ACTA CHIRURGIAE PLASTICAE

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CLINICAL FEATURES OF MEDIAN CLEFT OF NOSE

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Median cleft of the nose is a rare congential deformity of the face. Though first already described by Beclard in 1823 (quoted by Galanti in 1961), up to the present time the disorder has only been little studied and reported on in the literature with reference to but single observations (Bekritsky, 1935; Sheftel, 1958; Shcherbatov, 1958; Mikhelson, 1962; Krikun, 1965; Burian, 1960; Galanti, 1961; Krmpotic, 1961; Lerner, 1965; Khoo-Boo-Chai, 1965).

The present communication is based on the investigation of 64 patients with median cleft of the nose, who called at the Institute between the years 1958 and 1970; most of them (51) were females (Tab. 1).

In the obstetric case histories, no repeating factor could be ascertained, which might have been connected with the development of this disorder. From his own experience, the author is unable to confirm or refute the theory of its hereditary transmission, adhered to by many authors (Esser, 1939; Esserova (quoted by Burian), 1960; Khoo-Boo-Chai, 1965), because he was only able to ascertain it in the issues of six patients in whom however, it manifested itself only by a doubled tip of the nose.

In many patients, the author observed psychogenic features in the development of their personality, accompanied by reactive phenomena which corresponded to the degree of deformity.

In median cleft of the nose, the local signs vary in dependence on the degree of involvement of the nasal tissues and the adjacent parts of the face. However, repetition of certain deformities and defects made it possible to divide the patients into the following groups:

1. median cleft of the cartilaginous component,
2. median cleft of the bony component and
3. median cleft of the chondro-osteal components of the nose.

In each of these groups, three degrees of the deformity may be distinguished:

first or initial degree,
second or medium degree,
third or severe degree.

This classification is of great assistance on chosing the appropriate mode of surgical treatment.

Median Cleft of Cartilaginous Component of Nose

First-degree cartilaginous cleft was diagnosed in twelve patients and was characterized by a shallow groove between the alar cartilages on the tip of the nose, frequently without any skin changes (Fig. 1). Moderate hypoplasia of the two alar and the septal cartilages is typical of this degree of deformity. The septal cartilage is often split on its anterior edge.

Tab. 1. Clinical Features of Median Nasal Cleft in Patients Registered between 1958 and 1970

Location and degree of cleft	Number of patients	Age (in years)						Sex	
		up to 5	up to 10	10—16	17—19	20—29	30—39	M	F
1st-degree cartilage involvement	12	1	—	—	2	8	1	2	10
2nd-degree cartilage involvement	6	—	—	1	1	4	—	—	6
1st-degree bone involvement	1	—	—	—	1	—	—	1	—
1st-degree cartilage and bone involvement	13	—	—	3	3	6	1	4	9
1st-degree cartilage and 2nd-degree bone involvement	3	—	—	—	—	3	—	—	3
2nd-degree cartilage and bone involvement	14	—	1	3	1	6	3	—	14
3rd-degree cartilage and 2nd-degree bone involvement	2	—	—	1	1	—	—	1	1
3rd-degree cartilage and bone involvement	13	3	1	4	1	2	2	5	8
Total	64	4	2	12	10	29	7	13	51

In second-degree cartilaginous cleft which was found in six patients, the groove on the tip of the nose is deeper, which is usually accompanied by rather marked skin changes. The greatly deformed alar-cartilage rudiments do not provide enough support for the apical part of the nose and jut into the nasal vestibule. Every part of the septum may be shorter and broader than normal (Fig. 2).

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Third-degree cartilaginous cleft which is characterized by the extreme manifestation of all changes referred to above, has not been encountered by the author in its isolated form.

The nasal bones, the frontal processes of the maxillae and the parts of the face nearest to the nose are developed and spaced normally in patients with median cleft of the cartilaginous component of the nose.

Fig. 1. Girl with median cleft of 1st-degree cartilage involvement.

Median Cleft of Chondro-Osteal Components of Nose

The deformities which are typical of this group of patients, not only involve all components of the nose (skin, nasal bones, frontal processes of maxillae, triangular and alar cartilages and columella), but also the facial regions nearest to the nose.

The cleft is usually of the same degree in bone and cartilage, however, in rare cases, it may be more conspicuous in one or the other component.

a) In first-degree chondro-osteal nasal cleft, there was — apart from the groove which, in the patients of this group (13), extended onto the bony and cartilaginous components of the nose — an M-shaped deformity present in the triangular cartilages and the nasal bones. The skin changes in the nose, which are also characteristic of the other types of median cleft, were of an inconstant appearance. So, for instance, considerable thickening of the skin alternated with areas of marked atrophy and scarring (usually

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Fig. 2. Girl with median cleft accompanied by a broad and short columella, 2nd degree.

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along the groove), and then again with areas of normal or atrophic skin. In some patients, there was a fistula or cyst present in the region of the groove.

Deformation of the nose was frequently accompanied by hypertelorism, mainly by wide separation of the eye brows.

b) F i r s t - d e g r e e   c a r t i l a g e   a n d   s e c o n d - d e g r e e   b o n e   i n v o l v e m e n t   was found in three patients. In these cases, the changes in bone were more pronounced than in group a).

c) I n   s e c o n d - d e g r e e   c a r t i l a g e   a n d   s e c o n d - d e g r e e   b o n e   i n v o l v e m e n t , the nasal groove which is usually quite deep, runs obliquely and divides the nose into two unequal halves. The dorsum nasi, particularly its bony component, and the columella are very broad (up to 5 cm in width).

Hypertelorism is very conspicuous; however, none of the patients of this group showed divergent strabismus (Fig. 3). In case the groove ran an oblique course, hypertelorism was asymmetrical, and was accompanied by asymmetry of the eye brows. Such anomalies were found in 14 patients.

d) T h i r d - d e g r e e   c a r t i l a g e   a n d   s e c o n d - d e g r e e   b o n e   i n v o l v e m e n t   was found in two patients, and was characterized by an extreme cleft of the cartilaginous component.

e) T h i r d - d e g r e   c a r t i l a g e   a n d   b o n e   i n v o l v e m e n t , i.e., the grossest changes in every tissue, were met with in 13 patients. The breadth of the bony part was often larger than that of the cartilaginous part of the nose. The nasal walls were set apart, the columella reached a width of up to 1.2 cm, and the distance between the medial eye canthi of up to 6 cm (already at a juvenile age). This severe hypertelorism was accompanied by divergent strabismus (Fig. 4).

Apart from marked hypoplasia of the alar and septal cartilages with the latter's typical cleft on the dorsum nasi, replacement of the atrophic bone tissue by cartilaginous structures was frequently observed. In addition, unusual flattening and thickening of the frontal processes of the maxillae was ascertained.

H y p o p l a s i a   o f   t h e   t i p   o f   t h e   n o s e   a n d   t h e   c o l u m e l l a   was a frequent clinical sign in median cleft of the nose of any location, but it was most conspicuous in the more pronounced forms of the deformity (1st to 3rd degree). This hypoplasia can be slight or very marked, and then requires special surgical treatment.

Thus, in several patients with second-degree cleft, the length of the columella was no more than 0.5 cm, and in some cases of third-degree cleft, there was practically no columella at all. Such a severely short columella was accompanied by flattening and hypoplasia of the cartilaginous components of the nose, particularly obvious by extreme hypoplasia of the septal cartilage (Fig. 5). In these cases, a 1 cm wide and 0.4 cm thick musculo-fibrous band was found under the skin, running from the hypoplastic alar cartilages towards the frontal bone and pulling the cartilages and the columella upwards.

Fig. 3. Girl with median cleft of 2nd-degree cartilage and bone involvement. — Fig. 4. Patient with median cleft of 3rd-degree cartilage and bone involvement. Hair wedge in forehead, hypertelorism, divergent strabismus, wide separation of eye brows.

This band traversed the bridge of the nose, thus filling the angle between the nose and the forehead and screening the bottom of the cleft.

On histological examination, these bands proved to be composed of smooth-muscle and connective tissue together with an areolar fibrous stroma rich in nerve endings and vessels, which showed an embryonic structure.

By pulling the alar cartilages and the columella towards the bridge, this band was evidently one of the main causes of their hypoplasia, similarly as would have resulted from any scar contracture. This circumstance suggests that it should be expedient to excise this band as soon as possible (in reasonable limits), in order to give the cartilaginous components of the nose and the columella a chance to develop normally (Fig. 6).

In several patients, marked hypoplasia (down to 0.8 cm in length) of one nasal ála (Fig. 7) was observed in addition to the deformities typical of median cleft of the nose.

In some patients, a l a t e n t m e d i a n c l e f t was found, which manifested itself by a conspicuous breadth of the nose both in its bony and cartilaginous components, though no real cleft was apparent. The dorsum nasi was broad and flat from the bridge to the tip (Fig. 7). In this form of the deformity, the nasal bones are usually well developed, but the alar cartilages are hypoplastic and pulled upwards by a muscular or fibrous band. The triangular cartilages are united on the dorsum nasi, forming a trapezium. The septal cartilage is split on its anterior edge and altogether hypoplastic as in the apparent forms of median cleft.

Thickness and cleft of the cartilaginous part of the nasal septum, as well as a b n o r m a l i t i e s i n t h e n a s a l v e s t i b u l e a n d t h e n a s a l c a v i t y are most typical of median cleft of the nose. They are based on abnormal position of the alar cartilages and the "twist" of their medial processes. The condition of the nasal mucosa, the position of the conchae and of the other parts of the nasal cavity are normal.

N a s a l r e s p i r a t i o n was slightly impaired in patients with marked cleft of the anterior edge of the setpal cartilage and even in those with greatly hypoplastic cartilaginous components of the nose, manifested by the transversely oval shape (flattening) of the nostrils and their deformation due to the abnormal position of the medial alar-cartilage processes.

X - r a y e x a m i n a t i o n o f b o n e s a n d t h e a c c e s s o r y s i-n u s e s of the nose was carried out in 27 patients with median cleft of the nose. In the antero-posterior projection of patients with second-to-third-degree cleft, the shadow of the pyriform aperture appeared double-peaked (Fig. 8).

In the radiograms of patients with latent median cleft of the nose, the fissure was partly or completely filled with bone tissue.

The clinical degree of the median groove of the nose usually corresponds to its radiological degree. However, the cleft which could be seen in the antero-posterior radiogram of some patients, could not be found on clinical examination, because it was screened by fatty or connective tissue.

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Fig. 5. Man with median cleft of nose. Hypotrophic cartilaginous septum. — Fig. 6. Man with median cleft of nose of 3rd-degree cartilage and bone involvement. Marked hypertelorism, hypoplasia of tip of nose and columella, cleft in upper-lip vermilion.

Fig. 7. Girl with median cleft of nose of latent bone and 2nd-degree cartilage involvement. Defect in left ala nasi. — Fig. 8. Radiogram of patient with median nasal cleft. Double peak of piriform aperture.

Fig. 9. Man with median nasal cleft of 3rd-degree cartilage and bone involvement. Short columella, hypertelorism, wide separation of eye brows, anomaly of dento-maxillary system. — Fig. 10. Boy with median nasal cleft. Absence of nasal bones, tip of nose and columella, hypertelorism, wide separation of eye brows, osteoma of frontal bone, median cleft of upper-lip, anomaly of dento-maxillary system.

In the profile X-ray projection of patients with median cleft of the nose, the nasal bones appeared slightly shortened due to hypoplasia.

The accessory nasal sinuses were normal in all patients, except in one, in whom an osteoma was found in the frontal sinus.

In all groups of patients with m e d i a n   c l e f t   o f   t h e   n o s e (including that of firset degree), the following a n o m a l i e s   o f   t h e   f a c e were observed: a) a not very conspicuous median cleft of the upper-lip vermilion (11); b) cleft palate (3); c) anomaly of the dento-maxillary system (17 — see Fig. 9); d) deformation of the auricles (19); and e) asymmetry of palpebral fissures, eye brows and microphthalmia.

In patients with second-to-third-degree median cleft, additional anomalies of the face were repeatedly observed, such as considerable deformation of the frontal bone characterized by two large tubera separated by a groove, as well as a triangle of hair in the middle of the forehead reaching down to its lower third, osteoma of the frontal bone (Fig. 10), etc.

One patient was suffering from a congenital heart defect, and congenital anomalies in the limbs were observed in three others.

CONCLUSIONS

1. In median cleft of the nose, all its components (skin, bone, cartilage, fatty and connective tissue, vessels and muscles) can be involved. i. e., show abnormal position, hyperor hypotrophy, etc.

2. The essence of the most typical changes in median cleft of the nose (except the groove) lies in hypotrophy and cleft of the anterior edge of the septal cartilage, in hypotrophy and deformation of the alar cartilages, in the abnormal position of the triangular cartilages and nasal bones, which are joined on the dorsum nasi forming a deep groove, and in hypotrophy of the terminal part of the nose and the columella.

3. The most frequent abnormalities of the face in median cleft of the nose are hypertelorism, divergent strabismus, a wedge of hair on the forehead, wide separation of the eye brows, median cleft of the upper-lip vermilion and abnormal development of the dento-maxillary system.

SUMMARY

The paper presents the results of observations in 64 patients with median cleft of the nose, which bear witness of the existence of three locations (cartilage, bone, cartilage and bone) and three degrees of this disorder. The teratogenic process can involve all structural components of the nose; skin, chondro-osteal skeleton, muscles and vessels. The essence of the most typical deformities in median cleft of the nose (apart from the groove) lies in hypoplasia of the septal cartilage and the cleft of its anterior edge, in hypotrophy and deformation of the alar cartilages, in the abnormal position of the triangular cartilage and nasal bones, which are joined on the dorsum nasi forming a deep groove, and in hypotrophy of the terminal part of the nose and the

columella. The most frequent abnormalities of the face in median cleft of the nose are hypertelorism, divergent strabismus, a wedge of hair on the forehead, deformation of the frontal bone, wide separation of the eye brows, median cleft of the upper-lip vermilion and abnormal development of the dento-maxillary system.

RÉSUMÉ

La clinique des fentes médiannes du nez

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Le travail présente des résultats des examens chez 64 des malades atteints de la fente médianne du nez. Ces résultats parlent en faveur de trois localisations (le cartillage, l'os et la combination de l'os et du cartillage) et de trois étapes de ce défaut. Le procès aboutissant à la naissance de ce défaut peut comprendre même toutes les componnentes du nez, c'est-à-dire la peau, se skelet cartillagineux et osseux, les muscles et les vaisseaux. La base des changements les plus typique de la fente du nez médianne (sauf le sillon) repose sur le développement insuffisant du cartillage du septum et de la fente de sa partie visant le dorsum du nez, sur l'atrophie et déformation des cartillages allaires, sur la position anormale des cartillages triangulaires formant sur le dorsum du nez par leur union un sillon, et finallement sur le manque de la pointe du nez et sur le manque du septum cutaneux. Les déformations de la face les plus fréquentes en suite de la fente médianne du nez sont l'hypertélorisme, strabismus divergens, les sourcils trop éloignés, des cheveux en forme de triangle sur le front, la déformation de l'os frontal, la division médianne du lèvre supérieur (de sa partie rouge) et, finallement, sur le développement anormal de l'appareil des dents et de la mâchoire.

ZUSAMMENFASSUNG

Klinik der medialen Nasenspalten

L. A. Krikun

In der Mitteilung berichtet man über die Beobachtungsergebnisse bei 64 Kranken mit medialen Nasenspalten. Diese Ergebnisse zeugen von drei Lokalisierungen (im Knorpel, im Knochen und gemeinsam im Knochen und im Knorpel) und drei Stufen dieses Defektes. Der Prozess, der zur Defektentwicklung führt, kann alle Nasenteile befallen (Haut, Knochen- und Knorpelskellett, Muskeln und Gefässe). Das Prinzip der typischsten Veranderungen bei medialen Nasenspalten (mit Ausnahme der Furche) beruht auf unvollkommener Entwicklung des Septumknorpels und auf der Spalte seines zum Nasenrücken gewandten Abteils, ferner auf abnormaler Lage der dreieckförmigen Knorpel und Nasenknochen, die am Nasenrücken zu einer Rinne verbunden sind, und schliesslich auf der Nichtentwicklung der Nasenspitze und der Nasenscheidewand. Die häufigst vorkommenden Veranderungen im Gesicht bei der medialen Nasenspalte sind Hypertelorismus, divergenter Strabismus, Haarkeil an der Stirn, Deformation des Stirnknochens, breiter Abstand zwischen den Augenbrauen, mittlere Verteilung der Rote der Oberlippe und abnormale Entwicklung des Zahn-Kieferapparates.

RESUMEN

Clínica de las grietas medianas de la nariz

L. A. Krikun

En el informe se presentan los resultados de la observación en 64 enfermos con las grietas medianas de la nariz. Estos resultados demuestran tres localizaciones (en el cartílago, en el hueso y en el hueso y cartílago) y tres grados de este defecto. El proceso, el que tiende al desarrollo del defecto, puede atacar todos los componentes de la nariz (la piel, el esqueleto huesoso y cartilaginoso, los músculos y los vasos). La substancia de los más típicos cambios en la grieta de la nariz mediana (excepto la raya) es en el desarrollo incompleto del cartílago septal y en la grieta de su parte que se dirige al dorso de la nariz, en la atrofia y en la deformación de los cartílagos de ala, en la posición anormal de los cartílagos triangulares y de los huesos de nariz juntados en el dorso de la nariz en la reguera y finalmente en el mal desarrollo de la punta de la nariz y del tabique de piel. Los más frecuentes cambios en la cara en la grieta mediana de la nariz son el hipertelorismo, estrabismo divergente, la cuña de pelo en la frente, la deformación del hueso de frente, un espacio ancho entre las cejas, la división central del color rojo del labio superior y el desarrollo anormal del aparato del maxilar dentario.

REFERENCES

1. **Krikun, L. A.:** Vestn. Oto-rino-laring., 1 : 55, 1965.

2. **Mikhelson, N. M.:** Reconstructive Operations in the Maxillo-Facial Region. Moscow, 1962.

3. **Burian, F.:** Acta Chir. plast., 2 : 180, 1960.

4. **Galanti, S.:** Ann. Laring., 60 : 583, Torino, 1961.

5. **Krmpotic, J.:** Arch. Ohr- Nas- u. Kehlk.-Heilk., 177 : 417, 1961.

6. **Lerner:** Plast. reconstr. Surg., 34, 2 : 197, 1965.

7. **Khoo-Boo-Chai:** Plast. reconstr., Surg., 36, 6 : 626, 1965.

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OPERATIVE METHODS OF PALATOPLASTICS IN CONSIDERATION OF THE POSTERIOR NEUROVASCULAR BUNDLE

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Only a little more than 150 years ago the first palatoplasty was successfully carried out. Instruments and technique were rather crude at first, there were only few personal experiences and no wonder that the results were not satisfactory. Wardill wrote in one his reports in 1928 that amongst currently applied operations only a very small percentage shows up good or perfect results and that it requires a high dose of optimism on part of the surgeon to continue in this work. He stated further that the anatomic closure between the nasal and oral cavity was in a high percentage of cases achieved by surgeons specially trained for such operations. With regards to rehabilitation of speech the results were also practically unequivocal, but unequivocally bad from this aspect. When asked "what then the surgeon may be able to achieve in operative steps in patients afflicted with cleft of the palate?" Wardill replied that according to results at the time, one patient out of ten is able to speak well, the only benefit the other patients have from the operation is that their oral cavity is separated from the nasal cavity.

Since this comment by Wardill in 1928, surgery of clefts advanced and underwent many changes. Changes in that sense that we are in a position to declare to-day that the relation of unsuccessfully treated cases to successfully treated cases has reversed so that there are not 90% badly speaking and 10% well speaking patients but rather 90% well speaking and 10% badly speaking persons. It was the dissatisfaction on part of Wardill and Kilner with the unsuccessful surgical rehabilitation of patients with palatal clefts in the first 40 years of our century which caused the reversion of unsuccessfully treated percentage, at least to a great extent. These two surgeons suggested a new technique of palatoplasty in 1937, which affords with different modifications and supplementations to the experienced surgeon good anatomic and also functional results in a high percentage of operated on cases.

Various techniques and tactics are used in surgery of palatal clefts at present. Those of us who carry out routine checks in their patients in the years following the primary operation, are aware of the fact that there still remains

a certain percentage of unsatisfactory results, stigmatising patients with cleft of the palate by bad speech, hearing defects, defects of facial growth and sometimes by psychologic or psychosocial problems.

What are the reasons for these unsatisfactory results? I divide them into the following categories: 1. technical efficiency of the surgeon, 2. tactical approach and timing in special individual problems, 3. possibilities afforded by different operative methods. It is this last category which I should like to discuss here.

The number of secondary corrective operations is in large series the direct indicator of the suitability of the given method (type of operation).

The Langenbeck type of palatoplasty is being combined by adherents to this type of operation with primary pharyngeal flap, because even if the operation is carried out by the best hands, if bridge flaps are used a short palate is produced in 50% of the operated on cases. Others, being aware of the disadvantages of mucoperiostal bridge flaps, suggested new types of primary palatoplasty with the palate being pushed back, prolonged or at least not shortened. Many names would have to be recalled in connection with technical improvements and progress in palatoplasty. Omitting the history I should like to draw your attention now to a discussion of V — Y and W — Y technique as we have been carrying it out with certain modifications at the Department of Plastic Surgery in Bratislava systematically since 1950.

Wardill and Kilner published this technique in 1937. By oblique incision of the oral mucoperiosteum, three flaps are formed in clefts of only the soft palate (V—Y palatoplasty) and four flaps in complete clefts of the secondary palate (W—Y palatoplasty). Complete clefts of the primary and secondary palate are closed in two operations. In the course of cheiloplasty the nasal base and the anterior palate is sutured at least up to foramen incisivum by means of mucoperiostal flaps and thus the complete cleft is changed into a cleft of the secondary palate. In the second operation this cleft is closed by elongation by means of four flaps (W—Y).

Elevation of the palatinal mucoperiosteum alone, does not yet prolong the palate. The soft palate must be completely freed from the posterior edge of the hard palate which is short in many cases and keeps the connected soft palate in frontal direction and away from the posterior pharyngeal wall. In "push back" operations (Dorrance, J. B. Brown) the nasal mucosa and the fibrose connection is simply separated at the posterior edge of the palatine bone. Some surgeons (Barsky, Cronin, Manchester) form flaps of nasal mucoperiosteum at the base of the nasal cavity covering by their means the open wound at the nasal aspect of the retropositioned soft palate. At our Department we free completely the fibrose connection of the soft palate with the bone, free the tensor-levator system from its pathologic position, disconnect the nasal mucoperiosteum sufficiently for suture without stretching, but do not cut it through.

These are the procedures taken with the purpose of mobilizing the n a s a l m u c o p e r i o s t e u m in the process of palatal elongation. Something must

of course also be done with the posterior neurovascular bundle, which keeps the oral-mucoperiostal flaps in forward position. This problem has been solved in different ways. In 1927 Limberg recommended to c h i p o f f the posterior wall of the pterygopalatinal canal and warned against cutting the neurovascular bundle. This procedure was introduced by Conway in America in 1947 and was accepted by many surgeons as routine procedure in "push-back" operations and elongation palatoplasty.

The use of hammer and chisel on the growing maxilla in order to chip off the posterior wall of the pterygopalatinal canal is a traumatizing interference and for this reason many surgeons prefer to p u l l o u t the posterior palatinal artery from its canal "as a bird pulls out a worm from its hole in the ground" as Yules declared in one of his surveys in 1970.

I imagine this manouvre to be only successful in cases where this is actually not even necessary, the palate being sufficiently long. If the palate is really short, such pulling out of the nervo-vascular bundle will not be sufficient. If this is done by force the contents of this bundle are damaged or even torn. A safe method is the d i s s e c t i o n of the posterior neurovascular bundle from the posterior mucoperiostal flaps, as suggested by J. B. Brown in 1937 and by Millard and Edgerton in 1962.

Arthur Barsky wrote in 1964 in his book the following interesting sentences which I should like to repeat word by word: "Whereas W-Y and "push-back" procedures are able to afford l i m i t e d retroposition, two obstacles prevent the surgeon from producing an o p t i m a l amount of retroposition: 1/ the neurovascular bundle which can not be mobilized as much as is being reported and 2/ the secondary contraction of any type of wound area left on the nasal aspect. I f m a n w a s a l l o w e d t o c u t t h r o u g h t h e n e u r o - v a s c u l a r b u n d l e, the first obstacle could be removed but the possible complications are so obvious that this operational step is not being recommended (Broadbent and Hochstrasser 1959)."

I read this declaration by the esteemed and experienced plastic surgeon with great interest, because at that time I had already ligated and cut through posterior neurovascular bundles for the purpose of elongation, about 1000 times. Pulling the neurovascular bundle out, did not seem sufficiently effective to me and ostectomy seemed to contradict the basic principles of atraumatic technique. I studied regional anatomy in detail and arrived at the opinion that neither development of the soft palate nor growing maxilla could suffer by cutting through the neurovascular bundles. In 1952 I decided to cut the neurovascular bundles in each of my W/V-Y palatoplasty and to study the effect of this undertaking as a longitudinal clinical experiment. Now in 1971 I am convinced that this practice affords in a simple manner achievement of maximum elongation possible with neither immediate nor late effect in the patient. Such free elongation decreases the percentage of necessary secondary corrective steps radically.

It would be too lengthy to describe the anatomy of blood supply and innervation of the palate in detail within this report. If studied in detail however,

it is clear that interruption of the neurovascular bundles can not damage innervation and function of mucous glands in the soft palate, blood supply of the
soft palate nor the growing maxilla. The descending palatine arteries and
nerves supply only the mucoperiosteum of the hard palate and a sufficient
amount of clinical proof that the posterior mucoperiostal flaps survive ligature
without noticeable complications, is at hand. The only nerve fibres which
might possibly influence development and quality of the soft palate, are the
fibres of the small palatine nerves but they do not escape any palatoplasty
with the exception of osteoperiostal plasty of the Dieffenbach type.

On basis of longterm observations in a large series of operated on patients
and on basis of experiments in Beagle puppies (aged six weeks at the time of
operation) I should like to repeat that cutting through the neurovascular
bundles in W/V-Y palatoplasty causes no damage in the healing of the flaps
and causes by itself no damage to the growing maxilla. The explanation is
simple. The reason is that these structures obtain their blood supply and innervation of mucose glands of the soft palate from other sources and the small
contribution from the descending palatine artery and nerve can be readily
compensated by rich anastomosis from the vicinity.

Cutting through the posterior nervovascular bundles affords mobilisation
of the posterior flaps to a greater extent than the extraction from the foramen
or ostectomy. The vascular supply of the palatine mucoperiosteum is cut in
W/V-Y palatoplasty by oblique incision and ligature for the purpose of complete
freeing of the flap, occurs only 10 to 12 mm behind this first interruption at
the frontal edge of the posterior flap. Ligature above foramen is a simpler
procedure than dissection and furthermore cutting through the bundle affords
complete and direct approach to the posterior edge of the hard palate in the
process of freeing the soft palate from its attachements to the bone.

This separation from the attachments on the bone must be complete. As
soon as all attachments of the soft palate were separated from the bone (at
the edge of the cleft itself, on the posterior edge of the bony palate, from
tuberositas maxillae and from the posterior edge of the medial pterygoidal
plate) and as soon as the nasal mucoperiosteum has been sufficiently mobilized
in direction of the base of the nasal cavity — medially from the cleft and in
ventrodorsal direction from the posterior edge of the hard palate — then the
musculature of the soft palate dislocated forward to the shortened posterior
edge of the cleft hard palate and f r e e d from it will mobilize the soft palate
in posterior direction. The extent of this retroposition (elongation) may be
clearly seen and measured on the distance of the shining sectioned edge of the
anterior fibrose segment of the soft palate from the posterior edge of the bony
palate. Between these two borderlines the elongation is indicated by the width
of the blue-grey mucosa.

The only limiting factor preventing completely free mobilization of the
soft palate in direction to the posterior pharyngeal wall is in this stage of the
operation, the nasal mucoperiosteum. We mobilize this nasal mucoperiosteum
in our W/V-Y palatoplasty but we do not cut it through as it is done in the so

called "push-back" palatoplasty. Thus we evade the wound area on the nasal aspect of the palate where the mucoperiosteum of the hard palate and mucosa of the soft palate is sutured completely without defect.

This method of semi-radical mobilization of the soft palate c o m b i n e d w i t h   f r e e i n g   t h e   t e n s o r - l e v a t o r   s y s t e m dislocated in forward direction affords in experienced hands more than 80% competent palates in large series and this is certainly more than the approximately 50% achieved according to the statistics published by Langenbeck type of palatoplasty without primary pharyngeal flap. The nasal mucosa is sutured along the entire length of the cleft and no open wound area remains on the nasal aspect for secondary contraction. The secondary contraction after the operation is for these reasons minimal and the soft palate remains soft and freely mobile.

CONCLUSIONS

The main steps in modern W/V-Y palatoplasty may be summed up into the following points:

1) complete freeing of the soft palate from the bony attachments

2) freeing of the tensor-levator system dislocated in anterior direction

3) freeing of the transversal tension on the suture a) by elongation of the tensor by means of hamulus infraction, b) medial mobilization of the lateral pharyngeal wall

4) complete suture of the nasal mucoperiosteum of the hard palate and nasal mucosa of the soft palate without defect which would heal by contraction of the soft palate.

5) elongation of the palate achieved by freeing the levators from their pathologic attachment occurs by suture of the mucoperiostal flaps by W/V-Y method. Yet particular care must be taken in the reconstruction of the levator arch by careful suture in the functional central third of the soft palate.

6) detailed knowledge of the anatomy and function of the participating structures and atraumatic surgical technique are the principal conditions for successful operation.

Those who carry out primary pharyngeal flaps for supplementing palatoplasty, do so according to my experiences unnecessarily in at least 80 out of 100 cases.

SUMMARY

At the Department of Plastic Surgery, Komenský University, Bratislava palatoplasty has been carried out systematically by the same method since 1950. The basis forms the 3 and 4 flap palatoplasty Wardill-Kilner which has been modified in some details in the course of the years. The palate is amply mobilized medially and in ventrodorsal direction. Mobilization in medial direction is achieved from the Ernst's space by infraction of hamulus and by freeing the lateral lamellae of the upper constrictor from its attachement at the posterior edge of the medial lamella of processus pterygoideus. Mobilization of the soft palate in direction to the posterior wall of the pharynx is carried out by

1) ligature and cutting the posterior neurovascular bundles and

2) complete detachment of the muscles of the soft palate from their pathologic attachment on edges of the cleft hard palate. After their freeing from the bone and carefully also from the nasal mucosa, the muscles will take up spontaneously their position in the central functional third of the soft palate. Precise suture of these repositioned muscles establishes suitable conditions for correct function of the soft palate. When the patients were last controlled in 1969 (50 patients 5 years and 50 patients 10 years after the operation) the group of experts ascertained (the results will be published) that in 87% of examined cases speech was good and no secondary necessary. The author does not make currently operation pharyngeal flaps.

On basis of detailed studies of regional anatomy, observations in patients during a period of 20 years and on basis of not yet published experiments in puppies (carried out jointly with Dr. Kremenák of Iowa University) the author declares that ligation of the posterior neurovascular bundles is not of negative influence upon development of the soft palate or maxilla.

RÉSUMÉ
Méthodes opératoires de la palatoplastique par rapport spécial au faisceau neurovasculaire postérieur
Š. Demjén

A la clinique de chirurgie plastique de l'Université Komenský à Bratislava, la palatoplastique se réalise depuis 1950 en utilisant systématiquement une seule méthode. C'est la palatoplastique de 3 et 4 lambeaux de Wardill — Kilner laquelle on prend pour la base et qui était modifiée en détail au cours des années. Le palais est richement mobilisé dans la direction médiale et ventrodorsale. On réalise la mobilisation dans la direction médiale de l'espace de Ernst en faisant une infraction du hameçon et en dégageant la lamelle latérale du constricteur supérieur à partir de son insertion au bord postérieur de la lamelle médiale de l'apophyse ptérygoïde. La mobilisation de la voile du palais dans la direction vers la paroi postérieure du pharynx se réalise

1. par la ligature et la discision des faisceaux neurovasculaires postérieurs et

2. par la séparation complète des muscles de la voile du palais à partir de leur insertion pathologique au bord de la fente raccourcie de la voûte palatine. Après avoir dégagé les muscles mentionnés de l'os et, bien soigneusement, aussi de la muqueuse nasale, ceux-ci prennent spontanément leur position naturelle dans le tiers fonctionnel central de la voile du palais. Une suture précise de ces muscles rémis en place engendrera les conditions favorables pour une fonction correcte de la voile du palais. Pendant le dernier contrôle de nos malades en 1968 (50 malades de 5 ans et 50 malades de 10 ans après l'opération) la commission des experts a constaté (les résultats seront publiés) que dans 87% de cas la prononciation des malades examinés était bonne et c'est pourquoi il n'a pas été besoin d' une intervention secondaire. L'auteur lui-même ne fait pas professionnellement le lambeau primaire de pharynx.

En conséquence d'une étude détaillée de l'anatomie régionale, de l'observation des malades durant 20 ans, même qu'en conséquence des traveaux expérimentaux sur des petits chiens qui n'étaient pas encore publiés (en coopération avec Dr. Kremenák de l'Université de Iowa), l'auteur déclare que la réalisation des ligatures des faisceaux neurovasculaires postérieurs n'exerce aucune influence négative sur le développement ni de la voile du palais, ni de la voûte de celui-ci, ni du maxillaire.

ZUSAMMENFASUSSUNG

Die Operationsmethoden der Palatoplastik mit Hinblick auf das hintere neurovaskuläre Bündel

Š. Demjén

An der Klinik der plastischen Chirurgie der Komenský-Universität in Bratislava wird die Palatoplastik seit dem Jahre 1950 systematisch mittels einer Methode ausgeführt. Als Ausgangsbasis dient die Drei- und Vierlappenpalatoplastik nach Wardill-Kilner, die im Verlauf der Jahren in ihren Einzelheilten modifiziert wurde. Der Gaumen wird medial und in Vorderhintenrichtung ausgiebig mobilisiert. Die Mobilisierung in der Medialrichtung erfolgt aus dem Ernstschen Raum und zwar durch Infraktion des Hamulus und Freilegung der lateralen Lamelle des oberen Konstriktors von ihrem Ansatzpunkt an der hinteren Kante der medialen Lamelle des processus pterygoideus. Die Mobilisierung des weichen Gaumens in der Richtung zu der hinteren Wand des Pharynx erfolgt durch

1. Ligatur und Durchschneidung der hinteren neurovaskulären Bündel und durch

2. völlige Trennung der Muskeln des weichen Gaumens von dem pathologischen Ansatzpunkt derselben an den Kanten des verkürzten gespaltenen harten Gaumens. Nach Trennung derselben vom Knochen und nach vorsichtiger Trennung von der Nasenschleimhaut nehmen die Muskeln in dem mittleren Funktionsdrittel des weichen Gaumens ihre natürliche Lage ein. Die präzise Sutur dieser reponierten Muskeln bildet günstige Bedingungen für die richtige Funktion des weichen Gaumens. Bei der letzten Kontrolle unserer Kranken im Jahre 1969 (50 Kranke fünf Jahre und 50 Kranke zehn Jahre nach Operation) hat die Expertenkommission festgestellt (die Ergebnisse werden veröffentlicht werden), dass in 87 % der untersuchten Fälle die Sprache gut war und dass kein sekundärer Eingriff benötigt wurde. Der Autor bildet nicht routinemässig einen primären Pharyngeallappen.

Auf Grund des eingehenden Studium der regionalen Anatomie und der Beobachtungen an Kranken nach 20 Jahren sowie auch an Hand noch nicht publizierter experimenteller Arbeiten an kleinen Hunden (gemeinsam mit Dr. Kremenák von der Universität in Iowa) behauptet der Autor, dass die Ligatur der hinteren neurovaskulären Bündel die Entwicklung des weichen Gaumens und der Maxilla negativ nicht beeinflussen kann.

RESUMEN

Métodos operativos de la cirujía plástica del paladar con respeto al fascículo neurovascular posterior

Š. Demjén

La paladaroplastia se efecta en la Clínica de la Cirujía Plástica de la Universidad de Komenský en Bratislava desde el año 1950 sistemáticamente por medio de un solo procedimiento. Este se basa en la paladaroplastia de Wardill-Kilner que usa 3 o 4 injertos y que ha sido modificada en pequeños detalles en el transcurso de los años. El paladar se moviliza reciamente en dirección medial y ventrodorsal. La movilización dirección medial se consigue desde el espacio de Ernst por medio de una fractura incompleta del gancho y el desprendimiento de la lamela lateral del constrictor superior de su inserción en el borde posterior de la lamela medial de la apófisis pterigoides. La movilización del paladar blando hacia la pared posterior de la faringe se realiza mediante:

1. una ligadura y un corte de los fascículos neurovasculares posteriores y

2. una separación completa de los músculos del paladar blando de su inserción patológica en los bordes del paladar duro fisurado y cortado. Después de ser soltados del hueso y de la mucosa nasal los músculos adoptan su posición natural en el tercio funcional medial del paladar blando. Una sutura precisa de éstos músculos repuestos forma las condiciones oportunas para una buena función del paladar blando. Durante el último control de nuestros pacientes en el año 1969 [50 pacientes operados hace 5 años y 50 pacientes operados hace 10 años] una comisión de expertos constató que el habla fue mejorada en 87% de los casos examinados y una intervención secundaria no fue necesaria. El autor no hace el injerto faringeal primario por rutina.

En base de un estudio minucioso de la anatomia regional, de observaciones de los pacientes durante 20 años, así mismo como en base de trabajos experimentales llevados a cabo en perros jóvenes y que no han sido hasta ahora publicados [en colaboración con el Dr. Kremenák de la Universidad de Iowa] el autor declara que una ligadura de los fascículos neurovasculares posteriores no afecta el desarrollo del paladar blando y de la maxila.

REFERENCES

1. **Braithwaite, F., Maurice, D. G.**: Importance of the Levator Palati Muscle in Cleft Palate Closure. Brit. J. plast. Surg., 21 : 60, 1968.
2. **Broadbent, T. R., Hochstrasser, A. E.**: Section of the Neurovascular Bundle: Its Effects on Palatal Bulk. Plast. reconstr. Surg., 23 : 607, 1959.
3. **Edgerton, M. T.**: Surgical Lengthening of the Cleft Palate by Dissection of the Neurovascular Bundle. Plast. reconstr. Surg., 29 : 551, 1962.
4. **Fára, M., Brousilová, M.**: Experiences with Early Closure of Velum and Later Closure of the Hard Palate. Plast. reconstr. Surg., 44 : 134, 1969.
5. **Fára, M., Sedláčková, E., Klásková, O., Hrivnáková, J., Chmelová, A., Šupaček, I.**: Primary Pharyngofixation in Cleft Palate Repair a Survey of 46 Years Experience with and Evaluation of 2,073 Cases. Plast. reconstr.. Surg., 45 : 449, 1970.
6. **Kriens, O.**: An Anatomical Approach to Veloplasty. Plast. reconstr. Surg., 43 : 29, 1969.
7. **Lewin, M.**: Plastic Surgery in Czechoslovakia. Plast. reconstr. Surg., 33 : 446, 1964.
8. **Millard, D. R.**: The Island Flap in Cleft Palate Surgery. Surg. Gynec. Obstet., 116 : 297, 1963.
9. **Peet, E.**: The Oxford Technique of Cleft Palate Repair. Plast. reconstr. Surg., 28 : 282, 1961.
10. **Rogers, B. O.**: Palate Surgery Prior to von Graefe's Pioneering Staphylorraphy [1816]: An Historical Review of the Early Causes of Surgical Indifference in Repairing the Cleft Palate. Plast. reconstr. Surg., 39 : 1, 1967.
11. **Ruding, R.**: Cleft Palate Anatomic and Surgical Considerations. Plast. reconstr. Surg., 33 : 132, 1964.

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FREE ADIPO-DERMAL GRAFTS IN THE SURGICAL TREATMENT OF PROGRESSIVE LIPODYSTROPHY

L. A. SOKOLOVA

Progressive lipodystrophy (Barraquer-Simons disease), which was first described in 1911, is one of the types of segmental disorders in fat metabolism, manifesting itself by the disappearance of fatty tissue from the head, face, neck, thorax and upper limbs; in the lower half of the body, subcutaneous fat is normally or even excessively developed.

This is a rare disease which is mostly found in women, usually starting to develop during childhood, most frequently between the age of six and eight. As a rule, the disorder is progressive, but has long-lasting remissions. Atrophy of the fatty tissue proceeds slowly, over years.

The aetiology and pathogenesis of progressive lipodystrophy have not yet been fully clarified. It was thought previously that its cause was an endocrine disorder (Marañon et Cascos, 1930), but this could not be confirmed by later clinical investigations, and is considered fallacious at present. The clinical and experimental experience of many authors (Simons, 1911; Parmelee, 1932; Chetverikov, 1943; Breytman, 1949; Shereshevsky, 1957; Shefer, 1962, and others) have come to the conclusion that the decisive role in the pathogenesis of progressive lipodystrophy is played by trophoneurosis in connection with limited and dynamic disorders of the vegetative centres in the hypothalamic part of the mesencephalon. According to many authors, the aetiological factor causing the diencephalic disorder, may be various infections or intoxications, but also psychical trauma, most frequently fright.

With lipodystrophy progressing, the face of the patient loses its rounded contour, the Bichat buccal fat-pads disappear, the facial skeleton becomes prominent, and in the face of a young person wrinkles appear in the skin, which become deeper when she smiles or speaks, thus disfiguring her still further and giving her the appearance of precocious senility. The parts of the body in which fat has disappeared, turn into models of muscles. In such cases — according to Simmonds — even on microscopic examination it may become difficult to find any subcutaneous fat. However, in the depth of the mamma or the orbit, fatty tissue does not become absorbed. In the extreme stage of the

Fig. 1. Patient R., a woman aged 17, progressive lipodystrophy

disease, the body of the patient demonstrates a conspicuous disproportion between the lower half, resembling a Venus of "ultra-Rubens" style, and the upper half, looking like a "skeleton with a death's head" (Fig. 1 a, b). The muscles, nerves and bones show no pathological changes whatsoever in the regions which have lost their fat, and the skin remains elastic, mobile and can easily be gathered into folds.

The patients suffering from progressive lipodystrophy frequently complain of getting quickly tired and irritated, of feeling chilly and dizzy, and of headache. Vegetative disorders, such as a low arterial pressure, tachycardia, acrocyanosis, a greyish hue of the skin, seborrhoea, etc., are observed quite frequently. No typical changes whatsoever can be found on the cranial nerves or the organs of the thorax and abdomen, neither has it been possible to disclose any noticeable deviation from the norm on laboratory examination of the blood, the urine or the metabolic processes. This distinguishes lipodystrophy from endocrine exhaustion in thyrotoxicosis or hypophyseal cachexia (Simons disease).

The prognosis, as to survival, of progressive lipodystrophy is good. However, improvement of the patient's condition has seldom been observed. Having reached its maximum extent, the process usually seems as though it has

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Fig. 2. Patient K., a woman aged 26, progressive lipodystrophy: a) prior to treatment, b) with plastmass inlays, c) one year after transplantation of free adipo-dermal grafts

come to a standstill, and the clinical picture then remains stable to the end of life.

Up to the present, no effective method of treatment of progressive lipo-dystrophy has been found. Any attempt at cumulating fat at the affected sites of the body by means of a high-caloric diet have failed so far. The patient gains weight, but fat is deposited in the subcutaneous tissue of the lower half of the body.

Conservative treatment does not eliminate the characteristic and most conspicuous symptom of progressive lipodystrophy, i. e., the disfiguring lean-
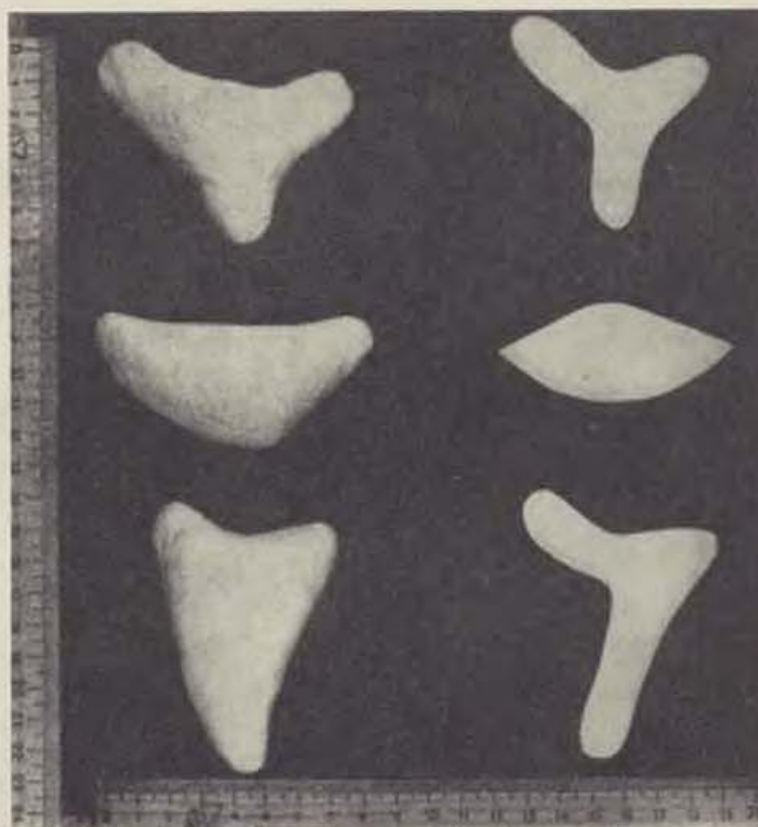

Fig. 3. Individual models of wax (left) and patterns cut from X-ray films (right), prepared before operation

ness of the face, which is particularly distressing to young people. Thus one of our patients (K.), a woman aged 26, was so depressed by her face growing thin that she constantly used inlays specially made of plastmass to fill the fallen-in cheeks (Fig. 2). Such patients can only be helped by filling the depressions in the face by means of a surgical intervention. In the available literature, the author did not encounter a description of a plastic procedure repairing the symmetrical atrophy of fatty tissue in the face in progressive lipodystrophy.

The author recommends a one-stage operation for the reconstruction of normal contours of the cheeks in this disease by means of a bilateral trans-

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plantation of free adipo-dermal grafts taken from the upper-outer quadrants of the buttocks. In order to be able to take these grafts during operation quickly enough and exactly of the required form, wax moulds are prepared beforehand, which have the shape and dimensions of the facial fat-pads ab-
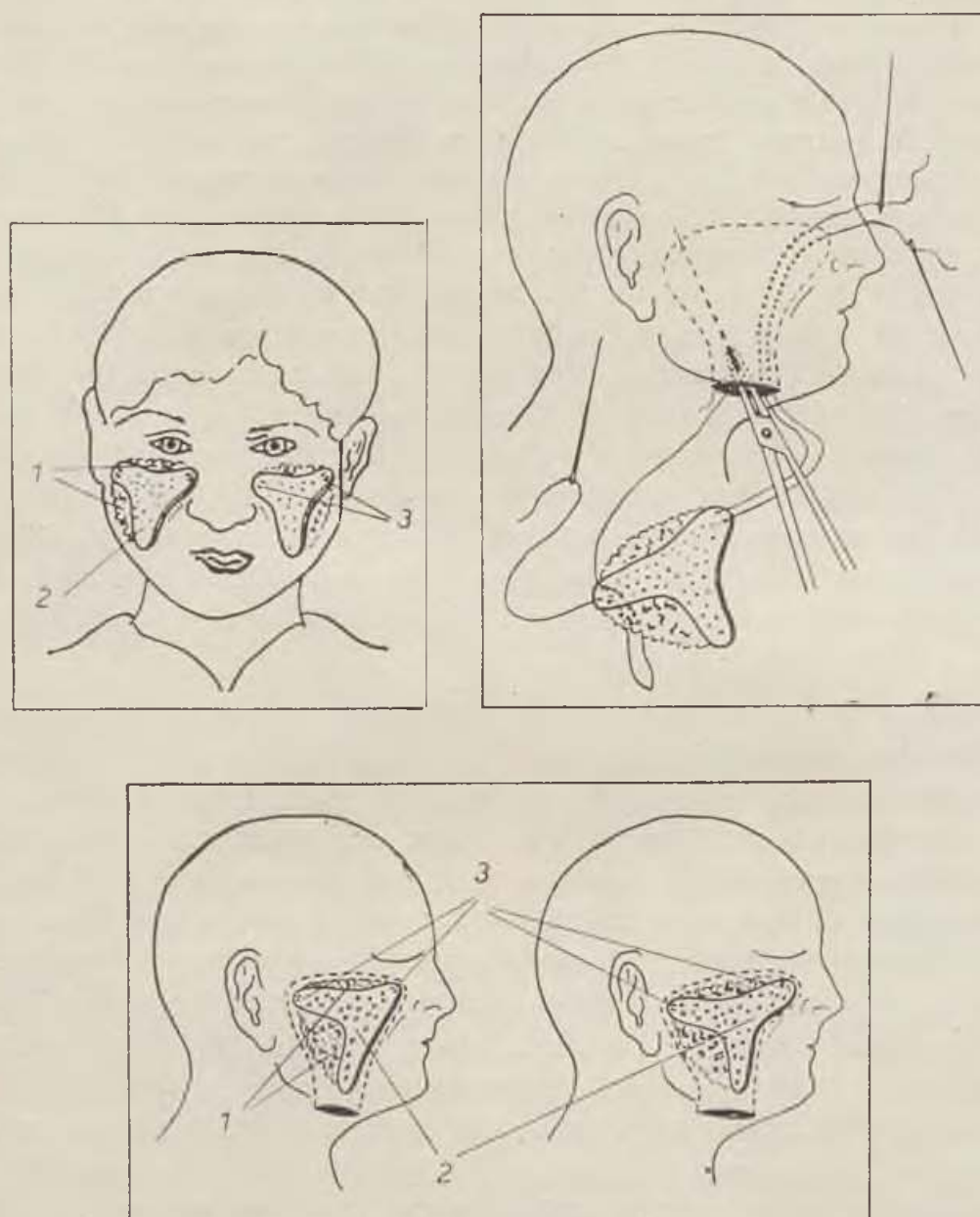

Fig. 4. Diagram of operation: 1 — fatty tissue, 2 — adipo-dermal layer, 3 — mattress sutures (for explanation see text)

sorbed during the lipodystrophic process. Moreover, patterns of X-ray films are cut, corresponding in shape and size to the dermal component of the grafts to be excised from the buttocks. At this stage, the possibility of laying untied sutures for subsequent closure of the wounds in the donor sites, is investigated (Fig. 3).

SURGICAL PROCEDURE

The operation starts with the formation of wide recipient cavities under the skin of the cheeks through incisions under the mandible or in the temporal regions. At the time during which haemorrhage is controlled by plugging the cavities with gauze pads and applying pressure from without, blocks of fatty tissue together with a supporting layer of corium are excised from the buttocks, of a size and shape corresponding to that of the wax models. Prior to excision, a split skin graft is taken off the site, which corresponds in shape to the X-ray film pattern. In order to achieve hypercorrection, the fatty part of the graft is taken 20% to 30% thicker than the wax model. Two catgut retaining sutures are laid to opposing edges of the transplant with 8 cm long and straight needles threaded to each end. These needles are caught in needle holders, one after the other introduced into the subcutaneous pocket in the cheek from the skin incision to the far end of the cavity, and thence punctured through the skin to the surface. The graft is then pulled into the prepared pocket bed by the catgut threads, placed into proper position and fixed by tying the threads over gauze rolls (Fig. 4). The skin wounds are closed by simple suture, and a pressure bandage is applied to the face, running the rolls from below upwards. The stitches are removed seven days after operation, but the pressure bandage remains in place for three to four weeks. In some cases antibiotics are administered before and after operation.

RESULTS

Since 1968, five patients have been operated on by the described method. The results were checked up after one to three years. During this time, some of the transplanted fatty tissue had undergone absorption, but complete atrophy was never observed. In all patients, the depressions in the cheeks had been filled permanently, and the skin did no more crease into senile-looking folds on smiling or speaking. All the patients were satisfied with the cosmetic results of the operation. Below a case history is presented for illustration.

Patient P., a woman aged 17, was admitted to the Maxillo-Facial Department on March 5, 1969, complaining of excessive leanness of her face, a process which had started at the age of five after scarlet fever. Sometimes she had been worried by dizziness and thirst, and had frequently suffered from furunculosis. Generally roboranting and sanatorial treatment had not arrested the process of the face growing thin.

On examination, there was marked symmetrical atrophy of the fat layer in the face, particularly in the region of the cheeks and temples. The facial skin was pale, of a greyish hue, could easily be gathered into folds and straightened out slowly after relief of the pressure. When smiling, deep longitudinal wrinkles formed on her cheeks. The layer of subcutaneous tissue in the cheeks, on the thorax and the upper limbs was markedly thin, while that on the trunk and thighs was some-what thicker than normal.

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Fig. 5. Patient P., a woman aged 17, progressive lipodystrophy: a) prior to operation, b) four weeks after transplantation of free adipodermal grafts, c) two years after operation

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The physical condition of the patient was good. The organs of the thorax and abdomen as well as the cranial nerves and the endocrine system did not show any pathological changes. Arterial pressure was 105/60 mm Hg and the blood and urine had no deviation from the norm. The case was diagnosed as progressive lipodystrophy. On April 3, 1969, under local anaesthesia, a plasty of both cheeks was carried out by the method described above, using free adipo-dermal grafts. The transplants were shaped accordingly and measured 8×7.5×2 cm. They were introduced into subcutaneous pockets in the cheeks through incisions made in the submandibular region. During operation, the patient received 200 ml of blood by transfusion, in order to compensate for the loss of blood. Antibiotics were not administered. The post-operative period was uneventful.

Two years after operation, the contours of the face looked good, and the patient was satisfied with this result (Fig. 5).

CONCLUSIONS

1. The plasty with free adipo-dermal autotransplants repairs the disfiguring leanness of the face in progressive lipodystrophy (Barraquer-Simons disease).

2. In symmetrical atrophy of fat in the face, a one-stage plasty of both sides of the cheeks is expedient.

3. In order to excise the adipo-dermal grafts as near to the required shape as possible, wax models imitating the atrophied fat accumulations in the face, should be made beforehand.

4. For the face plasty in progressive lipodystrophy, the transplants of fat are taken from symmetrical sites on the buttocks. They should somewhat exceed in size the amount required for correction, and should be supported by a strong layer of corium.

5. Introduction of fatty-tissue grafts into the roomy subcutaneous pockets can easily be realize through incisions in the submandibular and temporal regions, which are fully justified from a cosmetic point of view.

6. Mattress sutures laid at opposing sites of the graft edge, using long and straight needles, ensure good introduction of the graft, its proper spreading over the cavity and its fixation within it.

SUMMARY

A plasty is described in which free adipo-dermal grafts are employed for the repair of the disfiguring leanness of the face in progressive lipodystrophy (Barraquer-Simons disease). A total of five patients were operated on by this method. The results of this treatment, as checked up after one to three years, are good.

RÉSUMÉ

La plastie à l'aide du transplant adipo-dermal au cours de lipodystrophie progressive

L. A. S o k o l o v a

Le travail décrit la méthode de plastie à l'aide du transplant adipo dermal libre pour abolir la maigresse mutulante de la face au cours de lipodystrophie (Barraquer-Simons). Cinq des malades ont été opéré par cette manière et les résultats, contrôlés dans la période de une année a trois ans, ont été bien satisfaisant.

ZUSAMMENFASSUNG

Plastik mit losem Adipodermalpfropfen bei progressiver Lipodystrophie

L. A. S o k o l o v a

In der Mitteilung beschreibt man die Methode der Plastik mit losem Adipodermalpfropfen zur Behebung der deformierenden Gesichtsausmagerung bei progressiver Lipodystrophie (Barraquer-Simons). Es wurden mit diesem Verfahren fünf Kranke operiert und die nach einem bis drei Jahren überprüften Ergebnisse waren gut.

RESUMEN

Plástica por el injerto adipo-dermal libre en la lipodistrofia progresiva

L. A. S o k o l o v a

En el informe fue descrito el método de la plástica por empleo del injerto adipo-dermal libre para la eliminación del enflaquecimiento deformante de la cara en la lipodistrofia progresiva (Barraquer-Simons). Cinco enfermos fueron operados de este modo y los resultados reexaminados después de un año hasta tres años fueron buenos.

REFERENCES

1. **Breytman, M. Y.**: Progressive Lipodystrophy. Clinical Symptomatology and Differential Diagnosis of Endocrine Diseases, Leningrad, 1949, p. 625.

2. **Chetverikov, N. S.**: About the Clinical Vegetative Syndromes. 3rd issue of "Pathogenesis and Classification of Dystrophic Processes", Neuropathology and Psychiatry, Moscow, 12, 6 : 63, 1943.

3. **Shereshevsky, N. A.**: Barraquer-Si-

mons Disease, Klin. Endokrin., Moscow, 1957, p. 279.

4. **Shefer, D. G.**: Diencephalic Syndrome, Moscow, 1962, p. 199.

5. **Burian, F.**: Atlas of Plastic Surgery, Prague-Moscow, 1967, 1 : 106, 129—130: 2 : 39—41.

6. **Pešková, H.; Stockar, B.**: Hemiatrophia faciei progressiva, Acta Chir. Plast., 3 : 276, 1961.

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Preliminary Report

ALLOPLASTIC REPAIR OF BONE DEFECTS IN NOSE AND ANTERIOR WALL OF FRONTAL AIR SINUS ON PRIMARY SURGERY OF GUNSHOT AND OTHER WOUNDS
(An experimental study)

I. F. GERASHCHENKO, Y. Y. PANKOV

Peace-time and war injuries to the nose, both gunshot and other wounds, occupy a prominent part in the activities of the ORL Department. They can be combined with damage to the anterior wall of the frontal air sinus.

Various deformations of the nose and face, in the soft tissues as well as in bone, result from these injuries. These deformations require plastic repair which is sometimes rather complicated and may consist of many stages, in order to reconstruct the shape of the nose and correct the cosmetic defect. The authors of this communication intended to study the possibility of repairing bone defects in the nose and the anterior wall of the frontal air sinus with alloplastic material on primary surgical treatment of injuries to these parts in experiments on animals (dogs). Ftoroplast was used for the purpose.

METHOD

The dogs sustained injuries to their noses both ordinary and gunshot (from a Margolin pistol).

The primary surgical treatment of these wounds, carried out under an antibiotic (bicillin) screen, consisted in the bridging of bone defects with plates of ftoroplast, which were fixed to the edges of the defect with polyethylene threads or special clips.

Altogether 32 dogs were used for these experiments, and the time of observation was between two and 90 days.

RESULTS

Ftoroplast is well incorporated and provokes no noticeable reaction of the surrounding tissues. After healing of the wounds, the shape of the nose and the anterior wall of the frontal air sinus is preserved in the form as prior to injury.

The results attained in experiments on animals justify studying application of this method on patients.

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STANDART NON-CONTACT BURN. SUBCUTANEOUS
TEMPERATURE MEASUREMENTS IN A NON-CONTACT BURN

Z. PROUZA, J. MOSEROVÁ, J. JANEČEK

One of the basic requirements in experimental burns research is, no doubt, a dependable reproducibility of the thermal injury.

Stoner (1961) in his study "Critical analysis of traumatic shock models" has introduced clear requirements for an experimental shock provoking injury.

An experimental injury must fulfil the following requirements:

1. localization and character of the injury must be well defined;

2. the injury must be reproducible and a clear quantitative evaluation must be possible;

3. the density of thermal flux must be adjustable.

To obtain a standard experimental burn, an apparatus must be available, whose thermal energy output is standard and can be quantitatively expressed.

One of the oldest sources of thermal energy, which are still used extensively, are devices for contact burns. The construction and calibration of such devices are relatively simple; hot metal or hot liquid are mostly used for the transfer of thermal energy into living tissues, as well as all sorts of electrically heated ovens or inflammable materials ignited directly on the surface of the experimental object (napalm, magnesium, etc.). There exists, of course, a great number of studies concerned with the description of various burning devices, differing mostly in construction, while the principle of burning remains basically the same. The authors will list only few examples.

A hot metal plate which was heated electrically was used. The temperature was controlled by thermocouples. A glass cylinder filled with water heated to constant temperature was also used as well as direct contact with water (at a temperature of 70—90 ^{0}C).

Of interest are the studies of Salzberg and Evans (1950). These authors produced contact burns in dogs using an apparatus proposed by Brooks et al. (1951) — the source of heat being an iron plate of 64 cm^2, heated to 60 ± 2 ^{0}C.

Vaňásek et al. (1966) produced 25% of body surface burns in dogs by using the bottom of a copper vessel through which hot water flowed, heated to $80 \pm 0,4\ ^0C$, via Höppler's ultrathermostat.

Recently, non-contact burns are more frequently being produced by various apparatus. These devices may be divided into two groups:

— transfer of thermal energy by an optical system;
— direct non-contact transfer of thermal energy from source to object.

In the first type, a carbon arc or its modification is very frequently used as the source. Xenon, xenon-mercury and tungsten lamps, or tantalum carbide discs heated by induction, etc., are also used.

An optical system enabling the transfer of thermal energy from source to object is arranged either in a reflex or refraction system (Richardson, 1964).

Two parabolic mirrors are, however, employed most frequently.

Davis and Pearse (1959) used, for instance, an eliptic mirror for the energy transfer. Richardson (1964) used a composite optical system, which has the advantage of small energy losses through dispersion.

The second type of devices causing non-contact burns are apparatus, from which the energy is transferred directly to the object. As compared to the first type, these devices have the advantage of extending the area of burning (thus they can be used on larger experimental objects). While the devices of the first type are mostly used on small laboratory animals, such as rats, the second type may be employed in experimental burns in dogs, pigs, etc. An example of this second type may be found in the study of Davis and Pearse (1959). By the ignition of a mixture of 40,5% barium nitrate, 13,5% kalium nitrate, 19% magnesium and 27% aluminium, the authors, for the amounts 50, 100 and 150 g of this mixture, attained the density of thermal flux of $(2—22)$ cal$.$ cm$^{-2}.$ sec.$^{-1}$ (with an error of 10%) at the distance of 15, 30 and 45 cm. The experiments were carried out on pigs, the exposure to heat being ensured by a mechanical screen.

Calibration measurements in apparatus for non-contact burns pose a serious problem. In contact burn devices, the authors are generally satisfied with the knowledge of the temperature of the metal plate, heated bath, flame, etc. In devices producing non-contact burns, the following data are commonly observed:

— temperature of the surface of the source (in most cases measured by an optical pyrometer);
— distribution of density of the thermal flux on the object and its magnitude during the exposure (measured calorimetrically, radiometrically);
— spectral distribution of energy on the object (measured by a spectrophotometer or by photomultipliers).

The measurements by radiometers and colorimeters in the above mentioned devices have been described.

Barkley (1962) and his co-workers studied the influence of spectral distribution changes of the energy on the character of the resulting burns.

Considering the fact that all the devices described above are used for producing experimental burns in living experimental objects, it has to be ad-

mitted that all the methods listed are subject to a certain systematic error. For instance, in a contact burn, produced by a hot metal plate, the pressure of the source on the animal is difficult to control with precision, and the movements of the animal must also be taken into account (including the breathing). In non-contact burns, apart from the animal's possible movements, the room temperature, air flow and humidity, as well as the geometry of the transfer of thermal flux must be taken into consideration.

The authors used for experimental burns a non-contact plasma source, which yielded a high output of energy at a very short exposure. Nevertheless, the authors are of the opinion that the standard effect of thermal energy on a living organism cannot be properly evaluated, unless temperature changes in the traumatized tissues are being followed simultaneously (apart from the temperature parameters of the source and the geometry of the exposure of the object).

The authors performed subcutaneous temperature measurements in the area exposed to the thermal flux in laboratory rats. Maximum subcutaneous temperatures were determined in three concentric zones of the burn; thus an evaluation of the reproducibility and standardization of the thermal injury was obtained.

METHODS

a) *apparatus*

The experimental burn was produced by an apparatus which enables non-contact heat transfer from the source to the object. The source of heat is represented by a plasmatron, where the electric energy is bein changed into thermal energy and the low-temperature plasma originates. The plasma beam is projected on a rotating graphite electrode ($\emptyset$ 50 mm) whose front becomes the source of energy radiation. The temperature of the central part of the plasma beam amounts to $(29,000 \pm 1,000)^0$C. The temperature of the front of the graphite electrode after 30 sec. exposure to the plasma beam amounts to $(2,850 \pm 300)^0$C. An average output of the apparatus at the current of $(300—340)$A and at the voltage of $(200—220)$V amounts to (70 ± 10)kW.

There were two modifications of energy transfer from source to object:

— with the use of an optical system; two parabolic mirrors ($\emptyset$ 2,000 mm) at the focal distance of (848 ± 2) mm were used;

— through direct energy transfer.

The dosage of the thermal energy was achieved with the aid of a circular screen placed 100 mm from the front of the graphite electrode. The screen was controlled by an exposure chronometer (exposure error amouting to $\pm 0,3$ sec.).

In the first modification the front of the graphite electrode was placed in the focus of one mirror, the experimental object in the focus of the other mirror. Areas up to 20 cm² could be thus exposed, the mean density of the thermal flux being of $(22,5 \pm 0,85)$ cal . cm^{-2} . sec.$^{-1}$.

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In the case of direct energy transfer exposed to the thermal flux the area can be larger (with more extensive energy losses occur). In the distance of 120 cm from the front of the graphite electrode the mean density of the thermal flux is $(9,80 \pm 1,15)$ cal . cm^{-2} . sec.$^{-1}$ on a circular area the diameter of which is 10 cm.
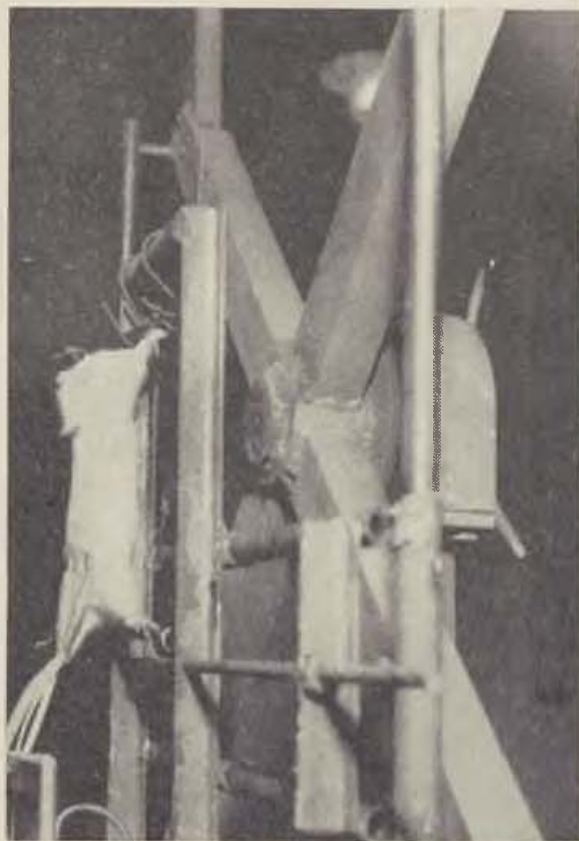

Fig. 1. Fixation of the experimental object on the apparatus during the exposure.

b) *experimental animals*

Male rats of the Wistar (Mezno) strain were used as experimental animals with an average weight of 200—250 g. The rats were fed on a standard diet, water consumption was not rationed. The animals were kept in a two week quarantine and then followed a two week adaptation period in metabolic or plastic cages; the temperature of the animal room was $(20—22)^0$C.

The animals' backs were shaved off under ether anaesthesia. Then the animals' extremities were tied to special metal frames (Fig. 1). The frames could be hung in the predetermined position within the apparatus in a vertical position. By a mechanical device the whole frames with animals could be moved. During one plasmatron ignition 6 animals could be exposed.

c) *subcutaneous temperature measurements*

The authors developed a method by means of which the subcutaneous temperatures under the traumatized skin could be measured. The temperature

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measurements were carried out with the aid of iron-constant thermocouples placed at the points of ordinary intramuscular injection needles; a graphical registration of measured values was performed by EZ 3 Tesla recorder. Calibration of thermocouples was performed before measurement using a water-or sand-bath.

In the case of indirect transfer of heat, the temperature was measured in three concentric zones of the burn [Fig. 2]:

1. central zone
2. intermediary zone
3. peripheral zone.

(The predestined location of the burn was known: the central part of the animal's back).

The needle was introduced under the skin outside the area destined for burning; then the thermocouples were subcutaneously shifted to the specific concentric area under the skin muscle, paniculus carnosus.
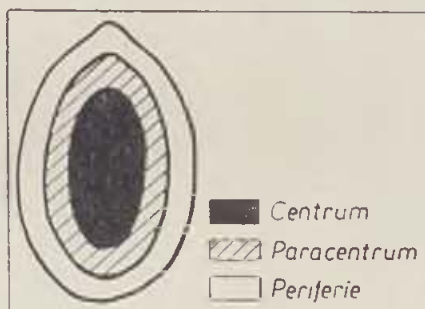

Fig. 2. Schematic picture of the burned area and the different zones measured

The described measurements were performed at two different thermal flux values in two groups of animals. (90 ± 3) cal . cm^{-2}, corresponding to 4 sec. exposure to energy flow; $(22,5 \pm 1)$ cal . cm^{-2}, corresponding to 1 sec. exposure.

In the case of direct energy transfer from source to object, measurements were carried out only in the centre of the burned area (in 6 sec. exposure also in the peripheral zone). Exposures of 6, 8, 10 sec., corresponding to the thermal flux of (59 ± 6), $(78,5 \pm 8)$, (98 ± 9), (118 ± 11) cal . cm^{-2} were used.

Subcutaneous temperature measurements were made before the burning with animals already placed in vertical position; thus control temperatures were determined. The thermocouples were put in position 5 minutes before the exposure to the thermal flux and remained for 5—10 minutes after the termination of the burning.

The temperature of the manipulation room was cca 18 ^{0} C; surface temperature of the skin on the animal's back measured before burning (with the aid of Biotherm thermistor skin thermometer) amounted to $(34,22 \pm 0,47)^0$C. Skin temperature measurements were performed in 20 rats.

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d) *statistical evaluation*

The values of the temperature curves obtained from the recorder were transferred into tables (absolute temperature calculations had to be based on calibration results). Control temperatures were taken 1 min. before the exposure.

Mean values as well as well as standard deviations were calculated for the different values obtained from a specific group of rats for a given exposure and area of burn. Temperatures obtained 1 min. before burning served as control values and all other values measured were evaluated in relation to the controls by Student's t-test at 5% level of statistical significance.
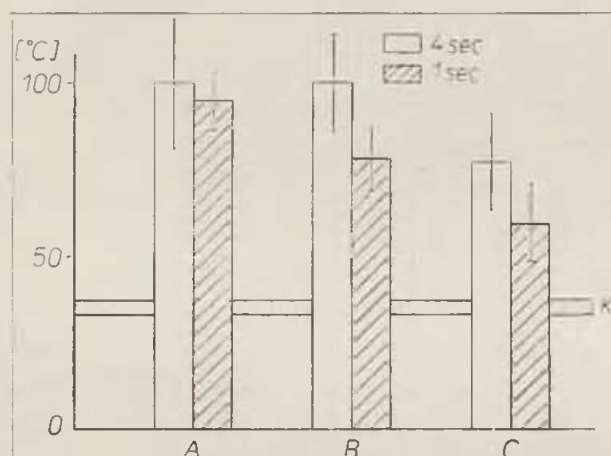
Graph 1. Values of maximum temperatures for 4 sec. (blank columns) and 1 sec. exposure (screened columns) to the thermal flux. Thermocouple locality: A - central zone, B - intermediary zone, C - peripheral zone (see Fig. 2). — Horizontal K band indicates the range of physiological subcutaneous temperatures. The column heights as well as the standard deviations are registered in ^{0}C

In indirect heat transfer, temperature values in different concentric areas were evaluated statistically in relation to the temperatures obtained in the central zone of the burn.

Temperatures were expressed both in absolute (^{0}C) and in relative values. In calculating the relative values, the control temperature or the central zone temperature respectively were taken as 100%.

In all, 81 animals were used in experiments using the indirect transfer of heat energy; 69 of these were evaluated statistically. In experiments employing direct heat transfer, 80 animals were used, 47 were included in the statistical calculation.

In some animals, the thermocouples became dislocated during the exposure to the thermal flux, or in some instances the apparatus failed to function properly. Such animals were excluded from statistical evaluation, as well as those exposed to thermal flux during a period of time, when the manipulation room temperature markedly decreased and consequently the conditions under which the experiments were performed could not be considered as standard.

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Tab. 1. Maximum subcutaneous temperatures

Temperature	Indirect energy transfer				Direct energy transfer							
	1 sec.		4 sec.		6 sec.		8 sec.		10 sec.		12 sec.	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
⁰C	94,5	7,91	100,3	17,70	66,31	11,42	59,75	2,36	67,13	15,04	75,27	16,72
%	271,5	22,7	288,2	50,8	170,0	29,3	194,7	7,7	203,8	45,6	233,3	51,8

100 % = control temperature = 34,8 ⁰C

RESULTS

Table 1 shows maximum subcutaneous temperatures at different exposures (indicated in absolute and relative values). The above temperatures were measured in the central zone using both the indirect and direct transfer of thermal flux.

In table 2 and in the graph maximum subcutaneous temperatures with the use of indirect heat transfer at both exposures (1 sec. and 4 sec.) in all the three described concentric zones are presented.

Values marked with a cross are statistically significant at 5% level.

DISCUSSION

As appears from the above results, the standard deviations in both modifications of heat transfer at various time exposures correspond to the given type of experiment, mainly when considering the number of animals used as well as technical difficulties connected with the fixation of anaesthesized animals.

In relation to the described temperature measurements carried out under specific conditions, this experimental burn can be considered as standard. Presicion of the standard is such, as is generally encountered in biological experiments.

Tab. 2. Maximum subcutaneous temperatures at 1 sec. and 4 sec. expositions
in three concentric zones

Temperature	1 sec.						4 sec.					
	C		PC		P		C		PC		P	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
⁰C	94,5	7,91	78,3	9,02	60,1	11,30	100,3	17,70	100,2	13,60	77,5	16,39
%	100,0	8,37	82,9*)	9,54	63,8*)	11,9	100,0	17,64	99,9	13,5	77,2*)	16,34

100 % = temperature in the centre
*) = statistically significant values at 5 % level (with regard to the centre)

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Results listed in table 2 at 1 sec. time exposure to the thermal flux clearly indicate that in the resulting burn there is a marked heat gradient: temperature measures in the three concentric zones is highest in the centre and lowest at the periphery. The values obtained in different zones differ significantly (at 5% level of statistical significance). The temperature difference between the central and intermediary and intermediary and peripheral zone amounts approximately to 20%. These results correspond with histological findings.

It cannot be expected that a totally homogenous burn can be inflicted [the average area of the burn being at 1 sec. time exposure $(15,8 \pm 2,15)$ cm^{-2}], nevertheless, the average area of the burn is large enough for studying local changes in the different zones on homogenous materials. Other devices for inflicting non-contact experimental burns with a high density of thermal flux (Davies and Pearse, 1959) mostly produce burns of a much smaller area. It is also important to stress that, as it appears from the standard deviation values, the described temperature gradient between the centre and periphery is reproducible.

As appears from the results obtained by measurements carried out at 4 sec. exposure, the difference between the temperatures in the central and intermediary zone is not statistically significant; between the temperatures in the intermediary and peripheral zone there is a 20% difference. This might lead to the impression that there is not a marked temperature gradient between the central and intermediary zone, and that consequently in these two zones the burn is homogenous. This, however, would be an erroneous supposition; histological findings confirm that also in the case of the burn produced at 4 sec. exposure the burn is distinctly not homogenous, but this heterogeneity is to be found in deeper layers of the subcutaneous tissue, in skeletal muscles of the animals' backs. This fact is in close relation to the fundamental principles characterizing the transfer of heat in tissues. One of the main parameters, which characterize heat transfer in different tissues is the heat conductivity and heat capacity of the tissues. If a given tissue is being heated from a source of a constant temperature for a longer period of time, the temperature in the tissues will go on increasing up to the point, where the state of "heat saturation" is attained; any further exposition to the same source will not be followed by any further increase of the tissue temperature. In the first phase, the supply of heat to the tissues is greater than the output of heat from the tissues into the surrounding media. In the phase of heat saturation, the supply and output of heat is equal, i. e. a state of equlibrium has been attained. (This state persists, unless a change in the heat output occurs). The amount of heat which 1 g of a given tissue absorbs from the beginning of the burning (or heating) up to the moment when the state of equilibrium has been attained, is called heat capacity. Henriquez and Moritz (1947) determined the heat capacity for epidermis $(8,86$ cal . g$^{-1})$, dermis $(0,77$ cal . g$^{-1})$, subcutaneous fat $(0,55$ cal . g$^{-1})$ and muscle $(0,90$ cal . g$^{-1})$ in pigs.

It appears that with the aid of 4 sec. exposure, the heat capacity is at-

tained in all layers of the skin, the skin muscle and subcutaneous tissues, where the measurements were performed.

After summarizing the results from both exposures (1 sec. and 4 sec.), we can see, that in the layer into which the thermocouple has been introduced, the heat gradient is much less significant at 4 sec. exposure than at 1 sec. exposure. It can be presumed (as confirmed by histological findings) that at 4 sec. exposure the heat penetrates into deeper layers of the tissues and that the rate at which the temperature penetrates beyond thermocouple is lower.

In order to produce a more extensive experimental burn with the aid of the apparatus described above, basic methodical studies have been made and temperature measurements carried out in the central zone of burns inflicted with the aid of direct heat transfer at all expositions tested (i.e. 6 sec., 8, 10 and 12 sec.). These were preliminary experiments carried out on smaller groups of animals; nevertheless, the results have proved to be rather interesting and therefore they have been included in this study.

With the aid of direct heat transfer, the tissues were exposed to a thermal flux of a lower intensity than in the case of indirect heat transfer; however, as the tissues were exposed to high temperatures at longer expositions, it may be expected that the nonphysiological temperatures penetrated into deeper layers of the exposed tissues, even if the subcutaneous temperature values obtained during the burning were lower than in the case of indirect heat transfer.

Of essential significance is the fact that the results attained by subcutaneous temperature measurements in different concentric zones at all exposures to the thermal flux and in both methods of thermal energy transfer are sufficiently reproducible.

The authors are of the opinion that the subcutaneous temperature measurements obtained during the heating period represent, in addition to other methods (laboratory examination, histo-pathology, etc.), are indispensable in the determination of an experimentally produced burn.

SUMMARY

An apparatus yielding a high density thermal flux was used, producing standard non-contact burns in male rats, at very short time exposure. An original method was developed for subcutaneous temperature measurements in selected zones of the burned area during exposure to the thermal flux. The values of the maximum temperatures at given exposures and in given zones, in case of direct thermal energy transfer from source to object as well as in cases of indirect transfer via an optical system have proved to be sufficiently reproducible and confirmed the standard character of the burn inflicted. The highest values of subcutaneous temperature measurements i.e. $(100,3 \pm 17,7)^0 C$, were found in the center of burned areas in the case of energy transfer via the optical system at 4 sec. exposure to the thermal flux, thermal flux density equaling to $(22,5 \pm 1)$ cal . cm^{-2}.

RÉSUMÉ

La brûlure de standard sans contacte. — Le mésurement des chaleurs de la peau chez les brûlures sans contact

Z. Prouza, J. Moserová, J. Janeček

Les auteurs ont mise en réalisation une brûlure de standard sans contacte chez les rats mâles à l'aide d'un appareil produisant une grande valeur du courant chalérique au cours d'une exposition très courte. Le mésurement des chaleurs sous-cutanées dans des parties respectives de la surface brûlée au cours de l'exposition au courant chalérique a été réalisé par une manière tout nouvelle. Les données des chaleurs de maximum dans des expositions et parties respectives dans le cas du transport directe de l'énergie chalérique de l'appareil à l'objet en question de même que dans le cas du transport indirecte par un système optique se montraient comme capable de réproduction et ainsi confirmaient la brûlure de standard. La donnée de maximum de la chaleur sous-cutanée au centre de la surface brûlée $(100,3 \pm 17,7)^0C$ était trouvée au cours du transport de l'énergie chalérique par le système optique durant l'exposition de 4″ au courant chalérique, où la valeur du courant chalérique équivaut à $(22,5 \pm 1)$ cal . cm^{-2}.

ZUSAMMENFASSUNG

Standardisierte Nichtkontaktverbrennung. — Messung der Unterhauttemperaturen bei der Nichtkontaktverbrennung

Z. Prouza, J. Moserová, J. Janeček

An einer Apparatur, die während einer sehr kurzen Exposition eine hohe Wärmeflussdichte erzeugt, wurde bei Rattenmännchen eine standardisierte Nichtkontaktverbrennung erarbeitet. Mittels einer originellen Methode wurde die Messung der Unterhauttemperaturen in auserwählten Zonen der verbrannten Fläche während Exposition dem Wärmefluss durchgeführt. Die Werte für die Höchsttemperaturen in den gegebenen Expositionen und Zonen erwiesen sich sowohl im Falle der direkten Übertragung der Wärmeenergie von der Quelle auf das Objekt als auch im Falle der indirekten Übertragung über ein optisches System ausreichend reproduzierbar und bestätigten die Standardmässigkeit der erzeugten Verbrennung. Den Höchstwert für die Unterhauttemperatur im Zentrum der verbrannten Fläche $(100,3 \pm 17,7 \,^0C)$ ermittelten die Autoren bei der Übertragung der Wärmeenergie über ein optisches System bei 4 Sekunden langer Exposition dem Wärmefluss [als die Wärmeflussdichte $(22,5 \pm 1)$ cal . cm^{-2} gleich ist].

RESUMEN

Quemadura normal incontacta. — Medición de las temperaturas subcutáneas en la quemadura incontacta

Z. Prouza, J. Moserová, J. Janeček

En los aparatos que producen la más alta densidad del corriente térmico durante una exposición muy corta fue elaborada la quemadura normal incontacta en los machos de rata. Por el modo original se realizó la medición de las temperaturas subcutáneas en las zonas escogidas del área quemada durante la exposición del corriente térmico. Los valores de las temperaturas máximas en dadas exposiciones y zonas tanto en caso de la transmisión derecha de la energía térmica de la fuente al objeto como

en caso de la transmisión indirecta por el sistema óptico se mostraron ser en la medida suficiente reproductibles y comprobaron la normalidad de la quemadura originada. El valor máximo de la temperatura subcutánea en el centro del área quemada $(100,3 \pm 17,7)^0C$ fue medido en la transmisión de la energía térmica por el sistema óptico en 4" exposición del corriente térmico [cuando la densidad del corriente térmico es igual a $(22,5 \pm 1)$ cal.cm^{-2}].

REFERENCES

1. **Barkley, K. M., Davis, T. P.**: The Effect of Spectral Distribution on the Production of Cutaneous Burns. Surg. Gynec. Obstet., 114 : 163, 1962.

2. **Brooks, J. W., Robinett, P. W., Largeb, T. L., Evans, E. I.**: A Standard Contact Burn. Surg. Gynec. Obstet., 93 : 543, 1951.

3. **Davis, T. P., Pearse, H. E.**: Use of the Carbon Arc and Burning Magnesium as Thermal Source for Experimental Burns. Ann-Surg., 1949 : 68, 1959.

4. **Gordon, A.**: An Instrument for the Direct Measurement of the Intense Thermal Radiation. Rev. Sci. Instr., 24 : 366, 1953.

5. **Richardson, D.**: A Thermal Radiation Heat Source and Imaging System for Biomedical Research. Contract No N 62269—1388, Cambridge, A. D. Little, Inc. 1964,

6. **Salzberg, A. M., Evans, E. I.**: Blood Volumes in Normal and Burned Dogs. A Comparative Study with Radioactive Phosphorus Tagged Red Cells and T - 1824 Dye. Ann. Surg., 132 : 746, 1950.

7. **Stoner, H. B.**: Critical Analysis of Traumatic Shock Models. Feder. Proc., 20 : 38, 1961.

8. **Tretyakov, I. V., Onduls, P. A.**: Pribor dlya vosproizvedeniya dozirovanogo termicheskogo ozhoga u laboratornykh zhivotnykh. Pat. Fiziol. Eksp. Ter., 4 : 68, 1960.

9. **Vaňásek, J., Mazák, J., Matěja, F.**: Příspěvek ke studiu erytrokinetiky, hemokoagulace a imunoelektroforetických změn při popáleninové nemoci a kombinovaném poškození ionizujícím zářením. Závěr. zpráva. Katedra vál. vnitř. lék. VLVDÚ, Hradec Králové, 1966.

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PLASMA IMMUNOREACTIVE INSULIN AND GROWTH HORMONE LEVELS IN BURNED SUBJECTS

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Every major burn is followed by a more or less pronounced endocrine and metabolic response. A hypercorticism was repeatedly described after burns, affecting both glucocorticoids, mineralocorticoids and adrenal anabolic N hormones. At the same time a hyperadiuretism was found, as well as an increased excretion of catecholamines (Goodall et al., 1957). It seems that the gonadotropin production decreases substantially after burns. All the above results are summarized and discussed in more detail in many publications (e.g. Artz, Moncrief, 1969; Doleček et al., 1969; Doleček, Kalina et al., 1970). Quite recently, the increased postburn plasma levels of immunoreactive insulin (= IRI) were described (Allison et al., 1968; Doleček et al., 1969a), as well as the increased levels of immunoreactive growth hormone (= IR-GH) (Doleček et al., 1969). Allison et al. (1967) reported about an impaired glucose tolerance and a delayed IRI response after hyperglycemia during surgery and after myocardial infarction.

The postburn elevations of blood glucose levels of various degree and duration are a well know phenomenon. During the last 20 years the b u r n s t r e s s p s e u d o d i a b e t e s in burned patients was repeatedly described, accompanied by a severe hyperglycemia (even over 1000 mg/100 ml), dehydration and coma, very often even with a fatal outcome (Evans, Butterfield, 1951; Moyer, 1955; Arney et al., 1960; Rosenberg et al., 1965).

The main f u e l after burns are fats. Increased values of FFA (free fatty acids) in burned subjects were described (Doleček et al., 1964; 1969; Birke et al., 1965). The sources of energy supply are highly influenced by the growth hormone — fats (FFA) are becoming the main fuel (Roe, Kinney, 1962; Bray, 1969). Various stresses are followed by an elevation of IR-GH levels in plasma (for a review see Hakagawa et al., 1969; Yalow et al., 1969; Samaan, Freeman, 1970). In some of them (e.g. uremia), in acromegaly (Cryer, Daughaday, 1969) the IR-GH levels behave quite differently than in normal, unstressed individuals: IR-GH levels do not decrease during hyperglycemia as usually, they can attain paradoxically even increased levels (e.g. in patients with diabetes).

We found many times high fasting IRI plasma values in burned subjects. These elevated values persisted in some cases even for many weeks, they attained high values again when various complications occurred. When glucose tolerance tests [= GTT] were carried out in burned subjects, an insulin resistance was repeatedly found, after an intravenous insulin administration the expected hypoglycemia did not occur alvays as usually. The possibility of a damage to pancreas as a consequence of overstimulation must be born in mind, with a possible development of the feared burn stress pseudodiabetes. The postburn damages to pancreatic beta cells were described [Sevitt, 1957; Kljačkin, Pinčuk, 1969]. We found elevated IR-GH values in burned subjects with elevated blood glucose levels.

To evaluate better all the above observations, 31 burned subjects were studied, most of them with major or even severe burns. Their blood glucose, IRI and IR-GH fasting levels were repeatedly determined, as well as after a standard glucose and crystalline insulin load.

METHODS

The burned patients included 28 men, 2 women and one child. Their mean age was 29.4 yr, with the range of 8—56. Most of them suffered major or even severe burns [e.g. see tables 2 and 4].

The venous blood was drawn between 07—08 a.m. into chilled tubes with heparin, it was immediately centrifuged and stored at —20 ^{0}C untill processed. The method used for IRI estimation was described by Hales and Randle [1963], with the use of kits from RCC, Amersham, England. The method for IR-GH estimation was described by Pennisi [1968] and Molinatti et al. [1969], with

Tab. 1 The mean fasting plasma immunoreactive insulin and blood glucose level in burned subjects ($\pm$ SD) in microunits/ml (IRI) and mg/100 ml

Postburn weeks	No of patients	Immunoreactive insulin			Blood glucose		
		Mean $\pm$ SD	Range	Difference*	Mean $\pm$ SD	Range	Difference*
Normal controls	21	23.1±12.8**	(2— 60)	—	74.2± 8.3	(60— 88)	—
I	10	30.4±15.6	(12— 61)	not sign.	103.1±29.4	(60—154)	sign. (p<0.001)
II	7	52.7±31.8	(4—100)	sign. (p<0.001)	85.4±38.9	(46—162)	not sign.
III	7	27.1±31.6	(8— 96)	not sign.	63.7±30.5	(52—106)	not sign.
IV	5	66.6±65.3	(15—142)	sign. (p<0.02)	64.2±11.5	(50— 76)	not sign.
V	6	49.0±46.0	(6—120)	sign. (p<0.05)	95.3±17.3	(72—116)	sign. (p<0.01)
VI	5	43.4±50.1	(10—132)	not sign.	76.6±14.2	(54— 91)	not sign.
VII	3	59.7±39.7	(28— 96)	sign. (p<0.05)	73.0±11.8	(60— 83)	not sign.
VIII	5	48.2±67.3	(10—168)	not sign.	75.8±25.7	(52—116)	not sign.
IX and more	7	17.1±12.1	(2— 36)	not sign.	68.6± 6.2	(58— 75)	not sign.

* Differences between the normal controls and burned subjects
** If the two extreme values are omitted (60 and 40 microunits/ml), the mean is 17.7 ± 9.3 microunits/ml

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Tab. 2 Glucose tolerance tests in burned subjects. Plasma immunoreactive insulin values (micro-units/ml) and blood glucose (mg/100 ml)

Name, Age, Burn	Post-burn weeks	Immunoreactive insulin				Blood glucose			
		0 min.	30 min.	60 min.	120 min.	0 min.	30 min.	60 min.	120 min.
Normal controls (n = 10)	—	13.6 ± 3.8	36.4 ± 21.6	44.8 ± 26.6	27.3 ± 15.9	85.9 ± 12.3	129.7 ± 22.7	130.2 ± 34.7	86.9 ± 13.5
S. J., 16,36 % II—III⁰	I	12	23	22	27	91	110	96	88
R. J., 23,25 % III⁰	I	16	63	64	30	83	126	142	99
B. J., 15,69 % mainly II⁰	II	4	127	80	26	99	165	199	122
H. M., 48,35 % III⁰	II	17	60	24	23	87	142	158	110
R. J., 23,25 % III⁰	II	27	78	84	63	95	99	95	56
B. A., 40,50 % II—III⁰	III	8	115	48	22	52	102	146	110
I. R., 39,47 % mainly III⁰	III	17	20	18	12	122	196	185	165
Č. F., 39,35 % II—III⁰	IV	20	124	156	119	50	110	138	130
B. J., 15,69 %* mainly II⁰	IV	22	24	17	14	56	80	52	44
F. J., 30,30 % II—III⁰	IV	5	8	21	20	87	169	130	98
I. R., 39,47 % mainly III⁰	V	75	160	720	100	75	134	130	75
Č. F., 39,35 % II—III⁰	VI	21	19	500	300	82	87	90	72
S. M., 22,28 %** III⁰	VIII	19	220	214	194	56	180	158	136
S. J., 16.36 % II—III⁰	IX	12	36	40	14	75	99	118	79
F. J., 30,30 % II—III⁰	IX	14	14	46	12	52	68	126	87
S. M., 22,28 % III⁰	XI	8	100	100	68	64	118	124	95
S. V., 23,25 % II—III⁰	XII	2	38	102	38	68	114	154	91
I. R., 39,47 % mainly III⁰	XIII	16	14	46	24	75	72	134	68
Mean ± SD		17.5 ± 15.9	69.1 ± 60.2	127.9 ± 186.7	61.4 ± 76.3	76.1 ± 19.4	120.6 ± 37.3	131.9 ± 34.8	95.8 ± 29.8

* healed, ** poor healing, All patients were males — only H. M. was a female

the use of kits from Sorin, Saluggia, Italy. The blood glucose levels were estimated from venous blood too.

The GTTs were carried out after an oral glucose load (1 g glucose/kg of body weight), the blood samples were taken before the glucose load, then after 30,60 and 120 min. When insulin was administered intravenously, 0.1 unit/ kg of body weight of crystalline insulin was used. The blood samples were taken before the insulin administration and 30 and 60 min. thereafter. The control IRI, IR-GH and blood glucose values were obtained from unburned subjects, with a normal weight, without any manifest endocrinopathy, not subjected to any stress.

RESULTS

Table 1 contains the means ±SD of both IRI and blood glucose levels in weekly intervals of 17 burned subjects. They are compared with the normal, control values. The control values from Tab. 1 are somewhat higher (23.1 ± ± 12.8 microunits/ml) than those from Tab. 2 (13.6 ± 3.8 microunits/ml). This was caused by two high IRI values (40 and 60 microunits/ml), as found in two normal fasting subjects from Tab. 1. If these two extreme values are omitted, the mean becomes 17.7±9.3 microunits/ml. If the latter value is used as a normal, control value, even more differences between the burned subjectcts and the normal controls become significant. The elevated mean IRI values persisted actually for 8 weeks, while at the same time the mean blood glucose values were significantly increased only during the first and fifth postburn week.

The results of 18 GTTs, with their IRI and blood glucose levels, are included in Tab. 2. For comparison, 10 GTTs (blood glucose and IRI) of normal controls (means ± SD) are included. In some of the former an impaired glucose tolerance can be found, from the IRI values in others an insulin resistance is quite obvious (e.g. S.M., 8 weeks postburn) — In a few cases an increased readiness for IRI release is manifest (Č.F., 6 weeks postburn; I. R., 5 weeks postburn), accompanied in the first case by a flat GTT. The first

Tab. 3 Mean fasting immunoreactive growth hormone levels in plasma (ng/ml) and mean fasting blood glucose levels (mg/100 ml) in burned subjects (±SD)

Postburn weeks (No of pts)	Immunoreactive growth hormone		Blood glucose	
	Mean±SD	Range	Mean±SD	Range
Normal controls (n = 10)	2.5± 2.4	(0.3— 7.5)	77.5± 9.6	(63— 97)
I (n = 6)	7.2±10.0	(0.8—27.0)	121.5±56.3	(64—212)
II (n = 10)	3.1± 1.1	(1.7— 5.2)	109.1±27.7	(83—159)
III (n = 7)	4.1± 2.1	(2.1— 9.8)	112.1±38.9	(56—168)
IV (n = 4)	2.8± 1.2	(1.6— 4.4)	111.3±52.3	(56—180)
V+VI (n = 4)	6.7± 2.2	(2.8— 8.6)	87.5±12.9	(75—100)
VII and more (n = 6)	1.3± 0.7	(0.3— 2.2)	71.7±14.4	(52— 91)

Table 3 contains both our previously published results (Doleček et al., 1969a) and the new results from 1971.

Tab. 4 Changes in immunoreactive growth hormone (in ng/ml) and blood glucose (mg/100 ml) levels in burned subjects during glucose tolerance tests and after intravenous crystalline insulin administration (0.1 U/kg)

Name, age, extent of burn		Glucose tolerance tests after an oral glucose load (1 g/kg of body weight), fasting, after 60 and 120 min.	
B. J., 15,69% mainly II⁰	IR-GH GLUC	3.8— 2.4— 3.3 (II)* 99 —100 —122	1.6— 1.5— 0.6 (IV) 56 — 80 —44
I. R., 39,47% mainly III⁰	IR-GH GLUC IR-GH GLUC	2.2— 2.4— 2.0 (III) 122 —185 —165 0.3— 0.9— 1.0 (XIII) 75 —134 — 68	7.3— 7.3— 4.9 (V) 75 —130 —75
R. J., 23,25% III⁰	IR-GH GLUC	2.9— 2.8— 1.1 (II) 83 —142 — 99	3.6— 3.3— 1.8 (III) 95 — 95 —56
H. M., 48,35% III⁰	IR-GH GLUC	3.8 — 2.6 — 1.5 (II) 87 —158 —110	
F. J., 30,30% II—III⁰	IR-GH GLUC	3.0— 1.7— 3.0 (IV) 87 —130 — 98	2.0— 0.3— 0.0 (IX) 52 —126 —87

		Crystalline insulin administered intravenously (0.1 U/kg of body weight), fasting, 30 and 60 min. after insulin	
I. R., 39,47% mainly III⁰	IR-GH GLUC	2.6— 11.4— 3.0 (III) 91 — 54 — 64	2.8— 2.9— 1.8 (V) 79 — 44 —52
R. J., 23,25% III⁰	IR-GH GLUC	2.2— 2.4— 3.7 (I) 64 — 52 — 68	3.3— 2.4—10.8 (II) 87 — 24 —60
H. M., 48,35% III⁰	IR-GH GLUC	1.6— 1.6— 2.9 (II) 87 — 28 — 28	1.4— 10.0— 6.5 (XIII) 68 — 28 —36
F. J., 30,30% II—III⁰	IR-GH GLUC	3.5— 3.0— 4.0 (III) 91 — 83 — 68	0.7— 0.9— 3.0 (XII) 72 — 12 —48
L. Š., 51,40% mainly III⁰	IR-GH GLUC	2.1— 20.0— 6.8 (IX) 72 — 32 — 72	

IR-GH — immunoreactive growth hormone
GLUC — blood glucose levels
* the weeks after burns are in parentheses
All patients, except H. M., were males

GTT of Č. F. is from the forth postburn week, the patient was not healed at that time, while in the sixth postburn week he was almost totally healed. In the patient B. J. (he was healing excellently) a marked change in his GTT during two weeks is obvious. In some patients who were healing excellently, regardless of the severity of their burns, both the IRI and blood glucose values were practically normal.

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Tab. 5 Normal levels of blood glucose, immunoreactive insulin and growth hormone during glucose tolerance tests (oral glucose load) and after the intravenous administration of crystalline insulin

Name, age, sex of the normal controls	Glucose tolerance tests after an oral glucose load (I g/kg of body weight)			
	Fasting	levels	60 min.	120 min.
M. J., 34, m	GLUC	75	201	75
	IR-GH	0.6	1.2	0.6
	IRI	9	100	25
P. F., 29, m	GLUC	95	122	79
	IR-GH	1.5	1.8	1.2
	IRI	14	28	10
P. E., 26, f	GLUC	79	99	79
	IR-GH	1.0	1.2	1.2
	IRI	10	14	14
B. L., 41, f	GLUC	102	138	102
	IR-GH	1.8	1.2	1.5
	IRI	12	69	42

	Crystalline insuline administered intravenously (0.1 U/kg of body weight)			
	Before	insulin	30 min.	60 min.
S. L., 22, f	GLUC	64	10	20
	IR-GH	1.1	12.0	12.0
H. P., 19, m	GLUC	48	32	28
	IR-GH	2.6	1.2	7.5
S. J., 35, m	GLUC	44	28	24
	IR-GH	1.5	1.0	6.2
B. A., 37, m	GLUC	79	16	48
	IR-GH	1.8	1.1	15.3
S. J., 10, f	GLUC	64	48	64
	IR-GH	1.7	29.0	3.8

GLUC — blood glucose
IRI — immunoreactive insulin (microunits/ml)
IR-GH — immunoreactive growth hormone (ng/ml)

Tab. 3 includes the mean IR-GH ± SD values in burned subjects as well as their blood glucose levels. Due to the widely scattered values, the significant differences between the normal means and the burned subjects are only in the group 5 and 6 weeks after burns (p < 0,02). But many individual values are definitely elevated (e.g. 8.6 ng/ml, 9.8 ng/ml, 27.0 ng/ml, etc.).

Tab. 4 present IR-GH and blood glucose levels in 6 burned subjects during GTT and after intravenous insulin administration. In some cases, an insulin resistance is quite obvious (no corresponding decrease in blood glu-

cose levels after insulin), as well as an inadequate reaction of IR-GH : IR-GH dit not decrease in spite of elevated blood glucose levels (e.g. I.R.), it dit not rise during a severe hypoglycemia in the time intervals followed by us (e.g. H.M.).

Finally Tab. 5 is included to show a few results (IR-GH, IRI, blood glucose) from normal controls during GTT and after intravenous insulin administration.

DISCUSSION

The main results from the whole study can be summarized as follows:

1. High fasting IRI values can persist in some burned subjects for many weeks,

2. Both the blood glucose and IRI values do not correspond always with the severity of burns. It seems that burns with a smaller IRI and blood glucose response have a more favorable course of the burn disease. The "iron men" react less virogously to the burn stress.

3. In many cases there is no correlation between IRI and blood glucose levels.

4. The normal fasting blood glucose and IRI values do not mean always a normal glucose tolerance and a normal IRI response after a glucose load.

5. In some burned patients, from the third postburn week on, relatively low blood glucose levels can be found.

6. In some burned patients, increased fasting IR-GH levels can be found.

7. In many burned patients, the IR-GH levels in plasma do not respond adequately to significant blood glucose changes (as seen in normal, physiological conditions).

The high or relatively even very high fasting IRI levels, lasting for many weeks, an exaggerated response of IRI to a standard oral glucose load (or carbohydrate meals generally), represent a serious strain for the pancreatic beta cells. A possibility of a permanent d a m a g e cannot be excluded, especially in predisposed individuals. We found repeatedly an impaired glucose tolerance in otherwise normal subjects 1—2 years after a major burn (Doleček, Kalina et al., 1970).

It is quite possible that b u r n s t r e s s p s e u d o d i a b e t e s c a n develop predominantly in those burned subjects who are overfed, especially with carbohydrates, whose insular cells can become at least temporarily exhausted. As the discrepancies between the IRI and blood glucose values show (e.g. high blood glucose levels and high IRI levels during GTT), both an insulin resistance and an impaired glucose tolerance are present. The insulin resistance is quite obvious from some results included in Tab. 4 (IRI and blood glucose levels after intravenous insulin administration). There was no drop of blood glucose in some patients, no rise of IR-GH after intravenous insulin.

The relatively lower mean IRI value for the first postburn week (Tab. 1) (30.4 ± 15.6 microunits/ml), accompanied by the highest mean blood glucose value (103.1 ± 29.4 mg/100 ml), can be the results of a blocking effect of

catecholamines on insulin release, as it was recently described by Porte et al. (1966). Other counterregulatory mechanisms (glucocorticoids, growth hormone) play an important role in the pathogenesis of an impaired glucose tolerance and insulin resistance.

The high IRI levels in some burned subjects, accompanied by relatively high blood glucose levels, can mean from the theoretical point of view not only an insulin resistance, but an "impaired quality" of the released insulin as well whose immunological properties are the same as in the normal insulin.

Both our previous report (Doleček et al., 1969a) and the present results (Tab. 3, 4) have described in some cases the i n c r e a s e d plasma IR-GH levels after burns. They are often present in spite of the elevated blood glucose levels. Under normal circumstances, high blood glucose levels are accompanied by a decrease of IR-GH in plasma. Similarly, after a major decrease in blood glucose levels, a marked rise of IR-GH levels usually takes place — but the latter does not occur always after burns (Tab. 4). It is quite evident that the study about IR-GH after burns will require much more experimental and clinical work, but event the present study on a very limited number of patients shows some differences between the normal controls and the burned subjects. Whether the above changes are useful (e.g. to stimulate the mobilization and metabolism of fats, to maintain a normal blood glucose level) cannot be said so far.

The main f u e l after burns are fats — the rise of FFA after burns was repeatedly described (Doleček et al., 1964; 1969; Birke et al., 1965), accompanied usually by elevated blood glucose levels. Under normal conditions, the increase of blood glucose levels is usually followed by a drop in FFA values. It is quite possible that the "glucose sparing effect" of glucocorticoids (Doleček et al., 1969) is responsible for this discrepancy. The glucose as such was not used as a common fuel (its supply is rather limited!), it was "spared" to supply the indispensable 4 C groups (oxaloacetate) to enable the entry of acetyl coenzyme A (2 C) — derived from FFA — into the Krebs' cycle and to maintain the glucose supply to brain cells. The brain cell energy supply is largely dependent on glucose supply, but during fasting, ketone bodies can be used as well (mainly the hydroxy-butyric acid). The whole type of metabolic response after burns is catabolic, the energy is n o t stored as fats with the help of insulin, but m o b i l i z e d — and for this reason the insulin resistance is probably not so unwelcome.

A somewhat higher values of both IRI and blood glucose from our first report about IRI and IR-GH after burns (Doleček et al., 1969a) could be caused either by a slightly different method used for IRI and blood glucose determination, by a different type of caloric intake, or by the fact that the average age of the patients from our first report was 43.6 yr (if one 8 yr old child is excluded), as compared with the mean age of 30.4 yr from the present group.

It is quite probable that a few therapeutic conclusions can be drawn from our results. Their main aim is to prevent the damage (or exhaustion?) of pan-

creatic beta cells, especially in the first postburn days or perhaps weeks in patients with a marked hyperglycemia. It is our opinion that small amounts of crystalline insulin should be added to glucose administered intravenously (usually as a 5 or 10 per cent solution), e.g. 4 units of insulin for each 10 g of glucose. Small amounts of insulin should be probably administered to all those burned subjects who are obese, overfed, especially with carbohydrates. It is quite probable that the danger of burn stress pseudodiabetes could be prevented by the above procedure. The other useful properties of insulin must be mentioned here again: its anabolic action, antisteatotic effect, glycogen sparing properties, etc. The amount of insulin added to glucose administered intravenously must be naturally carefully evaluated: whether to administer 2 or 4 units of crystalline insulin for each 10 g of glucose. More clinical trials are necessary.

The regular determinations of fasting blood glucose levels must become a r o u t i n e procedure in all major burns. It will be useful even to check regularly, e.g. once a week both the fasting blood glucose level, and its levels 2 hr after a glucose load or after a substantial meal rich in carbohydrates, to uncover a possible major impairement of the glucose tolerance.

The risks connected with the administration of the above small amounts of insulin are quite negligible if administered simultaneously with glucose. Were the resistance to insulin after burns caused by the presence of insulin of an impaired quality, hastily released from the pancreatic beta cells, the insulin administration could decrease the danger of treir exhaustion.

It is quite evident that the whole question as discussed above deserves much more experimental and clinical studies. The response of the burned organism is only rarely "ideal", it is on the contrary very often exaggerated. Our aim should probably be to make the response as "ideal" as possible, i.e. to spare the energy and protein resources as much as possible, and so to improve the course and prognosis of the burn disease, especially in patients with major burns.

SUMMARY

Fasting blood glucose, immunoreactive insulin (IRI) and growth hormone (IR-GH) levels were followed in 31 burned subjects. Increased IRI levels persisted in some patients even for many weeks after burns. Similarly, elevated IR-GH levels were found. There was rather often no correlation between the blood glucose, IRI and IR-GH levels. The high fasting IRI levels persisting for many weeks, represent probably a major strain to the pancreatic beta cells whose damage (temporary exhaustion?) could cause the dangerous b u r n s t r e s s p s e u d o d i a b e t e s.

Glucose tolerance tests and tests with intravenous insulin administration, were carried out repeatedly in burned subjects. Both an impaired glucose tolerance and insulin resistance were found (blood glucose and IRI levels were used as criteria). IR-GH behaved differently than under normal, physiological circumstances: it dit not decrease regularly during hyperglycemia, it did not rise always during hypoglycemia. The normal fasting blood glucose

and IRI levels do not exclude the presence of an impaired glucose tolerance and insulin resistance. They can be detected after a glucose or insulin (intravenous) load.

The simultaneous administration of small amounts of crystalline insulin and glucose was suggested, namely in burned patients with hyperglycemia, in overweight and overfed patients, especially with large quantities of carbohydrates. Insulin should be added to glucose administered intravenously. The regular blood glucose determination after burns must become a r o u t i n e procedure, including both fasting levels and levels 2 hr after a glucose load, or after a substantial meal rich in carbohydrates.

RÉSUMÉ

Les données d'insuline imunoréactive et du somatropine en suite de brûlures

R. Doleček, M. Závada, F. Beška, D. Buryšková

La glycaemie, les données d'insuline immunoréactive (IRI), de somatropine, d'hormone de croissance (IR/STH) dans le plasma en jeun ont été examinés chez 31 des brûlés au cours de trois mois suivant la brûlure. Les données élévées de IRI se montraient chez quelques-uns des brûlés même pendant plusieurs semaines. De même les données élévées de IR-STH ont été trouvées. Souvent il n'y avait pas de corrélation entre les données de glycaemie, IRI et IR-STH. Les données tres élevées de IRI en jeun subsistant au cours de plusieurs semaines, indiquent vrais emblablement une surcharge importante d'appareil insilunair, dont l'endommagement (l'explétion temporaire?) pouvait causer le tant infeste soit-disant burn stress pseudodiabetes. Chez les brûlés les auteurs ont soumis à l'épreuve les courbes glycaemique de même que les testes d'application intraveineuse d'insuline crystallique. On a toujours trouvé une tollérance amoindrie de glucose et la résistence envers insuline quand au données de glycaemie et celles de IRI. Les données de IR-STH étaient de même différentes de celles des personnes saines dans des conditions physiologiques: point d'abaissement au cours d'hyperglycaemie, point d'aggrandissement au cours d'hypoglycaemie. Les données normales de glycaemie et de IRI en jeun n'excluent pas la possibilité de la tolérance plus pire envers la glucose et la résistence envers l'insuline, telles qu'on les trouve dans le teste avec glucose et d'insuline intraveineux.

Les auteurs proposent d'appliquer de petites doses d'insuline crystallique avec la glucose chez les brûlés souffrant d'hyperglycaemie, chez les obèses et ceux trop nourris (surtout chez les personnes ayant trop de glycides). Cet insuline devait être appliqué intraveineusement dans la solution de glucose. Les données de glycaemie devait être chez les brûlés examinées quotidiennement et cela en jeun et deux heures après l'application de glucose de même que après les repas riches en glycides.

ZUSAMMENFASSUNG

Werte des immunoreaktiven Insulins und Somatotropins nach Verbrennung

R. Doleček, M. Závada, F. Beška, D. Buryšková

Bei 31 Verbrannten wurde die Glykämie, die Ruhe-Nüchternwerte des immunoreaktiven Insulins (IRI) und Somatotropins, des Wachstumhormons (IR-STH) im Plasma bis 3 Monate lang nach Verbrennung verfolgt. Die erhöhten Werte des IRI blieben bei

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einigen Verbrannten mehrere Wochen lang nach Verbrennung erhalten. Ähnlich wurden auch gesteigerte Werte des IR-STH gefunden. In vielen Fällen bestand zwischen den Werten für Glykämie, IRI und IR-STH keine Korrelation. Die hohen, mehrere Wochen andauernden Ruhe-Nüchternwerte für IRI repräsentieren wahrscheinlich eine belangreiche Belastung des Insularapparates, dessen Schädigung (zeitweilige Erschöpfung?) den befürchteten burn stress pseudodiabetes hervorrufen könnte.

Bei den Verbrannten wurden wiederholt glykämische Kurven und Teste nach intravenöser Verabreichung kristallinischen Insulins durchgeführt. Wiederholt wurde Beeinträchtigung der Glukosetoleranz und der Insulinresistenz festgestellt, und zwar sowohl im Sinne der Werte für Glykämie als auch für IRI. Die Werte für IR-STH verhielten sich desgleichen in vielen Fällen unterschiedlich von den gesunden Individuen unter physiologischen Bedingungen: sie zeigten keine Absinkung bei Hyperglykämie und keinen Anstieg bei Hypoglykämie. Die normalen Ruhe-Nüchternwerte für Glykämie und IRI schliessen nicht aus die Möglichkeit der Existenz einer verschlechterten Glukosetoleranz und Insulinresistenz, die bei der Belastung mit Glukose und intravenösem Insulin festgestellt werden können.

Vorgeschlagen wurde das Verabreichen kleiner Dosen kristallinischen Insulins zusammen mit Glukose bei Verbrannten mit Hyperglykämie, bei Fettleibigen und bei übermässig genährten Kranken (besonders mit übermässiger Zufuhr von Glyziden, Kohlenhydraten). Insulin sollte am vorteilhaftesten zusammen mit Glucose in Infusionen verabreicht werden. Die Untersuchung der Glykämie bei Verbrannten sollte eine vollkommen routinemässige Angelegenheit werden, wobei nicht nur die Ruhe-Nüchternwerte, sondern auch die Werte nach zweistündigem Abstand nach einer Standardbelastung mit Glukose oder nach einem Mahl mit reichem Glyzidengehalt verfolgt werden sollten.

RESUMEN

Valores de insulina imunoreactivo y los de somatotropina después de las quemaduras

R. D o l e č e k, M. Z á v a d a, F. B e š k a, D. B u r y š k o v á

Glucaemia, los valores de insulina imunoreactivo (IRI) y los de somatotropina, el hormón de crecimiento (IR-STH) en plasma en ayunas, fueron observados en 31 quemados durante el tiempo hasta tres meses después de la quemadura. Los valores elevados de IRI perduraban el algunos quemados hasta durante muchas semanas después del accidente. De manera semejante se encontraron también los valores elevados de IR-STH. Muchas veces no era ninguna correlación entre los valores de glucaemia, IRI y IR-STH. Los valores de IRI en ayunas los que duran durante muchas semanas, representan probablemente una carga importante del aparato insular, la damnificación del cual (el agotamiento temporario?) podría original el burn stress pseudodiabetes temible.

En los quemados se realizaban repetidamente las curvas de glucaemia y las pruebas después de la aplicación intravenosa del insulina cristalino. Repetidamente se comprobaron et empeoramiento de la tolerancia de la glucosa y el de la resistencia al insulina, tanto según los valores de glucaemia como también de IRI. Los valores de IR-STH se portaban también muchas veces diferentemente que en los individuos sanos en las relaciones fisiológicas: no bajaban en hiperglucaemia, no aumentaban en hipoglucaemia. Los valores normales de la glucaemia y de IRI en ayunas no excluyen la posibilidad de la existencia de la tolerancia de la glucosa y la de la resistencia al insulina, las que se pueden comprobar en la carga por la glucosa y por el insulina intravenoso.

Fue propuesta la aplicación de pequeñas tomas del insulina cristalino en junto con la glucosa en los quemados con hiperglucaemias, en los enfermos obesos y muy nutridos (sobre todo con glicidos excesivos). Lo mejor es apliar el insulina juntos con la glucosa en las infusiones. El examen de la glucaemia en los quemados tendría ser un asunto completamente de rutina es decir tanto en ayunas como también en dos horas después de la carga normal de la glucosa o después de una comida con el contenido rico de glicidos.

REFERENCES

1. **Allison, S. P., Prowse, K., Chamberlain, M. J.:** Failure of insulin response to glucose load during operation and after myocardial infarction. Lancet 1 : 478, 1967

2. **Allison, S. P., Hinton, P., Chamberlain, M. J.:** Intravenous glucose tolerance, insulin, and free fatty acid levels in burned patients. Lancet 2 : 1113, 1968

3. **Artz, C. P., Moncrief, J. A.:** The Treatment of Burns. 2nd Ed. Philadelphia, Saunders Co., 1969

4. **Bray, G. A.:** Calorigenic effect of human growth hormone in obesity. J. clin. Endocr., 29 : 119, 1969

5. **Cryer, P. E., Daughaday, W. H.:** Regulation of growth hormone secretion in acromegaly. J. clin. Endocr. 29 : 386, 1969

6. **Doleček, R., Endryáš, L., Kalina, J., Klabusay, L., Tichý, A.:** Metabolic Response of the Burned Organism. Springfield, C. Thomas, 1969

7. **Doleček, R., Buse, M., Kuperminc, D.:** Hodnoty insulinu a růstového hormonu v plasmě popálených (Insulin and growth hormone values in plasma of the burned subjects). Čas. Lék. čes. 108 : 1520, 1969

8. **Doleček, R., Kalina, J. et al.:** Léčba popálených (The Treatment of Burns). Praha, Avicenum, 1970

9. **Klyachkin, L. M., Pinchuk, V. M.:** Ozhogovaya Bolezn (The Burn Disease). Leningrad, Medicina, 1969

10. **Molinatti, G. M. et al.:** Radioimmunoassay of human growth hormone. J. nucl. Biol. Med. 13, 26, 1969

11. **Nakagawa, K., Horiuchi, Y., Mashimo, K.:** Responses of plasma growth hormone and corticosteroids to insulin and arginine with or without prior administration of dexamethasone. J. clin. Endocr. 29, 35, 1969

12. **Pennisi, F.:** A fast procedure for radioimmunoassay of H.G.H. J. nucl. Biol. Med. 12, 137, 1968

13. **Porte, D. Jr., Graber, A. L., Kuzuya, T., Williams, R. H.:** The effect of epinephrine on immunoreactive insulin levels in man. J. clin. Invest. 45 : 228, 1966.

14. **Samaan, N. A., Freeman, R. M.:** Growth hormone levels in severe renal failure. Metabolism 19 : 102, 1970

15. **Yallow, R. S., N. Varsano-Aharon, E. Echemendia, S. A. Berson:** HGH and ACTH secretory response to stress. Horm. metab. Res. 1 : 3, 1969

16. **Hales, C. N., Randle, P. J.:** Immunoassay of insulin with insulin antibody precipitate. Biochem. J. 88, 137, 1963

17. **Doleček, R., Závada, M., Buryška, M., Buryšková, D.:** Immunoreactive insulin and growth hormone levels in burned subjects. Rozhl. Chir. 50, 577, 1971

18. **Hinton, P., Allison, S. P., Littlejohn, S. Lloyd, J.:** Insulin and glucose to reduce catabolic response to injury in burned patients. Lancet 1, 767, 1971

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ENORMOUS ELEPHANTIASIS OF THE SCROTUM

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The term elephantiasis is already confined at present to a massive enlargement of dependent structures of the body, an irreversible state to which chronic lymphoedema has progressed by way of its transformation (4). The most affected areas are the lower limbs and the scrotum. Their often enormous enlargement develops secondarily to gradual blockage of the draining efferent lymphatic channels due to obstructive processes of various origins. Those are specific and unspecific inflammatory affections of the inguinal lymph nodes their tumorous infiltration, radiation or surgery performed in these sites (11). We are going, however, to limit ourselves to elephantiasis secondary to filarial infection, whose chief causative factor appear to be mature worms of Wuchereria bancrofti. The disease occurs rather only in the tropics. The adult worms settle predominantly in areas of low hydrostatic pressure of body fluids, in the groins and in the pelvis, and their antigenous decay products induce in the lymphatics changes which finally cause their obstruction (5, 6). The affected area is liable to secondary bacterial infection, too. This parasitic infection, too, prevails in the lower limbs and on the genitals. Massive enlargement due to filarial infestation occurs in a typical way especially in the scrotum.

Resulting from the loss of elastic fibres, hyperplasia of collagenous tissue and rigidity of tunica dartos, the scrotal skin thickens and gets warty and corrugated, with grooves forming between the rugged elevations. Since no folds form here, compared with those on the skin of the lower limbs, the scrotal skin resembles more the skin of a crocodile than that of an elephant. Jelly-like blubbery masses with lymph fluid in their cavities accumulate in the scrotal space between the fibrose trabeculae (1). The elephantoid scrotum may reach such a considerable weight, 100 kg (Pelletier) or 224 lb. (Mansen), the mass of tissue excised exceeding thus in weight that of the affected person following operation (3, 11).

In the lower limbs, through transformation of the lymphoedematous fluid and of the cellular tissue, an obstacle forms which interferes with drainage of the superficial lymphatics into the deep lymphatic field the efferent lymphatic channels being blocked in the groins. Surgical treatment which is here

the only suitable indication in the irreversible stage of the disease aims, of course, at preserving the limb. Excision of the lymphoedematous field in its entirety has been suggested with the respective measures aiming at establishing new lymphatic channels [Condoléon, Junge [7, 11]]. In the elephantoid scrotum, on the contrary, radical removal of the hypertrophied scrotal integuments with the lymphoedematous masses is indicated. It is, of course, possible to consider even here draining of the lymph from underneath the rest of the scrotal skin, but this method i n i t s e l f has proved to be of no permanent avail. For covering the preserved testicles and the cords there are several methods. It is possible for this reason to apply free skin-grafts or to create a suitable bed for them under the skin of the adjacent areas of the thighs or, eventually, to reconstruct a new scrotum from the remnant flaps of the less affected scrotal skin.

In spite of even reported good effects of accommodating the testicles under the skin of the thighs the method does not exclude the risk of interfering with spermatogenesis. For the treatment of an enormously enlarged scrotum we, therefore, consider the last of the above said methods the most suitable. In the removal of the scrotum, however, several facts must be taken into consideration. Along with the affection of the scrotal integument even the skin of the penis undergoes the same changes, but no affection of the corpora cavernosa and their sheathing has ever been noted and the lining of the glans as well as the inner skin of the prepuce does not become involved. Their lymphatics keep on being drained to the deep lymphatic field along the large vessels. While the scrotum is growing in bulk, the prepuce gets elongated and the patient passes urine through a channel formed from its inner skin [10]. Unless circumcision preceded, the preserved inner skin can be reflected back over the decorticated penis to cover the raw surface of its shaft, whereas the remnant flaps of the scrotal integument are utilized for remodelling the scrotum.

Irrespectively of these facts, we have not found in the available literature any satisfactory exact instructions as regards the removal of the scrotum itself, although even this stage of the operation may be handicapped by serious hazards. It is often unavoidable to make an incision directed on the cords in the groins, because the dissection of the testicles becomes difficult due to secondary inflammatory changes. But the exposure of the decorticated penis buried deep in the lymphoedematous masses also requires a special vertical incision. Even the lymphoedematous masses must be carefully dissected from the perineal muscles in order to prevent a relapse. In fact, it is sometimes not easy to satisfy all these demands and yet to build up a suitable covering for the contents of the scrotum. There exists at least the risk of sloughing at the skin margins [2, 3].

We faced once such a difficulty in the case of a massive enlargement of the scrotum, where, above all, the prepuce was missing due to previous circumcision and, in addition, hydrocele with periorchitis rendered the dis section difficult. We chose a method that has not currently been reported on,

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establishing a new scrotum by means of a frontal flap formed from the anterior area of the scrotal integument. An aperture was made in it for emergence of the penis. We present the case report as follows.

Yahya H., 25 years old, was conveyed with difficulty from a distant mountain village having been unable to walk for months already. The scrotum had been enlarging within years until its masive tumour resembled a large bundle. The patient was hardly able to climb several steps and kept on sitting on his scrotum, as a rule. He suffered from continuous leakage of urine, which irritated the skin.
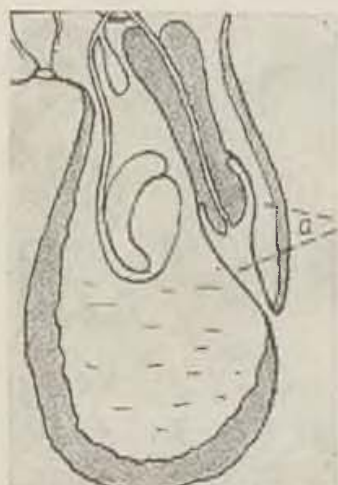
Fig. 1. Channel formed from the elongated inner skin of the prepuce. — Fig. 2. Elephantoid scrotum enlarged more in the anteroposterior diameter

The patient was rather undernourished. The enlargement of the massive scrotal tumour developed predominantly in the anteroposterior diameter and reached, when standing erect, down under his knees. The scrotal skin was indurated and hypertrophied and rather low in the mid-line it was possible to differentiate in the skin relief a part of the glans area with external urethral meatus. Urine trickling from it macerated the skin. Especially in the left groin lymph nodes were palpable. The left lower limb exhibited an oedema, too, which the patient had not been aware of as yet. The examination for microfilaria in the peripheral blood carried out according to routine (6) was negative, so was the Meinicke test.

After having taken the usual preoperative measures, we started the removal of the massive scrotal tumour. The patient was placed lying face upward with elevated pelvis allowing the lower limbs to hang down over the sides

of the table in the abducted position during the operation (3). Through longer incisions in the groins carried downwards on the scrotum, the testicles on their cords were first exposed and placed for the time being on the lower abdominal wall. They did not peel off easily on the left side, due to adhesions induced by perifuniculitis and periorchitis. A thick-walled hydrocele with accumulated clear yellowish fluid was present. A partial excision of its wall was undertaken. Both skin incisions were then carried downwards converging to the mid-line and joining here, so that a frontal flap formed from the
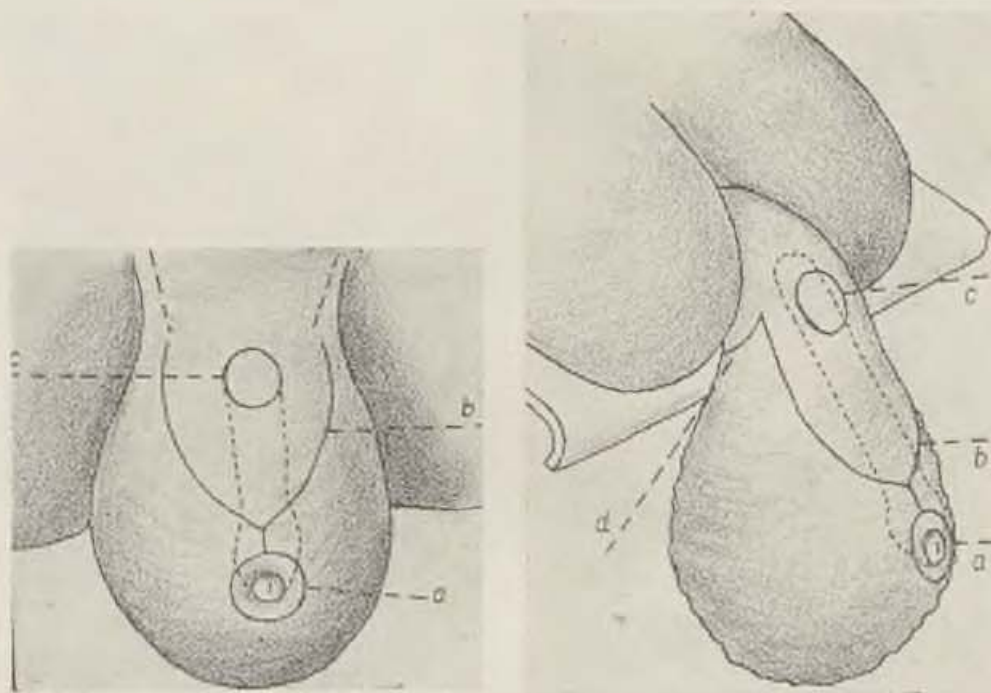
Fig. 3. Frontal flap a) incision encircling the external urethral meatus, b) margins of the frontal flap, c) aperture for emergence of the penis. — Fig. 4. a, b, c, the same as in Fig. 3. d) the incision on the perineum is carried close to the anus. For a better survey, the limbs are lifted up

relatively better preserved part of the scrotal integument. A circular incision was then made around the urethral meatus, while another vertical cut was led in the midline to the edge of the frontal flap. By means of dissection through the whole thickness of the tissue and lifting up the flap to the pubis we were able to expose the decorticated shaft of the penis buried in the depth. We pulled it through an aperture made in the flap for emergence of the penis. The dissection of the penile shaft was carried out on the inserted urethral sound.

The situation became rather difficult when we tried to lift up the massive scrotal tumour so as to be able to conclude its removal by means of incisions on the perineum where the changes of the scrotal integument were most advanced. It was beyond our power to handle the heavy burden. Further dissection through the upper incision posterior to the perineum was, of course, exacting and there was no clear view of the bottom of the operation field.

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Bleeding from the large new-formed arteries was by no means easy to control. That is why we were compelled to give up the recommended ruthless excision of the lymph masses from the perineal muscles. During the operation, dextran infusions were given and after it a blood transfusion was carried out. The removed massive scrotal tumour weighed about 45 kg, including the assessed volume of the accumulated lymph fluid.

Further healing took an uninterrupted course going on here and there per granulationem in the places of loose approximation of skin edges, without manifestation of subsequent infection. Oedema due to the remnant lymph masses subsided within a short time. The penis appeared to be elongated owing to the traction caused by a massive scrotal tumour — the patient had undergone previous circumcision — and kept seeming so even after surgery but it assumed in the course of time its appropriate length again and

Fig. 5. Emergence of the penis through the aperture in the flap. The skin apron is, regarding its shape, conform to the defect resulting from the removal of the scrotum

after several days the patient regained control of passing urine. Within one week after the operation the blood cell formula registered er 300 000, hb 60% and l 6800 and in the peripheral differential blood count eosinophils 6% were found.

The clinical picture of filariosis reveals itself in a typical way. Since the primary infect the basic symptoms develop intermittingly both with increasing alteration of the general condition and with signs of affection of lymphatics and with marks of arising circulatory defect [5]. Alteration of the blood picture with striking eosinophilia and first, of course, the direct proof of microfilaria in the peripheral blood confirm the diagnosis [8]. Usually, however, the surgeon meets only with the obstructive stage of the disease when the blockage of the lymphatics has induced irreversible damages being typical enough as to bring about a correct diagnosis. Most probably this was the matter in our case in spite of the incomplete result of the laboratory examination. Of course not every enlargement of the scrotum in the tropics is to be ascribed to filariosis but the occurrence of the disease in areas of

higher endemicity continues to be of importance as the proof of microfilaria is often a failure and the more severe the clinical symptoms the lesser is often the likelihood that microfilaria are provable. After the experience gained with our patient I should still like to mention another affection of genital whose causative relationship has been accepted differing, of course, according to the place where the parasite got stuck.

Where the ruptured lymphatic channels have got connected even high with the renal pelvis, chyluria (2) with typical stratification in the urine occurs. On the other hand, funiculitis with lymphostatis develops and symptoms of epididymoorchitis appear where the mature worms are trapped in the lymphatics of the cord. Frequently, hydrocele is present rising probably even from the retarded resorption of the fluid due to inflammation in the adjacent tissues. Microfilaria can be found in the folds of the tunica. Together with affection of scrotal and penile integument, the just mentioned affliction constitutes a group of urogenital filarial infestation (6). It is worth noticing that otherwise even the efferent ways of the inner lining of tunica are drained into the deep lymphatic ways and are not afflicted under the conditions of uncomplicated scrotal elephantiasis (11).

A radical removal of all diseased tissues being carried out, an attempt could be made, nevertheless, to establish in addition new efferent lymphatic channels from the newformed scrotum. Several ways have been suggested in this respect. It has been recommended, e. g. to assure a wide communication into the subcutaneous tissue in the adjacent areas, to the inner aspect of the thigh unless the limb itself is affected by the blockage of its lymphatics, or over the pubis to the lower abdomen. Here apertures in the sheath of mm. recti should be made in addition (10). Furthermore it was stipulated to expose into the subcutaneous space the perineal muscles carrying out radical excision of the lymphatic masses or to open and reverse the tunica vaginalis so that the propria gets attached to the subcutaneous tissue [Orr (11)]. We dare to put the question whether we did not achieve at least in this case similar results by means of excision of the wall of hydrocele, although an impeded resorption of its accumulated fluid might be expected. There were no signs of lymphostatis on the cord here and no traces of affection on propria at least. Although we did not manage excision of the lymphoedematous mass at the perineum in its entirety, the oedema outlasting after the operation subsided alike the pillar of the lymphoedematous mass left intentionally on the calf of the leg in the operation of the elephantoid leg according to Junge (7).

Finally, I should like to add a few remarks on the removal of the indurated scrotal integuments themselves. Large veins can be, as a rule, met with in the incisions close to the anus, further in the scrotal septum or beneath the urethra (3). But in the massive scrotal tumour even new large arteries form, in our case reaching almost the thickness of the little finger, two by two on either side. Therefore, it is advisable, in order to have all the time a clear view of the wound, to assure in advance lifting up the elephantoid

scrotum at the right moment by means of an overhead pulley provided with a sterile hook [4, 9]. Due to the technical difficulties we did not manage to get the device and had to pay for it being not able to turn up the heavy scrotum to lower part of the abdominal wall. It is furthermore useful to take into consideration the above said fact that, while the penis is buried deep into the blubbery masses, the urethra takes sometimes its course separately from the corpora cavernosa. The insertion of a urethral sound is helpful in preventing injury of the urethra at a position close to the perineum [2]. First, however, I should like to comment upon creating the frontal lap from the scrotal integument.

We chose this solution, in fact, out of necessity, as the only way possible when both incisions on the cords had to be made downwards and the unavoidable mid-line vertical incision for exposing the penile shaft would badly threaten the viability of the refashioned new scrotum. We proceeded to create the frontal apron in fear lest the dissection should give rise to skin margin sloughs at least because of the poor vascularity of the extensive anterior flap. Nevertheless, as it has been mentioned above, the results were satisfactory and even the forming of small flaps close to the aperture for temporary covering of the raw surface of the penile shaft did not matter. Bearing in mind the statements on frequent marginal sloughing we looked for an explanation of the good union of the skin edges in our case. We found it at last with Lovett-Campbell, A. C. (Trans. Roy. Soc. Trop. Med., 1948) who elaborated the method of the frontal flap and denoted it as the best just for the treatment of an enormous elephantoid scrotum.

Lovett-Campbell draws attention to the fact that the frontal apron is not formed from the very scrotal skin with its poor vascularity. As a matter of fact, it is a lower abdominal skin drawn over the pubis downward the traction being extorted by the weight of the massive scrotum. Its structure keeps on being well preserved, contrary to the hypertrophied and indurated integument of the affected scrotum itself, the anterior flap created from the ileopubic skin with Camper's fascia being generously supplied from branches of epigastric arteries. Two converging incisions joining below at an apex in the mid-line correspond to the direction of the cutaneous vessels. An aperture for emergence of the penis has to be made in a convenient spot, while even the possibility of a postoperative upward retraction of the flap is to be taken into consideration. Resulting angular bending of the shaft could interfere with the function of the penis. Loose approximation of the skin margins is preferable without exaggerated striving for achieving a perfect symmetry of the flap. The danger of marginal sloughs can thus be avoided. The spheroidal contour of the new scrotum will be restored in the course of time itself. For repeated dressing, if need to be, a scrotal plaster cast has been recommended, moulded on the completion of the operation and lined with tulle gras. A tourniquet has been recommended and haemostasis realized by means of ligatures and electric cauterisation [9].

Compared with the perfectly elaborated method of Lovett-Campbell, which we did not get acquainted with at the time of the operation to our detriment

we chose, anyhow, a procedure differing in some details. It was required, indeed, even by the unsimilar situation. The incisions directed on the cords and the testicles we made on purpose and created the frontal flap till carrying on the cuts downwards. Excision of the lymphoedematous masses at the perineum we did not carry out ruthlessly as recommended and relied, fortunately with success may be, on the draining effect of the exposure of tunica propria. We worked without any tourniquet, even this technique being favoured by some authors (3), as it renders possible a better approach to the perineum where the changes usually appear as it was reported to be most advanced. Otherwise, in the case of urgency, even a bicycle tube will serve. The bleeding from the large arteries had to be stopped by means of a technique worked out for large vessels. Provisional covering of the raw surface of the penile shaft enabled to shorten the time of the operation and to postpone the skin grafting, a procedure inevitable after previous circumcision. In the first place, however, an unpleasant experience we made gave rise to the necessity for warranting by all means the lifting of a heavy elephantoid scrotum in the second stage of the operation by means of the above mentioned overhead pulley.

Slight modifications of the method can be thus performed and applied while every case should be considered on its own merits, but, all the same, a general rule can be laid down, a general directive for the removal of the large elephantoid scrotum. In our opinion, the new scrotum is to be modelled from the frontal flap with an aperture for emergence of the penis, an apron of generous vascularity and suitable quality of the integument, abdominal in view of its provenance, according to the method first introduced by Lovett-Campbell.

We should like to express our thanks to the author of the mehod, Lovett-Campbell A. C., and to the editors of the "Transactions of the Royal Society of Tropical Medicine and Hygiene" for their kind courtesy to use the drawings in the text partly as a copy. We should also like to express our gratitude to Dr. Vlad. Šilhavý, CSc., for supplying the figures and we are indebted no less to the editors of the journal "Zeitschrift für Tropenmedizin u. Parasitologie" for the valuable suggestions as regards the relevant literature.

SUMMARY

The author confines himself, for the most part, to the technical suggestions of the surgical treatment of elephantiasis of the scrotum which represents the final stage of the disease induced by infestation with Wuchereria bancrofti. Against the affection of the lower limbs, the removal of the structure is only to be taken into consideration in the enlargement of the scrotum preserving skin flaps large enough for covering the testicles and the cords. In the treatment of an enormous enlargement of the scrotum the author created an anterior flap according to the method of Lovett-Campbell and pulled the decorticated penis through an aperture at the basis of the flap. Even thus the blood supply of the flap continues to be well preserved, as it was in fact

formed from the lower abdominal skin drawn downwards over the pubis by the weight of the scrotum. The penile shaft was covered for the time being with the skin flaps taken from this skin apron and their later replacement with skin grafts was taken into account. Lifting of the heavy enlarged scrotum by means of a pulley should be ensured so that the dissection on the perineum may be made easier. The case report has been stated and the text supplied with figures.

RÉSUMÉ

L'éléphantiasis énorme du scrotum

K. Holubec

L'auteur s'est limité pour la plupart aux remarques techniques concernant le traitement chirurgical des éléphantiasis énormes du scrotum présentant la forme finale de la filariose causée par l'infestation de Wuchereria bancrofti. Différemment de l'atteinte de l'extrémité inférieure dans le scrotum éléphantiasique on peut prendre en considération seulement la resection en réservant le reste de peau du scrotum combien on en a bésoin pour couvrir les testicules préservés. Pour le traitement d'une éléphantiasis du scrotum extrêmement grande pesant 45 kg l'auteur a formé le tégument de la paroi antérieure du scrotum d'après Lovett-Campbell et a fait sortir la verge décortiquée par une ouverture faite dans la base du lambeau cutané. Le lambeau reste en chaque cas bien vascularisé étant formé en réalité par la peau du hypogastre tendue en bas. La verge a aussi été couverte provisoirement de la peau prise du lambeau et on a compté avec son remplacement par les greffes cutanées plus tard. Pour un scrotum il est convenable d'assurer un accrochement à l'aide d'une poulie pour rendre plus facile la préparation de côté du périnée. Les tableaux et l'historie d'un cas de la maladie ont été adjoints.

ZUSAMMENFASSUNG

Enorme Elephantiasis des Scrotums

K. Holubec

Der Verfasser beschränkt sich grösstenteils lediglich auf technische Hinweise zu der operativen Behandlung grosser Scrotumelephantiasen, die die Endphase einer durch Infestation mit der Filaria Wuchereria bancrofti verursachten Krankheit darstellen. Im Gegensatz zu der Erkrankung der unteren Gliedmassen kommt beim elephantiatischen Scrotum in Erwägung lediglich die Resection mit Erhaltung eines übrigbleibenden Hautrestes, soweit er zur Deckung der erhaltenen Testes erforderlich ist. Für die Behandlung einer besonders grossen Scrotumelephantiase (Gewicht 45 Kg) bildete der Verfasser diese Hautbedeckung aus der vorderen Wand des Hodensackes nach Lovett-Campbell und führte den entrindeten Penis mittels einer Fensterung in seiner Base heraus. Dem Lappen bleibt auch so eine gute Gefässversorgung, weil er eigentlich durch die aus der Bauchwand herabgezogene Haut gebildet wurde. Der Penis wurde durch Verschiebenplastik aus dem Lappen provisorisch gedeckt und es wurde mit seiner späteren Ersetzung durch Spalthaut gerechnet. Für schwere Hodensäcke empfiehlt es sich, eine geeignete Hebevorrichtung vorzubereiten die die Operation am Perineum erleichtern würde. Die Arbeit ist mit Zeichnungen versehen und enthält auch die Kasuistik des beschriebenen Erkrankungsfalles.

RESUMEN

Elefantíasis excesiva del escroto

K. Holubec

El autor se limita de la mayor parte solamente a las observaciones técnicas para el tratamiento operativo de grandes elefantíasis del escroto, las que son la fase final de la enfermedad ocasionada por la infestación con Wuchereria bancrofti. A diferencia de la afectación de la extremidad inferior viene en el escroto hipertrófico en consideración solamente la amputación con dejar el resto de la piel del escroto, cuanto es necesario para la cobertura de los testículos conservados. Para la asistencia de la elefantíasis del escroto especialmente grande (peso 45 kg) el autor formó esta cubierta de la pared anterior del escroto según Lovet-Campbell y el pene decorticado hizo salir por la fenestración en su base. El lóbulo resta también así bien abastecido de vasos, porque es en el fondo formado por la piel sacada de la región hipogástrica. El pene fué cubierto provisionalmente con la piel del lóbulo y se cuenta con su reemplazo posterior por los injertos de la piel. Para los escrotos pesados es conveniente preparar la colgadura en la polea, la que facilitaría la preparación en el perineo.

Se adjuntan los dibujos y se indica la casuistica del caso mencionado de la enfermedad.

REFERENCES

1. **Anděl, Z.:** Některé zajímavosti z chirurgovy práce v tropech (Some interesting facts on the work of the surgeon in the tropics-in Czech). Prakt. Lék., 42, 750 : 1969.

2. **Basu, A. S., Chaterjee, P.:** Tropical surgery. London, Butterworths 1969.

3. **Bowesman, Ch.:** Surgery and clinical pathology in the tropics. Edinburg — London, E. + S. Livingstone Ltd. 1960.

4. **Bukley, G. J.:** Scrotal and penile lymphoedema. J. Urol., 87, 422 : 1962.

5. **Diop, A., Chabal, J.:** Indications chirurgicales dans le traitement des membres inférieurs d'origine filarienne. Bull. Soc. med. Afr. Noire Lge Franc., 11, 628 : 1966.

6. **Gratama, S.:** The pathogenesis of filarial infections. Trop. Geogr. Med., 21, 254 : 1969.

7. **Junge, W.:** Die operative Behandlung der Elephantiasis des Beines. Arch. Schiffs-Tropen. Hyg., 44, 550 : 1940.

8. **Kierfeld, G., Magnus, L.:** Chylurie infolge Filariosis. Der Urologe, 8, 314 : 1969.

9. **Lovett-Campbell, A. C.:** The surgical treatment of the large elephantoid scrotum. Trans. Roy. Soc. trop. Med. Hyg., 41, 645 : 1948.

10. **Taubert, G.:** Zur Elephantiasis scrotalis. Bruns' Beitr. klin. Chir., 215, 45 : 1967.

11. **Uhlíř, K.:** Elefantiasis nostras šourku a pohlavního údu (Elephantiasis nostras of the scrotum and of the penis-in Czech). Lék. Listy, 8, 425 : 1953.

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