des lésions métaboliques dans la peau d'aspect sain des malades brûlés. Pour le moment, nous nous contentons de citer quelques données confirmées par un nombre valable des contrôles ainsi que des malades. L'essentiel, c'est l'exploration des possibilités des recherches de la pathophysiology de la peau chez les brûlés. Nous-mêmes, nous tâchons d'interpréter l'augmentation de la résistance suivant l'irritation dans des états anormaux — tels que les brûlures — car nous sommes d'avis qu'il s'agit d'un changement ayant pour cause les lésions métaboliques dont l'explication pouvait améliorer non seulement le diagnostic, mais de même la thérapeutique de la maladie des brûlés.

ZUSAMMENFASSUNG

Die elektrophysiologischen Eigenschaften der Haut bei Verbrennungen

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Die Elektrophysiologie der Haut bietet uns eine zuverlässige diagnostische Untersuchungsmethode, die es gestattet, nicht nur die makroskopischen Veränderungen bei Verbrennungen der Haut, sondern auch die metabolischen Störungen in der scheinbar völlig normalen Haut dieser Patienten quantitativ zu erfassen. In der vorliegenden Arbeit wollen die Verfasser inzwischen auf einige Untersuchungsergebnisse hinweisen, die bereits an einem grösseren Krankengut sowie in einer grösseren Kontrollreihe beglaubigt worden sind. Im Grunde handelt es sich hier vorerst darum, ausfindig zu machen, welche Richtung die Erforschung der Hautpathophysiologie bei Verbrennungen einzuschlagen hätte. Die Verfasser selbst befassen sich hauptsächlich damit, den Anstieg des Hautwiderstandes nach Reizung bei pathologischen Zuständen, darunter auch bei Verbrennungen, zu interpretieren, da sie der Ansicht sind, dass diese Veränderung metabolisch bedingt ist und dass ihre Klarstellung nicht nur zur Verbesserung der Diagnostik, sondern auch zur Erhöhung der Wirksamkeit der Therapie der Verbrennungskrankheit beitragen kann.

RESUMEN

Las cualidades electrofisiologicas de la piel en los pacientes con quemaduras

J. Kryšpín, J. Skála, Z. Harantová y la ayudante técnica
J. Růžicková

Electrofisiología de la piel es un método diagnóstico seguro que permite hacer una evaluación cuantitativa no solamente de los cambios macroscópicos dentro la piel quemada sino también de los desórdenes metabólicos que se encuentran en la piel de los enfermos con quemaduras al parecer normal. Hasta ahora los autores han tratado de indicar algunos valores los que han sido verificado en un número de controles y pacientes suficientemente alto. Fundamentalmente estos estudios se efectuaron solamente con el motivo de investigar el curso que tuviera que adoptar la patofisiología de la piel lesionado por quemaduras. Los autores están ocupándose de la interpretación de la elevación en la resistencia óhmica siguiendo irritación bajo condiciones patológicas, entre otras, también las condiciones provocadas por lesiones causadas por quemaduras porque ellos toman esta elevación por un cambio condicionado del aspecto metabólico cuya elucidación va a contribuir no solamente a un mejoramiento en diagnosis sino también en el tratamiento de quemaduras.

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THE PROPOSED USE OF TETRACYCLINE ANTIBIOTICS FOR THE EVALUATION OF THE DEGREE OF BURNS

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The need for a method which would make it possible to distinguish the various degrees of burns during the numerous stages following injury is generally recognised. From a practical point of view it is most important to distinguish third degree burns from deep second degree ones, i.e. completely destroyed tissues from tissues capable of a certain degree of reparation. This need is reflected in the numerous methods put forward in the literature from the earliest to the most recent. The large number of proposed methods is not only evidence of their need but also of the difficulties encountered in establishing a suitable one.

Amongst the existing methods special importance is attached to those which utilize the changes in the distribution of some substances within the burned skin following their introduction into the blood circulation. For this purpose Dingwall (1943) made use of fluorescein (2 % solution) injected into the vein in a quantity of 10 ml. Cope, Langohr, Moore and Webster (1947) administered Evans' blue intravenously while Gouliau (1961), Bennet and Dingman (1957) employed radioactive phosphorus (^{32}P) to the same end. The common principle of all these methods lies in the evaluation of changes in the distribution of the injected substances at the site of the burns even though they vary in the procedures whereby the evaluation is carried out. In the case of Evans' blue, simple reading in daylight is sufficient, fluorescein requires a source of ultraviolet radiation and the method of Bennett and Dingman depends on the use of radioactive techniques. Another feature common to all these methods is that they actually evaluate changes in the blood supply, whether positive or negative.

The method put forward here by the present authors, though based on the methods referred to above, makes use of substances which have not been employed for this purpose hitherto. These substances are tetracycline antibiotics (TA). In numerous experiments the present authors have investigated the properties of these antibiotics in relation to pathologically changed tissues. They found that numerous pathological processes not only lead to changes in the permeation of TA but also present a feature which is very characteristic of these

antibiotics, that is their long-term fixation. Thus TA are retained for long periods in necrosis of the pancreas [Málek and Kolc 1960], ischaemic myocardial infarction [Málek, Zástava et al. 1961, 1962] and kidney rendered temporarily ischaemic [Málek, Kolc et al. 1961, 1962]. In previous communications attention was preliminarily drawn to the fact that the burned skin of the rabbit may also

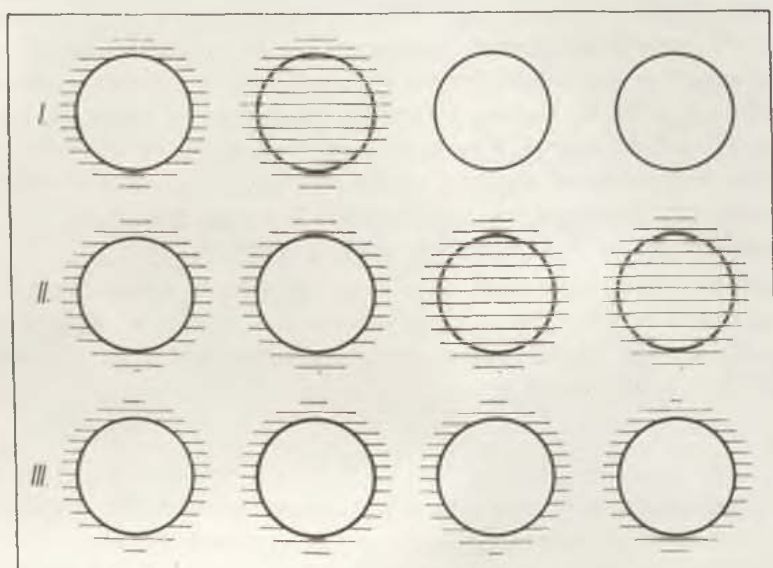


Fig. 1. Scheme of the dynamics of permeation and retention of chlortetracycline in burns of various degrees (I, II, III.) at different time intervals.

retain TA [Málek, Kolc et al. 1961, Málek 1962]. In all the processes investigated it was shown that the dynamics of permeation and retention of TA in pathological tissues reveal a borderline between healthy and damaged tissue. These properties of TA, just as their simple identification by means of golden-yellow fluorescence in ultraviolet light, pointed to the possibility of utilizing them in distinguishing various degrees of burns.

The aim of the present work was to ascertain whether the foregoing assumptions were correct. A simple experimental model was set up to reveal the dynamics of the process, and preliminary clinical observation was to establish whether the proposed method was practicable.

METHODS AND MATERIAL

In the experiments Chinchilla rabbits weighing approximately 2 kg. were used. The depilated skin on the back of the rabbits was burned by a specially devised apparatus. The main feature of this device was a metal plate, 1 cm in diameter, which could be heated to a certain temperature. In an effort to approximate to the pathology of burns of the human skin varying degrees of

temperature of the plate and varying durations of its contact with the skin had been tried out before the experiment proper. The authors succeeded in defining three clear-cut degrees which, of course, are not directly related to burns of the human skin. The temperature of the plate in producing a first degree burn was 57° C, in second and third degree burns 120° C, the duration of its apposition to the skin was 27, 10 and 30 secs. respectively.

Immediately after the burns were produced single doses of chlortetracycline (Aureomycoin) were administered intravenously in quantities of 20 mg/kg of weight. Following the administration of the antibiotic the fluorescence in ultra-violet light was studied at various intervals (immediately, after 15, 60 and 120 minutes and 24 and 48 hours). The wounds were thereafter excised, unstained sections of the tissues were procured in the freezing microtome or cryostat and examined under the fluorescence microscope (Zetopan, Reichert). The parallel sections were treated by the usual histological methods.

In the clinical part of the study 4 patients were given Aureomycoin in single doses or repeatedly in prolonged intravenous infusion (500 mg.) at various stages after the burn and the burns themselves were investigated at the end of the infusion and then after 18—24 hours.

RESULTS

In the experimental part characteristic changes were noted in the dynamics of the circulation of chlortetracycline in the damaged tissues. The changes manifested themselves not only by an altered permeation of the antibiotic into the burn lesion but also by its retention in the damaged tissue. The dynamics of the permeation as well as the retention were specific for the various degrees of the injury, as is illustrated schematically in Fig. 1. The picture of fluorescence at early time intervals after the administration (up to 15 mins) was alike in all the degrees, presenting a fluorescing edge around the burn. However, already following 1—2 hours first degree burns become differentiated from the other two degrees. Whereas the mildest burns become filled in giving fluorescence in their entire extent, in second and third degree burns fluorescence remains confined to a peripheral ring. Twenty-four hours after the administration of the antibiotic the fluorescence test yields entirely different results in the three degrees of burns. The mild burn no longer fluoresces at all, the second degree burn fluoresces in its entire extent and around the severest burn there remains only a fluorescent ring in its closest proximity. This differentiated picture of fluorescence does not undergo any changes during a further 24 hours following administration.

Examples of distinction between second and third degree burns seen in the macroscopic picture of fluorescence as compared with photograms in daylight are shown in Fig. 2. Fixed fluorescence was also noted microscopically either over the entire surface of the second degree burn or in the immediate neighbourhood of the third degree burn (Fig. 3).

The picture of fluorescence observed in patients suffering from burns was very varied and differentiated. During the infusion or immediately after it there

is weak fluorescence of the undamaged skin and intensive fluorescence in places of mild burns. The severest burns remain without fluorescence. At subsequent intervals the picture of fluorescence undergoes further changes. It disappears entirely from healthy skin and gradually diminishes over areas of mild burns. On the other hand, fluorescence intensifies in certain areas, especially



Fig. 2a.

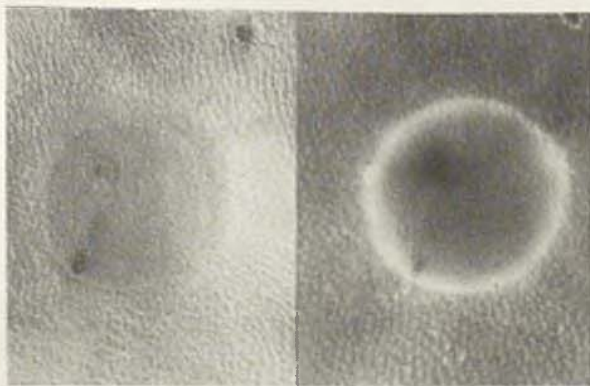


Fig. 2b.

Fig. 2. The different distribution of fluorescence in burns of rabbit skin of II. (a) and III. (b) degrees 24 hours after intravenous administration of chlortetracycline. Photographs in ordinary (left) and ultraviolet (right) light.

in the region of the severest burns. In such cases fluorescence is entirely fused and uniform or else mottled. Examples of highly differentiated and intense fluorescence of this type 24 hours after administration of the antibiotic can be seen in Fig. 4. This was the case of a 19-year-old patient who had suffered burns by flame to an extent of 40% body surface and on the fifth day after

the injury was given chlortetracycline (500 mg.) in an intravenous infusion. The areas of intense black seen in the picture correspond to third degree burns, areas of second degree (deep) burns show an intense glow, the blotchy patches correspond to second degree (superficial) burns. These findings were confirmed by the developing changes within the wounds.



Fig. 3a.



Fig. 3b.

Fig. 3. Examples of microscopic fluorescence in burned rabbit skin.

DISCUSSION AND CONCLUSIONS

The results of the experimental study have shown that the degree of the burn can be estimated on the basis of the distribution of TA in the damaged skin. The changes observed are, however, more complicated than is the case when, for instance, fluorescein is used. Fluorescein only reveals changes in distribution

soon after general administration, reflecting only the various degrees of blood supply. Observation of the damage can be adequate only if carried out soon after the administration of the fluorescing substance. In addition to the changes in distribution tetracycline antibiotics, on the other hand, reveal changes in the retention and fixation of the fluorescing substance within the damaged skin.



Fig. 4 Burns of the lower limbs in man. Differentiated fluorescence 20 hours after intravenous infusion of chlortetracycline. Photogram in ultraviolet light.

In studying this fluorescence in its entire dynamics the two phases can be clearly distinguished from one another. During the first phase soon after the administration of the antibiotic a mild burn is clearly distinguished from a deeper one. A mild burn fluoresces immediately in its entire extent whereas in severer ones the fluorescent ring is confined only to the surroundings of the damaged skin. Severer burns, however, become further differentiated at later intervals after administration (e.g. after 24 hours). In moderate degrees the burned area is filled-in entirely while in the severest degrees fluorescence remains confined to the periphery of the damaged tissue.

Preliminary clinical investigations also suggest that the distribution of the fluorescence within the burned skin, when observed in its entire dynamics, differentiates between the various degrees of damage. In this case the variance in the picture of fluorescence is even more marked than in the skin of the rabbit, just as the intensity of the fluorescence attains an unusually high degree.

In employing TA for the distinction of various degrees of burns there emerges a new element not utilised hitherto for this purpose. All the other methods, in which fluorescein, Evans' blue or radioactive phosphorus (^{32}P) are used, only reflect changes in the blood supply. The value of TA in differential diagnosis,

on the other hand, is augmented by their characteristic capacity to become fixed to tissues damaged to varying degrees. They not only reflect changes in the blood supply but also in the biochemistry of the tissues. As in the case of other damaged tissues, the persisting fluorescence reflects the formation of a complex of TA with damaged protein by means of bivalent metals, mainly calcium.

As against substances hitherto employed TA have still further advantages. Whereas fluorescein is a neutral substance and Evans' blue is even toxic, TA may act favourably in two more ways. Firstly, it should be borne in mind that fluorescing areas correspond to the stratification of the biologically effective wide range antibiotic. It provides, therefore, longterm protection of the burned area against invasion by microorganisms, even after single administrations. It is further known that TA are indicated in states of shock because of their capacity to delay the onset of the irreversible phase (Fine 1954). For these reasons TA are considered to be of great advantage in burns (Allgoewer and Siegrist). Mention may be made also of their possible protective effect on renal tissue which was studied, in the case of kidneys rendered temporarily ischaemic, by Hejnal et al. (1960) and Kočvara et al. (1962).

A shortcoming of the experiment described here lies in the fact that it was carried out on rabbits whose skin is histologically different from human skin. It will be desirable to supplement this study by experiments carried out on pigs whose skin resembles human skin to a greater extent and is commonly employed in the study of burns. The clinical observations will also require to be extended and it will be necessary to determine exactly by histological examination which degree of burn leads to longterm retention of TA and thereby to persisting fluorescence. The problem is being further studied in all these directions. The preliminary results described above are, however, very promising and fully justify the proposed use of TA in this hitherto unexplored diagnostic field.

SUMMARY

1. A method is put forward for the evaluation of the degree of burns by means of chlortetracycline.
2. In the burned skin of rabbits chlortetracycline, demonstrable by fluorescence, is spread and fixed characteristically according to the degree of the burn.
3. The possibility of using this fluorescence test in clinical practice is supported by the preliminary results obtained with it in patients suffering from burns.

RÉSUMÉ

Proposition d'une méthode par l'évaluation du degré des brûlures à l'aide des antibiotiques de la famille des tétracyclines

P. Málek, M. Dobrkovský, V. Zástava, S. Kolc

1. Proposition d'une méthode pour l'évaluation du degré des brûlures à l'aide de la chlorotétracycline.

2. Dans la peau de lapin brûlée, on peut démontrer par la fluorescence de la chlorotétracycline que celle-ci s'étale et se fixe d'une manière caractéristique par rapport au degré de la brûlure.

3. Les premiers résultats, obtenus jusqu'à maintenant à l'aide de ce test de la fluorescence, appliqué chez des malades atteints de brûlures, témoignent en faveur de l'utilité clinique de cette méthode

ZUSAMMENFASSUNG

Die Verwendung von Antibiotika der Tetracyclinreihe zur Bewertung des Grades von Verbrennungen

P. Málek, M. Dobrkovský, Vl. Zástava, S. Kolc

1. Es wird eine Methode zur Bewertung des Grades von Verbrennungen unter Verwendung von Chlortetracyclin vorgeschlagen.

2. In der von einer Verbrennung betroffenen Kaninchenhaut weist Chlortetracyclin, das mit Hilfe der Fluoreszenz nachgewiesen werden kann, eine vom Grad der Verbrennung abhängige Distribution und Fixation auf.

3. Die vorläufigen Ergebnisse dieser Fluoreszenzprobe erwiesen bei Patienten mit Verbrennungen die Brauchbarkeit dieser Untersuchungsmethode in der Klinik.

RESUMEN

Una proposición de emplear los antibióticos de tetraciclina para hacer evaluación del grado de las quemaduras

P. Málek, M. Dobrkovský, Vl. Zástava, S. Kolc

1. En este papel se propone un método en cuanto a la evaluación del grado de las quemaduras empleando clorotetraciclina.

2. En la piel quemada del conejo clorotetraciclina se extiende con la fluorescencia típica comprobada y está fijada según el grado de la quemadura.

3. Los resultados preliminares de esta prueba de fluorescencia en los enfermos con quemaduras hacen posible el empleo de este método también en la clínica.

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RE-INNervation OF FREE AND FLAP SKIN GRAFTS

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The authors studied re-innervation in free and flap skin grafts under clinical conditions. From the values obtained they tried to find out the average time of onset of the initial stage of re-innervation and of its completion as well as the way in which the transplant links up with the nervous system. These data are important in relation to the return of the patient to work. Determination of the criteria for the restoration of sensation may also provide information on when the patient can expect final adjustment of the transplanted skin, i.e. when less protection of the graft against possible damage is necessary, thus enabling him to take proper care of it.

The patients were examined at longer time intervals so that changes in the re-innervation and the increase in sensation both in quantity and quality could be registered. Sensation of all qualities as well as vegetative innervation were studied simultaneously so that the results could give a comprehensive view of the functional and biological regeneration of free and flap skin grafts.

Skin has its own cerebrospinal and vegetative innervation. The branching of cutaneous nerves increases towards the stratum papillare where they form superficial and deep networks. The fibres either end in the papillae or some fine fibres penetrate among the cells of the deep layer of the epidermis. Another group of nerves ends in the deep layers of the corium and the subcutaneous tissue around the hair follicles, glands and vessels.

The regional branches of the sensory nerves in the skin and the subcutaneous tissue have either free endings or special terminal structures. These endings are the site of touch, pain, cold and heat perception. The endings of perception lie in the deep layers of the epidermis in the form of free terminal nerve fibrillae. Meissner's tactile corpuscles are found in the papillae of the corium and Vater-Pacini's in the subcutaneous tissue. Krause's and Ruffini's corpuscles to which perception of heat and cold is ascribed are met with both in the corium and the subcutaneous tissue.

In the literature of the last decade there is no unanimous view as to whether restoration of sensation proceeds from the edges towards the centre or from the floor of the bed. The first view, however, is predominant but, at the same time, it is found that the mode and quality of re-innervation depends not only on the time elapsed from operation, but also on the method of transplantation

used, the course of healing and the conditions of the bed. A proper functional link-up with the organism of a free or flap graft presupposes that the transplanted tissues have again become part of the whole, that the skin analyzer for the region of the transplant has been restored and is controlled by the central nervous system. This link-up can be proved objectively by a series of physiological tests such as the determination of chronaxie, rheobase, the vegetative functions, etc. Sazontov (11) recommended pletysmography as an objective method for the examination of re-innervation and re-vascularization of transplants. Korovina (7) used the Minor test with pilocarpine for examining vegetative re-innervation.

The papers of various authors deal with the different mechanisms of re-innervation. Kredel and Evans (8), Hutchinson, Tough and Wyburn (5) believe that the ingrowing nerve fibrillae enter the skin graft independently of the presence of Schwann's sheaths. Davis and Kiltowski (3), and Gutmann (4), however, state the opposite.

Napier (10), Sazontov (11) and Korovina (7) maintain that the return of sensation proceeds, as a rule, from the edges of the transplant. Adeymo and Wyburn (1) assume both re-innervation from the edges on all sides of the transplant and subdermal re-innervation from severed nerve trunks in the bed. Kirov (6) carried out microscopic and clinical investigations in patients and experiments in rabbits. He found the nerve fibres growing into the transplant both ways and fixes the termination of re-innervation at a period of three years after operation or even more, particularly if healing has been complicated.

MATERIAL AND METHODS

The study of re-innervation was carried out in patients of the Clinic of Plastic Surgery in Bratislava. A total of 52 free skin grafts and 36 skin flaps were investigated within the period of four weeks to 41 months after operation. This stretch of time made it possible to study the return of sensation dynamically. Among the material were thin and thick free grafts placed both on a clean wound surface and on granulations, and flap grafts both direct and tubed. As donor sites the authors chose the back, thighs, abdomen, shoulder, etc. The method of testing sensation was the same for free and flap grafts.

Examination was carried out of tactile, pain and thermic perception and also of vegetative innervation by the perspiration test.

Touch was tested with cotton wool wrapped round a match stick which was drawn two to three times in succession over a stretch of 1 cm. on the same site. First the whole circumference of the graft was tested successively, afterwards the centre. By comparing the sensitivity of the normal skin with that of the edges of the transplant as well as that of the edges and the centre, information about the sensation of the individual zones was obtained. The results were then registered on graphs, separately for each case.

Perception of pain was tested with a needle applied vertically to the skin under even pressure which in normal skin produced a prick of slight intensity.

For comparison this was first tried out on the surrounding skin and the skin of the examiner himself.

Thermic perception was tested simultaneously with two test-tubes, one filled with pieces of ice, the other with water of 45—50° C. These tubes were then applied to the skin in irregular alternations.

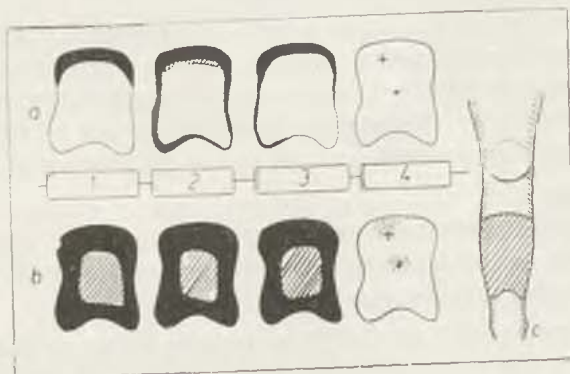


Fig. 1. a = 21 months after operation, b = 27 months after operation, c = situation; 1 = tactile, 2 = pain, 3 = thermic, 4 = perspiration; ■ = normaesthesia, ▨ = hypaesthesia, □ = anaesthesia.

Perspiration was tested by Minor's iodine-starch test. An amount of 0.1 ml. of 1 : 1,000 pilocarpine solution was injected into the graft intradermally and the respective area stained with a 5% solution of iodine. After swabbing the area around the puncture dry, some starch powder was sprinkled on it. A positive reaction could be registered after 1—5 minutes by ink blue spots appearing in an area of 3 cm. If no blue spots had appeared in 15 minutes, the result was considered negative.

Control examinations were carried out on areas of the same size and shape in the vicinity of the transplant or at the donor site.

Further tests by which it is possible to investigate the degree of the link-up of innervation between the transplant and the organism, are referred to in the literature, such as the morphine test, the non-specific reaction to a cantharidin plaster, the specific reaction to tuberculin, pletysmography, measuring of the skin temperature after exposure to cold or heat, etc. These tests were not carried out in the above study because they are complicated, require much time both for execution and registration of results, and because they constitute greater stress to the patient.

OBSERVATIONS AND RESULTS

By the investigation described above, the authors acquired some knowledge about the mode of re-innervation of free and flap skin grafts and of some conditions which have an influence on the restoration of sensation. They observed two types of re-innervation.

The first type was found in 48 free transplants and 20 flap grafts. This has a marginal zone of restored sensation which equals or almost equals that of the surrounding skin. The nerve fibres reach the graft from the edges; those from the proximal margin grow fastest, those from the sides somewhat slower, and the fibres from the distal margin grow the slowest or sometimes show almost no growth at all, mainly in the extremities.

There is also the middle zone which is hypaesthetic or which starts with a band of hyperaesthesia passing through various degrees of hypaesthesia into anaesthesia in the very centre. This is found in larger grafts. In grafts of smaller area the anaesthetic zone diminishes rapidly or cannot be found at all, because restoration of sensation proceeding from the edges soon reaches the centre.

In the patient H. K. (Fig. 1) a flap graft plasty was performed on the left leg for a condition following osteomyelitis of the tibia. The operations were carried out in the period between April 30 and July 24, 1953. At the latter date the flap was moulded into definite shape.

21 months later (April 28, 1955) perception of touch was restored in the proximal and side margins; all other parts of the graft were anaesthetic. The area of pain perception was somewhat broader comprising a narrow band around the whole circumference of the flap. The area of thermic perception almost equalled that of touch. The Minor test was slightly positive near the proximal edge, whereas in the anaesthetic zone it was negative.

Six months later (Oct. 20, 1955) the area of restored sensation of all qualities had grown considerably wider, and even the distal parts of the flap were now sensitive. The centre, however, still remained hypaesthetic. The Minor test was now positive on both previously tested sites.

The second type of re-innervation was found in two patients with free transplants. There re-innervation was effected in islets of unequal size and irregularly scattered over the surface of the graft. In both cases transplantation was performed to cover large skin defects after burns.

In some cases, where restoration of sensation had already been completed, the authors observed small areas of hyperaesthesia in which a stimulus was perceived more intensively than in the surrounding normal skin. The patients rarely complained of paraesthesia such as tingling, pins-and-needles, burning, etc., but these sensations usually spread peripherally, e. g. from the palm to the fingers.

The authors could also register the influence of scar tissue which acted as a barrier to re-innervation. A superficial marginal scar may prevent re-innervation of the adjacent part of the transplant which manifests itself either by complete anaesthesia or only slight sensitivity; paraesthesiae are common. At this time, the central zone may already be completely re-innervated.

In the patient J. S. (Fig. 2) a tubed flap plasty was performed for a condition following a war injury. The flap was completely spread out on Feb. 1, 1952. On check-up 39 months later (Dec. 9, 1954) it was found that suture lines were soft and almost negligible, but on the tibial side of the flap near its proximal

margin there was a scar 3 cm. broad. Sensation of all qualities had been restored on the entire surface of the graft with the exception of that adjacent to the scar.

The above study also enabled the authors to find out which quality of sensation returns first. Data in the literature indicate that it is usually pain perception. This was confirmed by the author's experience, since the return of

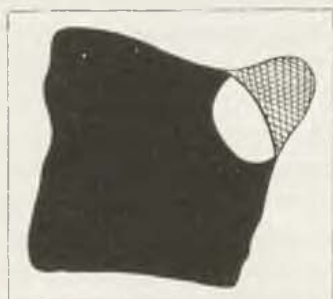


Fig. 2. ■ = normaesthesia, □ = anaesthesia, ▨ = scar.

pain perception appeared much earlier than that of tactile perception in most patients. More often, however, the authors observed an almost simultaneous return of both qualities of sensation, as is shown in Tab. 1. Of thermic perception, that of cold returned first and of heat last.

It may be that pain perception returns earlier than tactile perception because the tactile receptors are far more complicated and differentiated structures than the pain receptors which, in fact are only free-ending nerve fibres. The processes of central analysis and synthesis too, are more complex in tactile than in pain perception.

Tab. 1.

Types of restoration	Flaps	Free grafts
Earlier return of the perception of touch	1	0
Earlier return of the pain perception	8	9
Contemporary return of both qualities	16	28

According both to the statements of patients and the authors' experience, restoration of sensation started between four weeks and five months in free grafts, and six weeks and seven months in flap grafts. The upper limit, i. e. the time after which all qualities of sensation were found to be restored, was 30 months in free grafts and three years in flap grafts.

The Minor test was carried out in flap grafts. A positive result indicated that the sweat glands of the transplant were in good condition, their link-up

with the vegetative nervous system and the regulating influence of central nervous system on the secretory function of the skin, functioning properly. In cases, where all three qualities of sensation had been restored this test was always positive. The authors observed a certain connection between the Minor test and thermic perception. Where the thermic perception had not yet returned, the Minor test was still negative. The time after which the result could be registered, was one to five minutes. The appearance of only a few scattered spots was considered as a slight reaction, whereas a satisfactory reaction showed the vicinity of the puncture hole densely covered with dark blue spots.

Finally, the authors wish to point out that the material used for the study was to a certain extent heterogenous. The plasty with transplants was performed for various types of damage, mainly, however, for burns. The sites of the defect and of the donor area as well as the size of the transplants differed considerably. Complications during healing, too, affected re-innervation, and the individual differences in regeneration capacity must not be overlooked. The authors did not consider this heterogeneity to be an obstacle for the study, because they wanted to gather their knowledge under conditions actually existing in clinical practice.

CONCLUSION

1. The method used by the authors is quick, technically inexact but, at the same time, sufficient for clinical purposes.

2. Most free and flap grafts are re-innervated from the edges, and in a certain time sequence sensation increases towards the centre, both in quantity and quality. Bearing in mind this type of re-innervation all scar tissue must be removed and the transplant sutured into healthy surroundings.

3. The first to return is pain perception or pain perception returns simultaneously with tactile perception. Thermic perception returns last, perception of cold earlier than that of heat.

4. In the patients under observation restoration of sensation took place in a time interval between four weeks and 30 months for free grafts, and between six weeks and three years for flap grafts.

5. For practical purposes we must remember that the time needed for return of sensation in free and flap grafts cannot be determined exactly and thus no precise estimate of the patient's return to work can be made. Each patient has to be evaluated individually within the given time limits and with regard to the special circumstances of each individual case.

SUMMARY

The authors carried out a study of the restoration of sensation in free and flap skin grafts. They registered the changes in quantity and quality of re-innervation of the transplanted tissue in patients at various time intervals after operation. Most grafts were found to be re-innervated from the edges towards the centre. Bearing in mind this type of re-innervation, all scar tissue must be removed and the transplant sutured into healthy surroundings. The first sensation

to return was pain perception or the perceptions of pain and touch simultaneously. Thermic perception returned last. The process of re-innervation took place within a period of from four weeks to 30 months for free grafts and of from six weeks to three years for flap grafts. During this period vegetative innervation was also restored.

RÉSUMÉ

La réinnervation des greffons libres et des lambeaux cutanés

F. Mariš, I. Jurkovič, P. Kohút, A. Suchánek

Les auteurs examinent le retour de la sensibilité dans des greffons libres et des lambeaux cutanés. Sur leurs malades, ils ont observé les changements quantitatifs et qualitatifs de la réinnervation des tissus greffés, à des intervalles différents depuis le jour de l'opération. Le plus souvent, la réinnervation prend naissance à la périphérie et se propage en direction vers le centre. Tenant compte de ce type de réinnervation, il est nécessaire d'écarter les couches cicatrisées et de placer la peau greffée dans un entourage sain. C'est la sensibilité algique ou bien la sensibilité algique et tactile qui apparaît la première, la sensibilité thermique se manifeste la dernière. Le renouvellement de l'innervation dans les greffons libres s'accomplit au cours de 4 semaines à deux ans et demi, dans les lambeaux elle s'opère pendant 6 semaines à trois ans. A ce moment, l'innervation végétative du lambeau elle-aussi se trouvait renouvelée.

ZUSAMMENFASSUNG

Reinnervation von freien Hauttransplantaten und Hautlappen

F. Mariš, I. Jurkovič, P. Kohút, A. Suchánek

Von den Autoren wurde eine Untersuchung der Empfindlichkeitswiederkehr freier Hauttransplantate und Hautlappen durchgeführt. Bei den Patienten wurden quantitative und qualitative Veränderungen der Reinnervation des transplantierten Gewebes in verschiedenen Zeitabschnitten seit der Operation verfolgt. Die überwiegende Mehrheit wird von den Rändern in Richtung Mitte innerviert. Unter Berücksichtigung dieses Reinnervationstyps ist es notwendig die vernarbten Flächen zu entfernen und die transplantierte Haut in die gesunde Umgebung einzunähen. Zuerst wird die algische oder die algische mit der taktilen und schliesslich die thermische Empfindlichkeit erneuert. Die Innervationserneuerung von freien Transplantaten verlief von der 4. Woche an bis zu 2½ Jahren, der Lappen von der 6. Woche bis zu 3 Jahren. In diesem Zeitabschnitt wurde auch die vegetative Lappeninnervation erneuert.

RESUMEN

Reinervación de los injertos de piel libres y de los lóbulos de piel

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Los autores efectuaron una investigación en cuanto a la sensibilidad de los injertos de piel libres y de los lóbulos de piel. Observaban en los pacientes cambios cuantitativos y cualitativos de la reinervación del tejido transplantado durante diferentes espacios de tiempo después de la operación. La mayoría preponderante tuvo innervación desde el margen con la dirección al centro. En vista de este tipo de la reinervación es

necesario liquidar las áreas cicatrizadas y coser el injerto de piel en las áreas sanas. Dentro de poco tiempo se restaura la sensibilidad álgica o la sensibilidad álgica y táctil y finalmente la sensibilidad térmica. La restauración de la inervación de los injertos de piel libres transcurría dentro de 4 semanas hasta 2½ años, de los lóbulos de piel desde 6 semanas hasta 3 años. Durante este periodo la inervación vegetativa de los lóbulos también fue restaurada.

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BURNS CACHEXIA

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Cachexia in burns is a hitherto little studied problem of the pathology of thermal injuries. It is always caused by deep and extensive burns. The number of patients with burns cachexia is very large, indeed. More than 350 patients from various regions of the country treated at the burns department of the Academy in the last ten years, developed manifest burns cachexia of various degrees.

This paper is based on the author's experience collected from the observation and treatment of 197 in-patients with burns cachexia treated at the Clinic in recent years.

The terminology of this condition varies in the literature. It is called "chronic burns" (Ziffren 1953, Blocker 1953), "neglected burns" (Osborne 1954), "toxic cachexia" (Holubec and Karfik 1956), "cachectic form of sepsis" (Sokolov 1957, Medvedovskaya 1957) or it is identified with the cachexia after mechanical trauma (Petrov 1950, Bratus 1956, Postnikov 1957). The term "burns cachexia" is used but rarely.

The conception of burns cachexia has not been formulated exactly. At the Clinic patients with unhealed deep burns and a breakdown of the reparative processes in the wound, such as bleeding or considerable thinning of the layer of granulations together with signs of general deterioration, such as loss of weight, anaemia and hypoprothrombinaemia, development of contractures, oedema, bed sores, etc. are considered to be suffering from burns cachexia.

The pathogenesis of burns cachexia has been studied very little. On the basis of clinical experience and experiments carried out in animals at the scientific research laboratories for burns the author explains the pathogenesis of burns cachexia as follows: The primary causes are always extensive and deep burns. Only early operation (necrotomy and autoplasty) can forestall or control cachexia. All other methods of treatment are effective only in combination with surgery. In peace-time such operations can be performed in patients with deep burns not larger than 10—15% of body surface. In some cases the operation is postponed until the wound surfaces have become completely clean. In deep burns larger than 20% of body surface, because of the shortage of healthy skin,

the operation is performed in stages and so the unhealed burns are a source of cachexia for a long time.

The modern methods of treatment of deep burns are, unfortunately, not yet used generally. The following errors of treatment leading to the development of cachexia even in relatively small burns (3—6%), are observed:

1. Conservative treatment lasting for several months.
2. Plastic operations performed in many stages for burns up to 10—15% of body surface, particularly if the intervals between the stages are too long, i.e. in cases lacking the common contraindications of a one-stage operation.
3. The using of obsolete islet skin plasties (Reverdin, Davis, Yanovich-Chaynsky) in extensive burns.
4. Using homotransplantation without subsequent autotransplantation.
5. Underestimating the importance of medical treatment (artificial feeding, blood transfusion, drug therapy, etc.).

Clinically manifest burns cachexia is preceded by a prodromal period. According to the author's experience, these initial symptoms start early, frequently on the first day after injury. Severe burns always tend to produce cachexia due to the presence of large burned areas, nutritional disorders, infection, high fever, anaemia and hypoproteinaemia. The speed of development of burns cachexia is greatest between 4—6 weeks after injury, which is borne out by the changes in basal metabolism and the loss in weight. Patients with burns larger than 6% of body surface show an increase in basal metabolism of 25% up to the 40th day after injury (Gubler 1961). Later, basal metabolism is normal or decreased. Within the first month, the patients lose an average of 15% of their original weight, during the second month only 7—8%. The mean loss of weight during the first 24 hours can amount to 1.5 kg.; later the decrease in weight proceeds very slowly and stabilization on a lower level takes place.

The author cannot agree with the widespread opinion that cachexia is a relatively rare complication of burns sickness. According to his own experience in the treatment of patients with deep burns he considers that burns cachexia is a special phase of burns sickness with characteristic pathophysiological, morphological and clinical features.

Clinically manifest burns cachexia usually develops three to four weeks after extensive and deep burns passing through the following three stages: slight (compensated), manifest (subcompensated) and severe (decompensated). Successful skin plasty in one of these stages usually checks further development and leads to recovery. Proceeding from the afore-said, burns cachexia may be divided into three groups according to severity. The characteristic sign of each degree is the condition of the wound. In degree I cachexia the healing process is only slightly affected; in some patients it is slowed down or epithelization has been interrupted. In degree II cachexia bleeding granulations are characteristic. In degree III cachexia the healing process is disrupted: the granulations lose their characteristic appearance, change into a semitranslucent membrane or disappear completely. Not infrequently the wounds acquire the appearance of crater-like ulcers.

The speed with which cachexia develops depends on a number of factors (total area burned, age of patient, concomitant diseases), but the main factor remains the area of deep burns.

Fig. 1 depicts the basic clinical signs and symptoms of the different degrees of burns cachexia.

In degree I cachexia (43 out of 197 patients) slight or marked deterioration of nutrition can be observed. The skin — except during fever — is pale with an

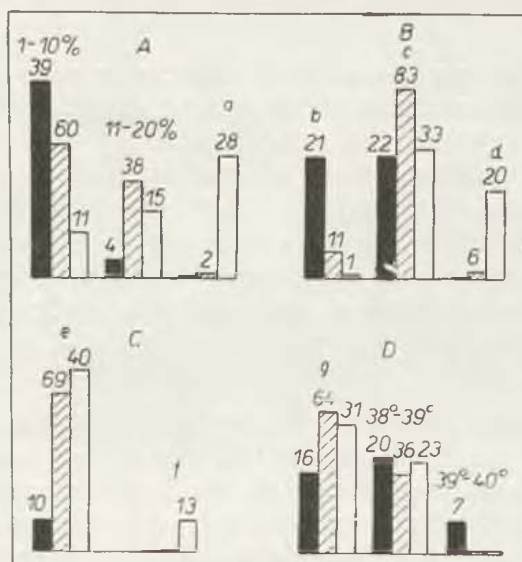


Fig. 1. A = area of deep burns, B = nutritional state of patient, C = changes in CNS, D = temperature, a = more than 20 %, b = slightly decreased, c = markedly decreased, d = cachexia, e = asthenic condition, f = psychosis, g = normal or slightly raised. — Degree of cachexia: ■ = degree I, ▨ = degree II, □ = degree III.

ashen tinge. The large joints are contracted and the muscles atrophied. The appetite is frequently poor, but sometimes unchanged. Most patients show but imperceptible mental changes. The temperature is usually of an irregular type, either slightly febrile (38—39° C), subfebrile or even normal. High temperatures (more than 39—40° C) are not characteristic for burns cachexia and are usually due to the elimination of sloughs. In all patients there was hypochromic anaemia and in half hypoproteinaemia; oedema and bed sores were absent. Manifestations of first degree cachexia are an indication for immediate autoplasty in order to prevent progression into a more severe degree.

The signs and symptoms of degree II cachexia (100 patients) are much clearer. The loss of weight in the patients is considerable and in some cases reaches the degree of cachexia proper. The skin and visible mucous membranes are pale, contractures of large joints more severe and the appetite is very poor or absent. Frequently a psychic disorder of an asthenic type can be observed. Some patients become tolerant to narcotics. The temperature does not usually

exceed 38—39° C. Marked anaemia and hypoproteinaemia are present. There is oedema in 51% of patients, but in a number of cases it can only be detected after the application of a tourniquet or an Esmarch bandage to the extremity, or in the face if the patient is nursed in a prone position. Latent oedema is usually due to hypoproteinaemia or to a disorder in the permeability of the vessel walls. Bed sores (in 18%) develop more often in the region of bone projections where the skin is under constant pressure, such as the sacral region, the heels, the anterior superior iliac spines, the patellae and less frequently elsewhere.

In degree III cachexia (54 patients) the loss in weight often reaches the degree of cachexia proper. Contractures of large joints are multiple and develop even at sites without burns. The muscles show marked atrophy. The patient usually has no appetite. The patients are mentally unbalanced (asthenic condition passing into manifest psychosis together with severe toxæmia). Most patients become tolerant to narcotics. The rise in temperature is slight and in some cases the temperature is subnormal or normal. Oedema is often considerable up to anasarca. Bed sores are regular and multiple.

As becomes evident from Tab. 1, most complications arise in degree II and III cachexia.

Provided the burns are the primary cause of cachexia, complete coverage of the wounds with autotransplants is the radical method of treatment which is fully justified. According to data from the literature, conditions in fully developed cachexia are not very favourable for autotransplantation (Petrov, Postnikov, Marcks, Trevaskis 1950, Artz, Reiss 1957 and others). Marinecký-Vojna, Petrov and Postnikov consider anaemia (Hb lower than 65%, erythrocyte count

Tab. 1.

Results of the Treatment of Complications of Burns Sickness in Dependence on the Degree of Burns Cachexia and the Complications Found at Post Mortem

Degree of cachexia	Number of patients (total)	Recovered	Died	Complications							
				Pneumonia	Nephrosis - nephritis	Nephrolithiasis	Parenchymatous hepatitis	Paresis of peripheral nerves	Haemorrhagic diathesis	Amyloidosis	Septicopyaemia
Degree I	43	43	—	4	1	1	—	2	—	—	—
Degree II	100	97	3	19	6	7	5	4	1	1	—
Degree III	54	21	33	29	10	1	2	7	2	2	4
Total	197	161	36	52	17	99	7	13	3	3	4
Died	36			28	2	—	1	—	1	2	4

less than 3,000,000) and hypoproteinaemia (total serum proteins less than 6%) to be a contraindication to autoplasty, because too many transplants slough off.

Correct preoperative treatment carried out with regard to the degree of cachexia, is indispensable. Contrary to the widespread opinion that the main task lies in acting upon the granulating surface of the wounds (Wallace 1941, Dufourmentel 1952, Artz et al. 1953 and others), the author considers improve-

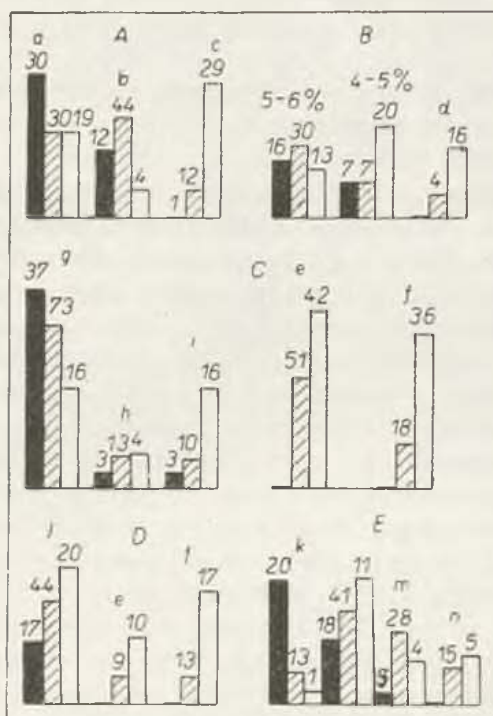


Fig. 2. A = anaemia (number of erythrocytes per mm² blood), B = hypoproteinaemia (total protein in blood serum), C = number of stages of autoplasty, D = deterioration of cachexia after operation, E = duration of hospital treatment, a = 3.5—4 mil., b = 2.5—3 mil., c = less than 2.5. mil., d = less than 4%, e = oedema, f = bed sores, g = one-stage, h = two-stage, i = many stage, j = anaemia, k = up to 2 months, l = 2—4 months, m = 4—6 months, n = more than 6 months

Fig. 1, 2. General data of area of deep burns, signs and symptoms, surgical treatment, postoperative course and time of treatment in patients with burns in dependence on the degree of cachexia. The figures heading the columns give the number of patients.

ment of the general condition of the patient to be the most important. It is well known that the granulating wound in burns actually reflects the general condition of the patient, i.e. of his power of compensation and defence. By improving the general condition of the patient, the condition of the wound improves, too. The quality of preoperative treatment is evaluated by a summary of clinical data: improvement or complete liquidation of anaemia and hypoproteinaemia, decrease of febrile temperatures, improvement of appetite, sleep and subjective

condition. Preoperative treatment ought to be completed as soon as possible, because any postponement may lead to deterioration and complications, such as pneumonia, septicopyaemia, amyloidosis, etc., and render the operation inadvisable or impracticable. It is, however, necessary to bear in mind that the effect of preoperative treatment may not be evident in patients with deep and extensive burns (over 20—30% of body surface). In such cases, autoplasties carried out in stages under unfavourable conditions and without regard to the severity of cachexia are actually a kind of preparatory measure for the operations to follow.

In degree I cachexia preoperative treatment consists mainly in an improvement in food intake and where patients show marked anaemia and hypoproteinaemia, also in 1—3 blood transfusions.

In degree II cachexia preoperative treatment has to be prolonged. Extremely useful are blood transfusions without which it would usually be quite impossible to improve or liquidate anaemia and hypoproteinaemia and the disorders linked with them. For blood transfusion every possible means must be made use of. Subcutaneous veins are often unuseable. At the Clinic, therefore, we frequently apply other methods, such as infusion into the superficial veins of the neck (65 transfusions), the corpus cavernosum penis (33 transfusions) or very often intramedullary transfusion under general, nitrous oxide anaesthesia with a mask, carried out during dressings (267 times). Transfusions are effective only if they are given in adequate average daily doses of 100 ml. blood and more during the whole preoperative period. In clinical practice this has been achieved by transfusion of 500 ml. of blood every two to three days in adults or by still more massive transfusions of 750—1250 ml. of blood at longer intervals.

In preparing the patient for autoplasty early coverage of the wounds by means of homotransplants is of great importance and has been performed at the Clinic 85 times. The best results, i.e. complete (or almost complete) take of the homotransplants were attained if the grafts were taken from live donors. Skin from cadavers preserved by various methods gives poor results, because it sloughs off too quickly. The elaborating of more efficient methods of conservation and utilization of cadaver skin certainly deserves more attention, because the use of homografts from live donors will hardly find wide application in extensive burns.

The medical treatment must be strictly individual. Antibiotics are indicated in high temperatures and prolonged bacteriaemia. Because of vitamin shortage in the organism, all patients must be given vitamins. In loss of appetite the food must be of high caloric value (up to 4,500 cal. a day) and rich in proteins (up to 200 g.), and must be given by a permanent catheter made of plastic material and introduced via the nose into the stomach or the duodenum. This method of feeding has been widely practiced at the Clinic (in 150 patients). A permanent catheter left for one to three months does not give rise to any complications, and the results of this method of feeding are very good. Steroid preparations (Cortisone, Prednison, Prednisolon) must be given when there are signs of hypofunction of the adrenal cortex. In haemorrhagic diathesis, Rutin, Vicasol, vitamin PP, ascorbic acid, antihistaminics and calcium salts are used.

In degree III cachexia preoperative treatment is the same as in degree II, but more intensive; larger blood transfusions and homotransplants must be used and feeding by permanent catheter is indispensable. In deep burns extending over more than 20 to 40% of body surface, particularly in the later period of burns sickness, preoperative treatment should not be drawn out and if it remains unsuccessful, immediate autotransplantation should be performed followed by further stages of auto- and homoplasty in order to provide coverage for all wounds as soon as possible.

Surgical treatment is carried out according to the basic principles of plastic surgery. In cases of cachexia it is justified to carry out autotransplantation in as few stages as possible in order to provide coverage for the wounds as soon as possible. The number of stages depends on the degree of cachexia (see Fig. 1). In burns of an area of 15—20% of body surface the wounds ought to be covered in one or two stages. In burns larger than 20% this must be completed in a few stages but with the shortest possible intervals between autoplasmic operations, at the same time, covering the rest of the wounds with homotransplants using the various methods utilizing epithelization from the edges ("postage stamp" method, Jackson's operation, etc.). According to the generally recognized principle of plastic surgery, the areas around the large joints should be covered first, if it is impossible to cover all wounds in one stage. In case of cachexia, however, this principle is put aside in favour of the leading idea of the operation, i.e. the coverage of the maximum wound area, since it is the wound which is the cause of cachexia. During the operation, all subsidiary measures, such as repair of scar contractures, manipulations, adjustment of deformities, etc., must be refrained from even if they should look temptingly simple. They ought to be postponed for later, after cachexia has been overcome, and when they can be undertaken without risk.

Skin autoplasty up to 500 cm² and homoplasty can be successfully completed under local or general anaesthesia using a mask. More extensive autoplasty can only be carried out under general anaesthesia. Potentiated anaesthesia with nitrous oxide using controlled respiration is indicated. These plastic operations, of course, entail a certain risk, but are still justified, because one has to bear in mind that all patients inevitably die if not operated on. The most dangerous complications arising during operation are cardiac arrest (3 out of 338 cases during primary and secondary operations) and shock (13 cases). Early and effective therapy resulted in successful resuscitation of 15 patients; one woman died from shock on the table.

During the postoperative period it is imperative to continue with the treatment of cachexia, because it frequently becomes worse (Fig. 1).

With the modern methods of treatment by autoplasty the vast majority of cachectic patients can recover. The limits for the success of the treatment are, however, set by the extent of deep burns. 177 out of a total of 197 patients with cachexia, i.e. 90% were operated on. Twenty patients could not be operated on because of their extremely poor condition and the development of severe complications rendering skin transplantation impossible. These patients showed an area of deep burns exceeding 20—40% of body surface with degree III cachexia.

Out of a total of 36 deaths, 32 were patients with deep burns exceeding 30% of body surface. The remaining four patients who also had deep burns on 20% of body surface, died from intercurrent diseases (hepatitis, pneumonia, and one woman from shock during operation).

In all cases that died the characteristic dystrophic and atrophic changes were found in the internal organs and tissues at post mortem. It is important to note that death from burns cachexia was not caused by obviously irreversible changes in the internal organs, as can be observed in cachexia following mechanical trauma (Davidovsky 1944, Strazhesko 1944, Gubergrits 1945, and others), but due to the complications accompanying burns sickness, most frequently pneumonia, septicopyaemia etc. The various complications in these patients found at post mortem, are shown in Tab. 1.

The time spent in hospital by patients with cachexia who were not discharged cured, also corresponded to the severity of cachexia (Fig. 1).

Prevention of cachexia in extense and deep burns can be effected only through the interruption of its development by means of early operation, i.e. necrotomy and autoplasty. This, however, can only be done in patients with deep burns not exceeding 10—15% of body surface.

In burns larger than 10—15% of body surface and after unsuccessful early operation or its postponement, cachexia inevitably develops. In these cases all prophylactic measures must aim at the prevention of a more severe degree, i.e. of degree II and particularly degree III cachexia. This may be achieved by medical treatment as described above. An important part in the prevention of cachexia is played by autoplasmic skin transplantation carried out in stages and combined with homotransplantation. According to the Clinic's experience in this way it is possible in a number of patients with deep burns up to 35—40% of body surface to maintain their condition at the level of degree II cachexia and prevent development of degree III. Prevention of burns cachexia saves both effort in and costs of the treatment of patients with burns.

CONCLUSION

1. Burns cachexia is not a complication of burns sickness, but one of its special phases.
2. Success of the radical treatment of burns by means of autoplasmic skin transplantation depends on the combination of surgical and medical treatment of burns cachexia.
3. Prevention of burns cachexia can definitely be effected by early operation in combination with medical treatment.

SUMMARY

A study of the pathogenesis, clinical features, treatment and prophylaxis of burns cachexia was carried out on the basis of the experience collected in the treatment of 197 patients. Development of cachexia starts in the first days

after injury. It becomes quite evident in the third or fourth week, as a phase of burns sickness per se. Cachexia shows three degrees according to severity.

The aim of surgical treatment is the speediest possible coverage of all wounds with autotransplants. The success of the operation may be ensured by medical treatment, i.e. blood transfusion, homotransplantation, artificial feeding via permanent catheter, drug therapy.

More than 80% of patients with burns cachexia can be cured with the modern methods of treatment. Cachexia can be prevented by early operation in combination with medical treatment.

RÉSUMÉ

A propos de l'exténuation après brûlure

V. I. Filatov

L'analyse présentée de la pathogenèse, des symptômes cliniques, de la thérapie et de la prophylaxie de l'exténuation après brûlure résulte des expériences faites sur 197 malades traités. L'exténuation commence à se déclarer dès les premiers jours après le traumatisme, pour se manifester par des symptômes cliniques expressifs au cours de 3—4 semaines, en présentant l'aspect d'une période distincte de la maladie par brûlure. On peut distinguer trois degrés différents, suivant la gravité des symptômes.

Le but de l'intervention chirurgicale consiste dans la formation rapide d'une couverture aux endroits brûlés à l'aide de l'autogreffe. Le succès de cette opération peut être assuré au moyen d'une thérapie conservatrice (transfusion sanguine, homéogreffe, alimentation par sonde, application de médicaments).

A l'heure actuelle, la mise au point des méthodes permet d'atteindre la guérison de plus de 80% des malades exténués. La prophylaxie de l'exténuation consiste dans une opération faite à temps, en combinaison avec les méthodes thérapeutiques conservatrices.

ZUSAMMENFASSUNG

Die Kachexie nach Verbrennungen

W. I. Filatow

Auf Grund der Erfahrungen mit der Behandlung von 197 Patienten wird eine Analyse der Pathogenese, Klinik, Behandlung und Prophylaxis der Kachexie nach Verbrennungen durchgeführt. Die Entwicklung der Kachexie setzt in den ersten Tagen nach dem Trauma ein, eine klinisch markante Kachexie tritt nach 3 bis 4 Wochen als ein selbständiges Stadium der Verbrennungskrankheit ein. Nach dem Grade der Kachexie unterscheidet man 3 Stufen.

Ziel der operativen Behandlung ist eine möglichst schnelle Deckung aller Verbrennungen durch Autotransplantate. Der Operationserfolg kann durch konservative Massnahmen unterstützt werden (Bluttransfusionen, Homoplastik, Ernährung mittels Sonde, medikamentöse Behandlung).

Mit den modernen Behandlungsmethoden kann eine Wiederherstellung bei mehr als 80 % der kachektischen Patienten erzielt werden. Der Kachexie kann durch rechtzeitige Operationen in Verbindung mit konservativen Behandlungsmethoden vorgebeugt werden.

RESUMEN

Algunas notas sobre la extenuación después de quemaduras

V. I. Filatov

El análisis de la patogenesis, de los síntomas clínicos, de la terapéutica y de la profilaxis de la extenuación después de quemaduras se realizó a base de las experiencias referentes al tratamiento de 197 enfermos. La extenuación aparece durante los primeros días del traumatismo; la extenuación expresiva del aspecto clínico aparece después de 3—4 semanas que presentan un período distinto de la enfermedad de quemaduras. Uno puede distinguir tres grados diferentes según la gravedad de síntomas.

El fin de la intervención quirúrgica consiste en la formación rápida de la cubierta de todos los lugares quemados por medio de los auto-injertos de piel. El éxito de la operación puede ser asegurado por la terapéutica conservativa (transfusiones sanguíneas, cirugía homo-plástica, alimentación con ayuda de la sonda, aplicación de medicamentos).

Aplicando los métodos del tratamiento actuales más de 80% de los enfermos con la extenuación después de quemaduras pueden ser curados. La profilaxis de la extenuación consiste en las operaciones ejecutadas a tiempo en combinación con los métodos de la terapéutica conservativa.

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(V. I. Filatov): Sredni pr. 35, flat 14, Leningrad V 4, U.S.S.R.

ANNOTATION

Clinic of Plastic Surgery, Sofia (Bulgaria)

Director: J. Holevich, M. D.

Anaesthesia in skin plasties after burns

D. MADJAROV

The author deals with the problems connected with anaesthesia in plastic operations after burns. He refers to the experience acquired from the treatment of 326 patients in a total of 645 operations.

In the introduction stress is laid on the problem of operations requiring much time, often with the patient in a non-physiological position and whose general condition is sometimes not satisfactory. For small and short operations in patients older than eight or ten, he recommends local or intramedullary anaesthesia. In most patients, however, he chooses general anaesthesia. In patients with disorders of parenchymatous organs and in poor clinical condition he favours local anaesthesia, sometimes combined with general anaesthesia, using Pressuren together with nitrous oxide and oxygen. In extensive scar contractures, satisfactory analgesia cannot be achieved with local anaesthesia, in addition to which the operation becomes more difficult. When covering large granulating areas, a combination of nitrous oxide with oxygen has been recommended generally, but the author usually employs ether-oxygen anaesthesia with spontaneous respiration. He stresses the advantages of intubation anaesthesia, as compared with any other technique, without increasing the risk to the patient.

On rare occasions he chooses spinal anaesthesia in operations in the lower extremities.

Premedication is calculated according to the age and the condition of the patient. In children up to the age of two he gives atropine, to older patients morphia plus atropine in amounts according to the table. Patients over sixty receive Dolargen to avoid the inhibitory effect of morphia on the respiratory centre. In patients with mental disturbances premedication is supplemented by barbiturates or chlorpromazine which are continued even during the postoperative period. Otherwise postoperative analgesia is attained with morphia or Dolantin.

For the induction of general anaesthesia, the author uses ethyl chloride and ether in children, and short-acting barbiturates and relaxants in adults. In case

of damage to the liver parenchyma he successfully uses a dose of 1 g. of 5 % Pressuren. Based on his own experience he does not recommend anaesthesia of long duration maintained with barbiturates.

In extensive and long operations under general anaesthesia he stresses the need for meticulous compensation of blood losses by transfusion and supertransfusion. This is particularly necessary in children who generally react even to small losses of blood, but who also badly tolerate an intake of larger quantities of fluids. During operation he maintains blood pressure and pulse rate at satisfactory levels and only exceptionally uses analeptics. He also stresses the need for the closest cooperation with the paediatrician when the child is coming round from the anaesthetic.

1. In skin plasties after burns involving small areas in adults, the author recommends local anaesthesia.

2. In extensive defects he advises the use of general anaesthesia.

3. For general anaesthesia he chooses light, non-toxic analgesia.

4. Intubation has many advantages and provides for the most physiological conditions during operation.

5. The decision to operate depends on the blood protein level, the ionic concentration, the blood count, the haematocrit and the urine.

6. During larger operations he gives blood, plasma, electrolytes, vitamins and glucose intravenously.

For references see original paper.

(Dr. D. Madjarov): Urvich 13, Sofia, Bulgaria

REPORT ON THE "FIRST LATIN AMERICAN CONGRESS OF PLASTIC SURGERY, NORTHERN ZONE"

From August 26 to September 1, 1962, the "First Latin American Congress of Plastic Surgery, Northern Zone" took place in Bogotá, Colombia.

Nearly 150 surgeons from 15 countries, participated in this event. Due to the scientific and social success reached, this Congress became one of the most important world events of this branch during the present year.

The President of this Congress was Professor Guillermo Nieto Cano and the secretary General Professor Felipe Coiffman. Doctors Guillermo Rojas, León Hernández and Jaime Guzmán were Vicepresidents and Dr. Delfín Borrero Durán was the Treasurer.

The scientific sessions took place at the "Hospital Militar Central" whose magnificent installations contributed to the success of this scientific event. Although the official languages were English and Spanish, all the lectures were simultaneously translated into Spanish, English, French and Portuguese.

Besides the scientific exhibitions, there was a surgical demonstration televised in closed circuit. It was an operation to correct a hare-lip using Ralph Millard's technique and was performed by the author.

Among the participants the following surgeons should be mentioned: Hector Ardao [Uruguay], Maurice Aubry [France], Arthur Barsky [U.S.A.], Fortunato Benalm [Argentina], Joseph W. Connelly [U.S.A.], Alfonso D'Avino [Italy], Bromley S. Freeman [U.S.A.], Robert Hardaway [U.S.A.], Eugenio Bonavita [Uruguay], Hector Marino [Argentina], Ernesto Malbec [Argentina], Ralph Millard [U.S.A.], Ivo Pitanguy [Brazil], Austin D. Potenza [U.S.A.], Gilbert Senechal [France], James W. Smith [U.S.A.], and Richard Stark [U.S.A.].

The scientific meetings took place during the morning and the afternoon. At the end of each of them a panel discussion took place. These panels were led by prominent surgeons to whom the participants asked written questions about the corresponding subjects of the session.

The official subjects of the Congress were distributed in four groups: 1. Surgery of the Hand. — 2. Burns and Shock. — 3. Maxillo-facial Surgery. — 4. Aesthetic Surgery.

Besides these subjects, many others were presented during the session of Free Subjects. There were numerous scientific films most of them of excellent quality.

Since it is impossible for us to comment on each of the papers presented we shall mention those which caught the main attention of the participants:

"Abductor Digiti Quinti Transfer for Thumb Opposition" (film), William Littler and presented by Eugenio Bonavita.

"Aneurysms of the Palmar Arteries", James W. Smith.

"Pathology and Treatment of Burn Scars in the Dorsum of the Hand", Hector Ardao.

"Reconstruction of the Thumb by a Toe Transplant", Bromley Freeman.

"Mechanisms of Healing of Digital Flexor Tendons", Austin D. Potenza.

"Surgical Treatment of Decubitus Ulcers", Guillermo Rojas-Rodriguez.

"Therapeutic Indications of Hemangiomas", A. Rodriguez de Lima.

"Vaginoplastica with Skin Graft", Bension Goldemberg, Alvaro Vallejo, and Fabio Henao (with film).

"Bases for a Better Understanding of the Problems of Burns", Fortunato Benaim.

"Plastic Surgery in the Hiroshima Atomic Bomb Victims", Arthur Barsky.

"Influence of Fibrinolysin in Shock", Robert Hardaway.

"Mastoplasty", Hector Marino.

"Classification of Facial Anomalies", Richard Stark.

"Grafts and Prosthesis in Rhinoplasties", Ernesto F. Malbec.

"The Use of the Island Flap for Cleft Palate Lengthening", Ralph Millard.

"The Problem of the Nasal Base in Rhinoplasties", Gilbert Senechal.

"Function and Aesthetics of the Nasal Tip", Alfonso D'Avino.

"Utilization of the Endobuccal Vestibular Approach in Rhinoplasties", Gilbert Senechal.

"Pharyngeal Flaps", León Hernández.

"Ileocystoplasty with Inverted Seromuscular Flaps" (Reconstruction of Functional Bladders), Pablo Gómez Martínez.

"Reposition and Harmonization of the Septum", Gilbert Senechal.

On Thursday August 30, during the afternoon a session took place together with the participants of the "Congreso Latinoamericano de Cirugía Oral", in which interesting lectures on Maxillofacial Surgery were presented. We must mention here the presence of the Oral Surgeons Guillermo A. Ries Centeno, from Argentine, Lowell Mc Kelvey, from Puerto Rico and Waldemar Wilhelm from Colombia.

The participants of the Congress belonging to the Latin American Society of Plastic Surgery of the Northern Zone Countries, held a general assembly in which among others the following decisions were made:

1. The creation of the "Latin American Foundation of Plastic Surgery Society" was approved. This project was presented by Bension Goldemberg and he was encharged with coordinating its functions.

2. It was decided to recommend to the Editor of the Journal of the Sociedad Latino-Americana de Cirugía Plástica to translate all the scientific articles into Spanish.

3. To recommend all the members to take out a subscription for the Revista Latino-Americana de Cirugía Plástica.

4. To recommend members to take out a subscription for the Journal of Plastic Surgery and especially for the Journal of the Sociedad Latino-Americana de Cirugía Plástica, for Acta chirurgiae plasticae of Prague, for Plastic and Reconstructive Surgery, for the British Journal of Plastic Surgery etc.

5. Caracas, Venezuela was chosen to be the place of the "2nd. Latin American Congress of Plastic Surgery, Northern Zone" and A. Rodriguez de Lima was elected to be Convener of the Executive Committee.

6. Dr. Goldemberg's following proposition was approved: Any Plastic Surgeon, who for any reason ceases to belong to his respective Society, automatically stops being member of the Latin American Society of Plastic Surgery. This proposition must be approved by the General Assembly of the Southern Zone of the S.L.A.C.P.

The social activities for the participants were numerous, of which we will mention the Lunch at the Lagartos Club, preceded by a Water Skiing exhibition and a visit to the famous Salt Cathedral of Zipaquirá.

The official ending took place at the elegant Militar Club of Bogotá with a splendid Banquet.

The Executive Committee is preparing the publication of a well illustrated book on the Transactions of this Congress.

ANNOUNCEMENTS

The American Cleft Palate Association (formerly the American Association for Cleft Palate Rehabilitation) will hold its twenty-first annual meeting on May 9, 10 and 11, 1963, at the Shoreham Hotel in Washington, D.C. — U.S.A.

Richard C. Webster, M. D., Brookline, Massachusetts, is President of the Association. The Program Chairman is Mohammad Mazaheri, D.D.S., Lancaster, Pennsylvania — U.S.A.

An International Anaesthesiological Symposium sponsored by the Hungarian Anaesthesiological Society and dealing with the subject of the choice of anaesthesia in certain branches of surgery, will be held in Budapest on Sept. 25, to 28, 1963.

The agenda is to comprise the questions of anaesthesia in gynaecology, obstetrics, urology, ophthalmology, otolaryngology, paediatric surgery, neurosurgery and neuro-traumatology. In the morning of Sept. 28, a panel discussion will be held on the subject: "Organizational Problems of an Anaesthesiological Service".

The secretariate of the Symposium will be pleased to send a preliminary programme on request.

Adress of the secretariate:

"Symposion Internationale Anaesthesiologiae — Budapest 163",
Clin. Chirurg. Ia Ullői ut. 78, Budapest VIII, Hungary

At the 5th Conference of the Polish Society of Plastic and Reconstructive Surgeons, the following officers were elected for the next two years:

Dr Michael Krauss, President

Dr Teobald Adamczak, Vice-President

Dr Zygmunt Kratochwil, Secretary

All correspondence should be adressed to: Sekcja Chirurgii Plastycznej Towarzystwa Chirurgów Polskich, Szpital Chirurgii Plastycznej, Dworkowa 1, Polanica-Zdrój, Poland.

PRELIMINARY INFORMATION FOR CONTRIBUTORS

Original papers on all aspects of plastic surgery can be accepted for publication in *Acta chirurgiae plasticae* in Russian, English, German and French. Two clearly legible copies of the manuscript are required. Each article must be provided with an adequate resumé in at least three copies. The heading should include the name of the institution at which the work dealt with has been carried out, i. e. name of institution, name of the head of the institution with full academic title, in the case of a university clinic the name and place of the university. References should be listed in the internationally accepted manner. Illustrations: photographic documentation — black and white, not retouched, glossy. Drawings and graphs must be clear and suitable for reproduction. In the case of all illustrations a vertical arrangement is welcome. Illustrations must be clearly marked, with the lower edge indicated on the reverse side. Similarly the annotation of photographs and graphs on the reverse side must include their number and the author's name together with the title of the article. The proper position of each illustration should be clearly indicated in the manuscript so that it may be correctly placed in the text. The editorial board relies on authors to limit their articles to a reasonable length.

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