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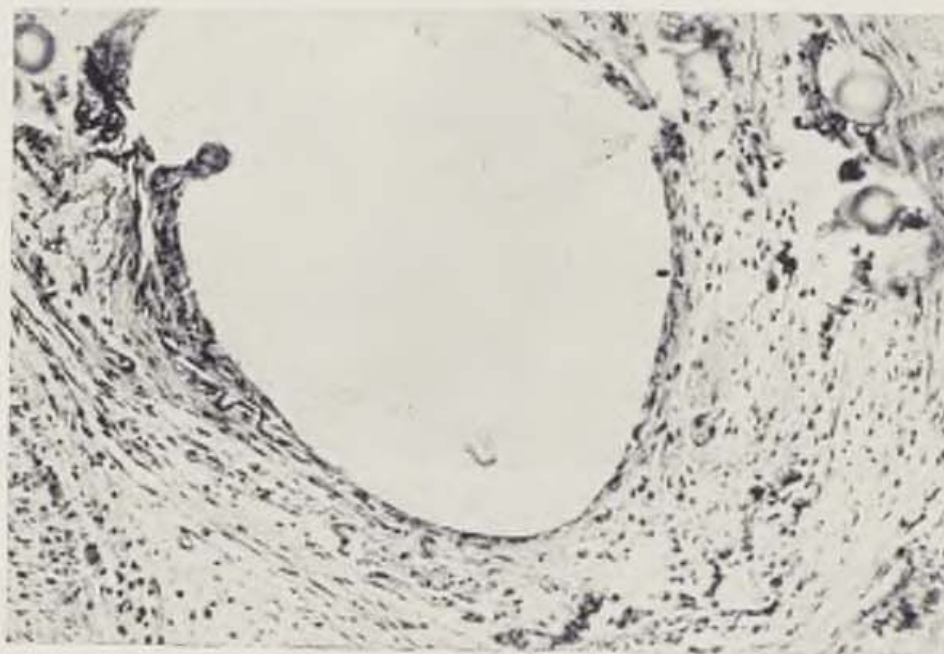


Fig. 1. Transverse section of artery at the site of suture. HE \times 400



Fig. 2. Oblique section of artery near the suture. HE \times 400

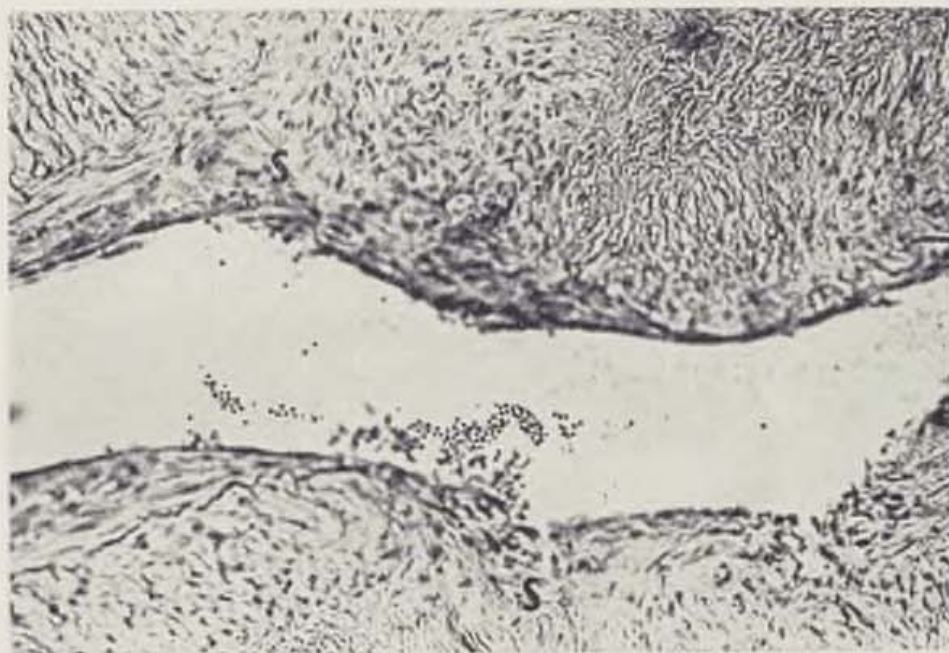


Fig. 3. Longitudinal section in the area of arterial suture and free flap (S). HE \times 400

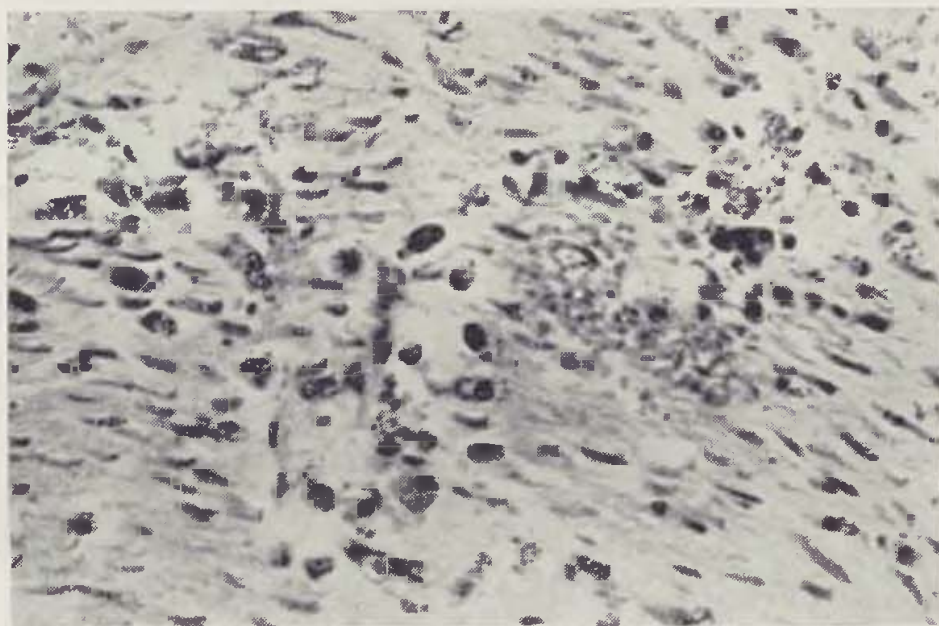


Fig. 4. Perivascular connective tissue of flap in the vicinity of the suture. HE \times 800

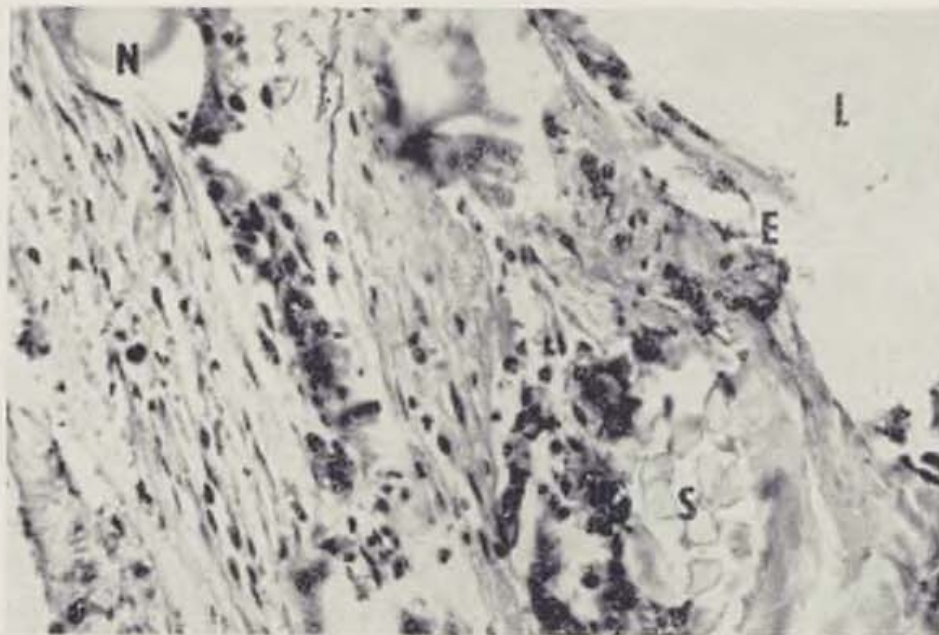


Fig. 5. Transverse section at the site of arterial suture. HE $\times 800$, L — vascular lumen, E — endothelium damaged by suture, N — monofilamentous 10-0 nylon, S — polyfilamentous 8-0 silk

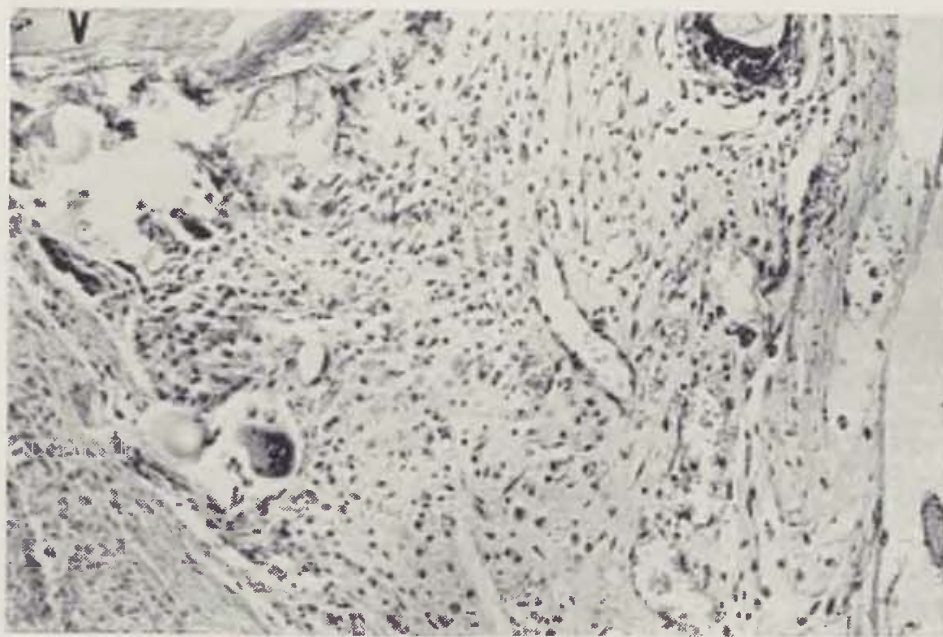


Fig. 6. Transverse suture near sutured vessel. HE $\times 400$. V — vessel

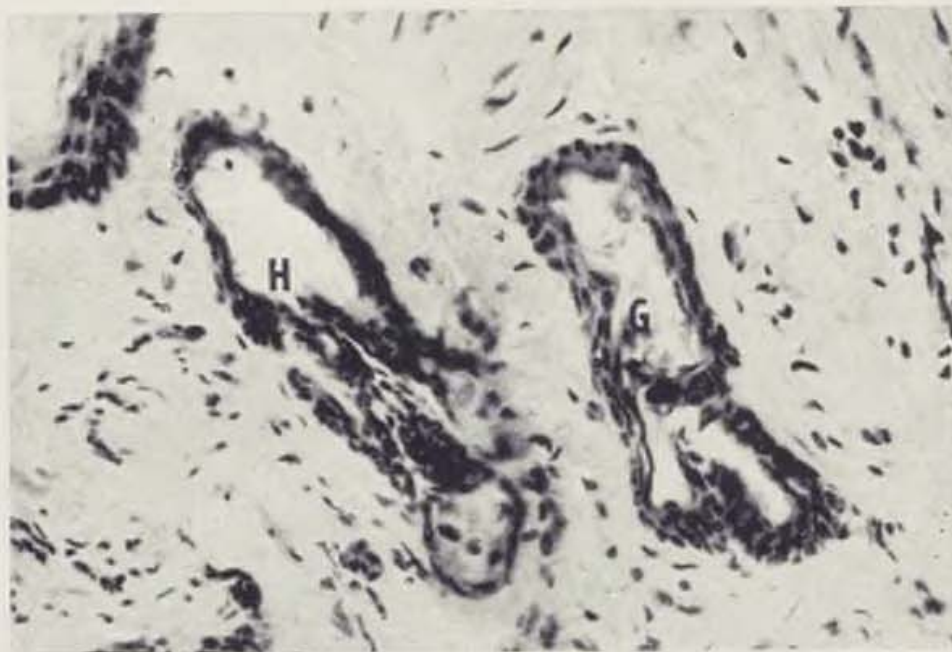


Fig. 7. Sectioned flap specimen on day 14. HE \times 800. H — hair follicle. G — sebaceous gland

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FREE FLAP IN AN EXPERIMENT — A HISTOLOGICAL VIEW

J. FEDELEŠ, Š. ZBOJA, J. SLEZÁK, J. DREXLER, J. JANOVÍČ, M. BROZMAN, V. SEKAN

Microsurgery is fast becoming a widely used technique. Microvascular anastomosis as the basis of the technique has already been cultivated to a relatively high degree of perfection. However, there are as yet too few fundamental studies dealing with the process of healing in microvascular anastomosis.

At the Department of Plastic Surgery, Bratislava, we have been studying free flap transfer in animal experiments by means of surgical techniques since 1975. We have had suitable material at our disposal, and that was why we came to be interested in the process of healing in the microsurgical suture of the artery and the flap.

MATERIAL AND METHODS

The rabbit was chosen as the experimental animal as its vessels are sufficiently like those in humans. Intravenous anaesthesia was decided on and also intramuscular anaesthesia using Thiopental.

The actual free flap transfer was performed on the animal's back involving flaps 4×7 cm in size, and on the ears involving flaps sized 7×4 cm. A total of 70 such experiments were performed. Specimens of tissue designed for histological examination were taken in 20 cases, half of them on day 7 after the surgical operation, the other half on the 14th postoperative day. The tissue specimens were fixed in Lillie's buffered formol, standardly stained with haematoxylin-eosin, and studies magnified X 400 and X 800.

Fig. 1 shows a cross section of an artery 0.8 mm at the site of suture. The vascular wall shows signs of mechanical damage caused by the suturing material. The lumen is patent, the vessel surrounding is in fibrotic connective tissue. The architecture of the vessel is partially preserved. Also in view is monofilamentous suturing material transversely sectioned.

Fig. 2 shows a transverse section of the artery in the vicinity of the suture. Except for the thickening of the intima, the vascular architecture is practically normal. There is increased perivascular cellularity.

Fig. 3 shows a longitudinal section of the sutured artery of the flap; there is full patency.

Fig. 4 shows perivascular connective tissue in the suture area with a multitude of macrophages and phagocyte-invaded remnants of erythrocytes.

Fig. 5 shows fibrotic connective tissue at the site of the suture of the vessel with transverse sections of monofilamentous suturing material 10-0 Nylon, and polyfilamentous suturing material 8-0 silk.

Fig. 6 shows immature fibrous connective tissue close to the sutured vessel (top left) with a multitude of capillaries.

Fig. 7 shows an ear flap with preserved structure of skin adnexae — hair and sebaceous glands.

EVALUATION AND DISCUSSION

It appears in terms of overall evaluation that thrombosis and partial occlusion of the vascular lumen tend to develop fairly frequently. However, the thrombus was found canalized as early as day 7 after surgery. On day 14, there was already a minimum of thrombosis. The flaps survived in all cases even though some 30% were partially affected by fibrosis, apparently as a result of temporarily impaired blood supply. One point to make is that in view of the flap survival rate no anticoagulants were employed. Nevertheless, the use of suitable anticoagulation therapy (heparin failed to prove its worth in rabbits) might well eliminate thrombosis as well as fibrosis which we were able to reveal in 30% of the flaps in our experiments involving histological observation.

J. H.

SUMMARY

The authors performed histological examinations of vessels sutured by means of microsurgery and made tissue specimen checks in free flaps transferred on rabbit back and ear. The specimens were taken on days 7 and 14 after surgical operation. No anticoagulants were given to the experimental animals.

Histology revealed partial fibrosis of the flaps and partial vascular thrombosis at the site of the suture in 30% of the cases involved. The fibrosis appeared to be in connection with temporarily impaired blood supply during thrombotic involvement at the site of vascular suture.

ZUSAMMENFASSUNG

Freier Lappen im Experiment — histologische Sicht

Fedeleš J., Zboja Š., Slezák J., Drexler J., Janovič J.,
Brozman M., Sekan V.

Die Autoren unternahmen histologische Kontrolle der mittels mikrochirurgischer Technik durchgeführten Gefäßsuture sowie Kontrolle des Gewebes der übertragenen freien Lappen am Rücken und an der Ohrenmuschel des Kaninchens. Das Material

wurde am siebenten und vierzehnten Tag nach dem chirurgischen Eingriff gewonnen. Die Versuchstiere wurden mit keinen Antikoagulantien behandelt.

Bei histologischer Untersuchung wurde partielle Fibrotisierung der Lappen und partielle Thrombotisierung der Gefäße an der Stelle der Suture in 30 % aller Fälle gefunden. Die Fibrotisierung stellen die Autoren in Zusammenhang mit der vorübergehend verschlechterten Ernährung bei der Thrombotisierung am Ort der Gefäßsuture.

RÉSUMÉ

Lambeau libre dans l'expérience — aperçu histologique

Fedeleš J., Zboja Š., Slezák J., Drexler J., Janovič J.,
Brozman M., Sekan V.

Les auteurs ont réalisé un contrôle histologique de la suture des vaisseaux par la technique microchirurgique et un contrôle des tissus des lambeaux transplantés libres au dos et au pavillon de l'oreille du lapin. Le matériel a été pris le 7ème et le 14ème jour après l'intervention chirurgicale. Aucuns anticoagulants n'étaient pas administrés aux animaux expérimentaux.

Dans 30 %, l'examen histologique a démontré une fibrotisation partielle des lambeaux et une thrombotisation partielle des vaisseaux en endroit de la suture. Selon les auteurs, la fibrotisation est en relation avec la nutrition temporairement troublée dans la thrombotisation en endroit de la suture des vaisseaux.

RESUMEN

Lóbulo libre en un experimento — vista histológica

Fedeleš J., Zboja Š., Slezák J., Drexler J., Janovič J.,
Brozman M., Sekan V.

Los autores hicieron un control histológico de la sutura de los vasos mediante técnica microquirúrgica así mismo un control del tejido de los lóbulos libres trasplantados en el dorso y en la oreja de un conejo. El material fue tomado el día 7 y 14 después de la intervención. A los animales experimentales no se les suministraban ningunos anticoagulantes.

En los exámenes histológicos se encontró fibrotización parcial de los lóbulos con trombotización de los vasos en el lugar de la sutura en 30 % de los casos. Los autores relacionan, la fibrotización con la nutrición empeorada por el momento durante la trombotización en el lugar de la sutura de los vasos.

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FURTHER STUDY ON DYNAMICS OF SKIN THERMOASYMMETRY IN THE PERIOD OF RESTORATION AFTER REPLANTATION OF EXTREMITIES IN DOGS (REPORT II)

E. F. URATKOV, A. G. LAPCHINSKYI, S. A. PERESTORONIN, A. I. KAVESHNIKOV

Skin electrothermometry has got a broad utilization in surgical clinics as a method detecting disturbances in terminal blood circulation. In our previous report (E. F. Uratkov et al., 1975) we tried to reveal our results of long term utilization of this method for studying dynamics of microcirculation renewal in first days after amputated extremities were replanted in 100 dogs. The article also explained results of biometrical analysis of skin temperature measurements linked with various experiments of replantation of extremities including those which were preserved up to 26 hours. We were dealing with these experiments since 1953. (Lapchinskyi, 1960; Lapchinskyi et al., 1961, etc.).

First days of postoperational period revealed significant differences in dynamics of microcirculation renewal in animal with successful and unsuccessful operational results. When the replanted extremity starts to adhere and the terminal blood circulation is renewed, the positive skin thermoasymmetry (STA) could be traced since first days and hyperthermy of the transplanted extremity remained stable. And on the contrary, change of STA sign linked with the cross of temperature curves and increase of negative STA was considered to be an objective indicator of the blood circulation disturbance in the replanted extremity and was associated with blood cells aggragation, microembolism and formation of thrombi. Third type of STA dynamics represents low negative asymmetry with temperature curves practically parallel which could be traced just during the local disturbances of the terminal blood circulation, caused by general complications such as transplantational toxicosis, pulmonal shock, postoperational profuse bleeding, etc.

This report will continue describing the results of biometrical analysis of the same experimental material but in the late postoperational period.

We shall try to pursue the regenerative process of the terminal blood circulation in transplanted extremities during the late postoperational period on the basis of further study on STA dynamics.

METHODOLOGY

Skin temperature measurement was carried out by the universal electrothermometer "TEMP — 60" with thermistor. Measurements were always performed at the same point*) (2nd interphalangeal fold) with strict adherence to the following order: air, the intact extremity and then — the replanted extremity.

We took the temperature every day during first 5 weeks after operation and later on, if no problems in postoperational period, we measured every week. Data of skin temperature were recorded up to 9—10 weeks in majority of experimental records. Later on, we registered data just in single cases since temperatures of both transplanted and intact extremities started to equalize by that time. Skin temperature of healthy dogs, i. e. $34 \pm 0,12^{\circ}\text{C}$, was again considered to be a normothermic level.

Received temperature data of all animals were divided into groups during the biometrical elaboration with regard to the term of the blood circulation renewal in the replanted extremity. Each group was determined by its representative features. Average temperatures of the representative temporary groups formed the basis of primary temperature curves. Due to their complexity in the process of later analysis, the equalizing was done by the method of homogenizing. Curves were compared according to coefficients of both temperature variability and correlation of curves.

RESULTS

We observed increase of skin temperature in transplanted extremities up to the normothermic level in all animals during first 2 postoperational weeks [Fig. 1]. Skin temperature of extremities had stable dynamics while

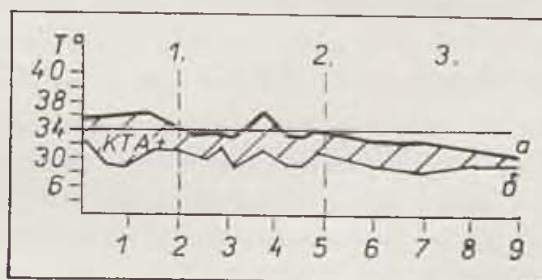


Fig. 1. General dynamics of skin temperature in first 9 weeks after successful replantation of amputated extremities. Fig. 2,3: 1, 2, 3 — period of normalization of skin temperature reactions in the healing process of deplanted extremities. — a — temperature of replanted extremity, b — intact extremity, c — air, vertical axis — temperature, horizontal axis — week after operation

*) Ostroumov's point

the temperature of intact extremities was apparently unstable. Coefficient of temperature variability of transplanted extremities was not higher than $3,07 \pm 0,58 \%$ in comparison to $5,3 \pm 1 \%$ of intact extremities with high reliability of differences ($t = 3,6$). Temperature of intact extremities apparently decreased during first weeks and was $4-5^{\circ}\text{C}$ below the normothermic level. At the end of first week STA reached in some cases 9°C when the average was $4,2^{\circ}\text{C}$. At this period we missed the correlation of temperature curves of both transplanted and intact extremities ($r = +0,25$), their correlation linkage was very weak.

During next 3 weeks STA remained positive from 2 to 5°C with the average $3,1^{\circ}\text{C}$. Coefficient of temperature variability of transplanted extremities increased at that period up to $5,12 \pm 0,78 \%$ compared to $8,02 \pm 1,24 \%$ of intact extremities while the reliability of their differences increased apparently ($t = 2,15$). At the same time we realized the tendency to slight decrease of skin temperature in the transplanted extremity when compared to the normothermic level. It affirmed an impression that gradual increase of synchronism of temperature changing started at that period in both intact and transplanted extremities. It was proved by the increase of positive correlation linkage up to the mean limits ($r = +0,49$).

After 6 and especially after 8 weeks when no complications of post-operational period were recorded, we can trace the tendency of temperatures in both extremities to equalize. Coefficients of variability of temperatures in extremities gradually tended to reach values the difference of which could not be statistically reliable (replanted — $C_v = 2,78 \pm 0,35 \%$; intact — $C_v = 2,40 \pm 0,33 \%$; $t = 0,78$). Correlation analysis of temperature curves reflected high degree of positive correlation linkage between them ($r = +0,74$). In all cases STA remained positive but its value dropped to $+2,7^{\circ}\text{C}$.

Influence of the room temperature inside vivarium on dynamics of skin temperature of replanted and intact animal extremities was learnt by means of correlation analysis of corresponding curves. Let us demonstrate it on the

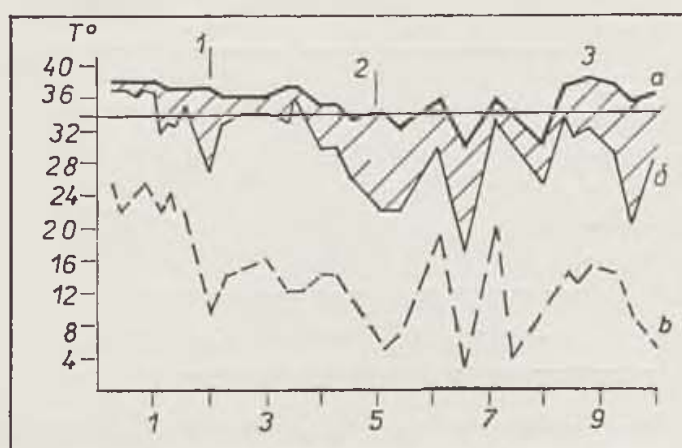


Fig. 2. Influence of outer temperature on skin temperature after replantation of the extremity



experiment of replantation of extremity in dog Din (record n. 360). Comparing the temperature curve of air with that of the intact extremity reflects apparent synchronism of their changing (Fig. 2). It can be precisely observed in 14th day, 36th, 46th and 52nd after operation, when we measured temperature during the walk inside vivarium yard. Synchronism of the temperature changing of the replanted extremity and the air does not exist up to 5th week after operation, when the changing can be observed in dynamics of the temperature in the replanted extremity and is synchronous with the air temperature. Even more apparently different degree of dependence to skin temperature in both intact and replanted extremity upon the air temperature is unveiled by correlation analysis of corresponding curves. Reckoning of the correlation coefficient between temperature of the intact extremity and the air proved their high linkage ($r = +0,78$). Coefficient of correlation between temperature indicators of the transplanted extremity and the air is equal to $+0,59$, what indicates significantly weaker linkage. Dynamics of correlation coefficients in various terms of postoperational period is interesting. Correlation coefficient of temperature in the intact extremity and the air in all postoperational period remains stable at the level of high linkage, while correlation coefficient of temperature in the transplanted extremity and the air in all postoperational period varies from unreliable linkage in first weeks up to high degree of linkage after 5—7 weeks.

When the postoperational period is complicated and complications were linked with later blood circulation disturbances in the replanted extremity, relations of temperature curves are of a new character: in first postoperational days dynamics of the skin temperature fully corresponds to the situation mentioned above but usually after apparent increase of positive STA, temperature curves cross and positive STA takes over negative character. If the microcirculation is disturbed due to local causes, negative STA increases

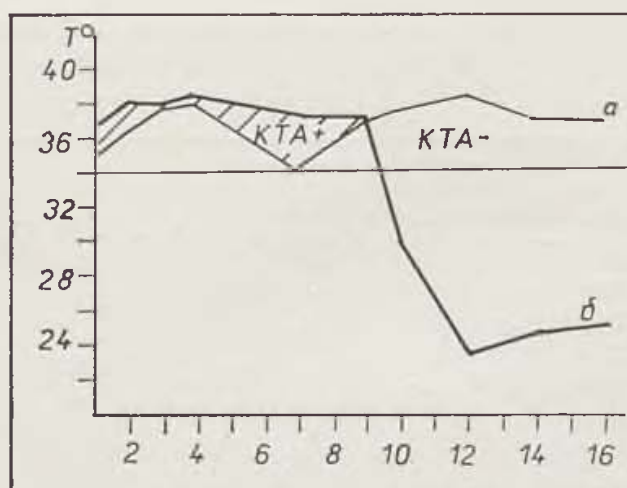


Fig. 3. Dynamics of skin temperature of dog's extremity, replantation of which was complicated by the thrombosis of fine arteries with following necrosis of replanted extremity. — a — temperature of intact extremity, b — temperature of replanted extremity, vertical axis — temperature, horizontal axis — days after operation

rapidly, while temperature of the intact extremity does not decrease but on the contrary, thus approaching the normothermic level. Experimental replantation of the extremity in dog Dax can be a concrete example (report n. 409). In 9 days after replantation of the amputated extremity, focal thrombosis of fine vessels in the transplant appeared with following development of



Fig. 4. Dog Biemka, who lived 12 years with good function of successfully replanted extremity preserved during 25 hours after amputation

focal necrosis of the transplanted extremity. This complication was reflected in dramatic drop of skin temperature in the transplanted extremity together with change of positive STA into negative (Fig. 3). If we start to take measures intensive enough at time (rheopolyglycin, heparin, fibrinolysin, etc.), temperature in the transplanted extremity will start to increase (Sedaya — n. 597; Gorbunok — n. 644 etc.). In some experiments the blood circulation disturbances in the extremity appeared many times and it was necessary to repeat already taken measures (Osen — n. 377; Bemka — n. 368 etc.), while in our latest case (n. 368) we succeeded in curing the animal that was in a very serious state, the blood circulation in the extremity was totally renewed and this dog happened to live more than 12 years up to the old age with replanted extremity perfectly functioning (Fig. 4). When diagnostics

Biometrical reasons of periodicity during normalization of skin temperature reaction of healing in replanted extremities

Period	Extremity	Average temp. °C	Coefficient of temp. variability % C- ± m	Indicator of differ. t	Coeff. of correlation r	STA °C
First	replanted intact	34,9 30,7	3,07 ± 0,58 5,30 ± 1,0	3,6	+ 0,25	+ 4,2
Second	replanted intact	33,2 30,1	5,12 ± 0,78 8,02 ± 1,24	2,15	+ 0,49	+ 3,1
Third	replanted intact	31,0 28,3	2,78 ± 0,3 2,40 ± 0,3	0,78	+ 0,74	+ 2,7

of the developed blood circulation disturbance is determined late, when STA is already negative, we sometimes succeeded in increasing the skin temperature by intensive medical measures. However, such a renewal of the microcirculation in tissues damaged by anoxia was not rarely followed by death as a result of transplantational toxicosis frequently linked with pulmonal shock. According to A. G. Einhorn [1974] autopsy revealed parietal thrombi inside magistral veins in the transplanted extremity, thrombosis and aggragation of blood elements in fine vessels, edema of the brain, toxic changes in kidneys and embolus in lung arteries [John — n. 407 etc.].

EVALUATION

Particular hyperthermic reaction of tissues in the replanted extremity, clinically determined by palpation was realized at the beginning of this century. But relatively recently its objective records by electrothermometers developed (G. S. Lipovetskyi, 1968; A. D. Christitch et al., 1970; A. G. Lapchinskyi and E. F. Uratkov, 1970, 1973; E. F. Uratkov et al., 1972, 1975 etc.). This kind of reaction can be observed during the replantation of the extremity, immediately after the blood circulation is renewed and remains in first days after operation. Individual scientists using thermometry paid their attention to the simultaneous more or less enduring drop of temperature in the intact extremity (G. S. Lipovetskyi, 1968; A. D. Christitch et al., 1970). But some authors did not realize postoperational hyperthermic reaction and even described the cases of temperature drop in replanted extremities that increased according to their data only later on.

Laboratory headed by A. G. Lapchinskyi deals with the experimental replantation of fully separated extremities since 1953. Determination of the skin temperature was always considered one of the most valuable indicators of the blood circulation state in the transplanted extremity (A. G. Lapchinskyi and E. F. Uratkov, 1970, 1973). Our analysis of the skin temperature dynamics in replanted extremities corresponds roughly to the results of majority of investigators. Using comparative method for STA investigation of

large material with elaboration of quantitative data by biometrical method on EVM "Nairi — 2" enabled us to make the already existing knowledge of this problem more precise from the theoretical and practical points of view.

Analysed material gives us possibility to determine 3 basic normalization periods of the skin temperature reaction in the healing process of replanted extremities. Due to the fact that local temperature represents basic demonstration of the transport function of the microcirculatory system it is possible to consider these periods reflections of the dynamics of normalization in the terminal blood circulation of replanted extremities. Periods are following: 1. period of hyperthermy (1st—2nd week of postoperational period); 2. period of synchronization of the skin temperature reactions in both transplanted and intact extremities (3rd—5th week); 3. period of normalization of the skin temperature reactions (after 6th week). This kind of division is well founded from the biometrical point of view when coefficients of variability and correlation of temperature curves in various postoperational periods are compared [See the Table].

First period. During 2 weeks since the blood circulation is renewed, the skin temperature in the replanted extremity is not only much higher than the temperature in the intact extremity but usually it is higher than the normothermic level. Temperature in the intact extremity is in majority of cases brought down to the normothermic level. Causes of the temperature drop in the intact extremity after the blood flow is renewed are not explained enough; following information are considered concrete:

1. A. D. Christitch et al. (1970) seeks the cause in the vasoconstriction of the intact extremity, what is reaction of adaptability reducing the volume of vascular bed due to the extension of vessels in the denervated extremity and enormous amount of blood aggregation.

2. Total denervation of the transplanted extremity is inevitable due to the amputation. In accordance to E. I. Kuznietsov's research (1961), it is always possible to trace the increase and stabilization of the skin temperature in the desympathized extremity during sympathetic denervation. In such cases the size of STA in extremities is determined by changes of the skin temperature in the intact extremity which preserves the capability to respond to outer influences, room temperature included.

3. Spastic reaction of microcirculatory network of the intact extremity can be explained by the inlet of acid metabolites from the transplanted extremity into blood as well as by the increase of carbon dioxide and vasopressin content. This mechanism is very apparent during the vascular thrombosis of the transplanted extremity. After humoral isolation of both transplanted and intact extremities, the cause of spasm of vessels in the intact extremity is removed, its temperature increases, approaching the normothermic level, while temperature in the transplanted extremity continues to drop down to the temperature of outer environment (Fig. 3). That means we can presume that humoral toxic factor plays the precise role in the STA mechanism and

depends on the state of tissues and on the character of metabolism in the transplanted extremity. This problem needs further investigation. Research of E. V. Gurova (1959) corresponds to the mentioned above particularities of microcirculation in the replanted extremity during first days after operation. Electrophysiologic materials gave her a basis to determine this period as a period of humoral linkage of the replanted extremity with organism when myoneural apparatuses of the extremity are in the state of deep denervating parabiosis and vessels are paralytically extended. Extension of vessels is linked with tremendous increase of venous pressure, development of edema connected with postoperational lesion of anatomic ways of both blood and lymph escape out of the extremity. Following thermometric particularities are characteristic for this period: 1. hyperthermy of the transplanted extremity with characteristic stability of the skin temperature; 2. hypothermy of the intact extremity with characteristic changeability of the skin temperature level; 3. positive STA in both transplanted and intact extremities.

Second period. First symptoms reflecting normalization of microcirculatory reactions are shown in 3rd—5th week after operation as a gradually increasing synchronism of temperature changing in both replanted and intact extremity and room air. This period seems that sympathetic innervation of vascular bed in the replanted extremity starts to renew. Characteristic for this period is: 1. gradual increase of synchronism of dynamic changing of temperature curves in both transplanted and intact extremities; 2. drop of positive STA in extremities on the account of synchronism increase of temperature changing.

Third period. Starting from the 6th week, the precise synchronism of changing of temperature curves developed in majority of successful experiments. After mathematical homogenizing they were in balance and apparent tendency to mutual approaching appeared. This dynamics of STA can reflect total sympathetic reinnervation of terminal vessels in the transplanted extremity. It corresponds to E. V. Gurova's work (1959) dealing with medium term normalization of venous pressure in the transplanted extremity within 30 and 60 days after the replantation when edema is gone and the extremity is able to start walking. Total temperature normalization in extremities, after reaching symmetrical normothermic level, appears approximately after 8—12 months of the postoperational period. According to electromyographic information, neuromuscular passage, (A. G. Lapchinskyi, 1960), lymph escape and supporting function of the replanted extremity are restored by that time. Our observation shows that not only terms after the replantation, but first and foremost capability of the transplanted extremity to be functionally active and intensity of training are reflected in the normalization of both, velocity of temperature and other physiologic factors. This period has got following thermometric particularities: 1. total synchronism of dynamic temperature changing in both transplanted and intact extremities; 2. continuous drop of STA in both transplanted and intact extremities down the norm after 8—12 months of postoperational period.

In our experimental material, STA kept positive character during the whole research and did not leave the norms of normal changing in later period after operation. We cannot agree with the view of A. D. Christitch et al. (1970) on the existence of inevitable change of STA into negative level and we could suppose, author's described observations show some late enduring microcirculation disturbances in transplanted extremities.

NOTE IN CONCLUSION

Ideas of S. P. Botkin and A. A. Ostroumov on serious clinical importance of local skin temperature, strengthened by classic research of Kuemmerle (1958) on physical and physiological basis of skin thermometry made this method one of the leading in the diagnostics of the terminal blood circulation disturbances. The methodologic analysis of study on temperature asymmetry (E. I. Kuznietsov, 1961, etc.) and appearance of reliable, simple to use and portable thermistor thermometers helped them to a certain degree.

Our research showed skin electrothermometry to be highly effective method able to unveil the microcirculation disturbances in replanted extremities. First symptoms of these disturbances are shown so early that their diagnostics can have significant prognostic meaning and can signalize the necessity of in-time correctives to be taken in treatment process. High sensitiveness and objectivity of this method enable us to use it as a scientific research method. Electrothermometry made it possible to realize that sympathetic reinnervation of the blood bed in the extremity appears much earlier than somatic reinnervation of its other tissues.

CONCLUSIONS

1. Postoperational *dynamics of the skin temperature* in both replanted and intact extremities during various postoperational periods *reflects that the microcirculatory system has the reactions to the inner and outer factors already renewed.*

2. Dynamics of synchronism renewal of temperature curves changing reflects that the neurovascular reactions of microcirculatory system are renewed, shows the *sympathetic reinnervation of vessels* which starts from 3rd—5th week after operation and *appears much earlier than the somatic reinnervation of the transplanted extremity.*

3. It is the *spastic reaction of terminal vessels in the intact extremity, responding to the activity of humoral toxic factors*, that are dependent on the metabolism character and state of tissues in the transplanted extremity, that plays significant role in the mechanism of skin thermoasymmetry (STA) in extremities together with the outer temperature influence. This reaction is the *first functional diagnostic indicator of microcirculation disturbances in the transplanted extremity.*

4. *Crossing of temperature curves* at the time when positive STA turns into negative is *always preceded by the increase of positive STA* being the

reflection of spastic reactions of terminal vessels in the intact extremity and the *earliest symptom of microcirculation disturbance* in the transplanted extremity.

L. B.

S U M M A R Y

Dynamics of skin temperature in both replanted and intact extremities in dogs was studied by the method of electrothermometry during 9—10 weeks of postoperational period. This article represents continuation of the previous information on thermometry linked with first days after operation attained in 100 experiments of replantation on extremities. Results from the biometrical analysis of skin temperature changes in healing replanted extremities are explained. Utility of comparative method in study on skin thermoasymmetry (STA) on the material representative enough together with contemporary computers for study of coefficients of variability and correlation enabled to realize some regularities of theoretical and practical importance for the clinics.

Postoperational dynamics of the skin temperature in both replanted and intact extremities reflects marked periodicity in the renewal of neurovascular reactions. Dynamics of the renewal of synchronism in temperature curves changing reflects the renewal of neurovascular reactions in the microcirculatory system and shows that the sympathetic reinnervation of vessels starting from 3rd—5th week after operation appear much earlier than the somatic reinnervation of the transplanted extremity.

It is the spastic reaction of terminal vessels in the intact extremity, responding to the activity of humoral toxic factors that are dependent on the metabolism character and the state of tissues in the transplanted extremity, that plays significant role in the mechanism of skin thermoasymmetry (STA) in extremities together with the outer temperature influence. Crossing of temperature curves with the turn of positive STA into negative is always preceded by the increase of positive STA, thus being the first symptom of microcirculatory disturbances in the transplanted extremity.

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

Weitere Studien über die Dynamik der Hautthermoasymmetrie während der Wiederherstellungsphase nach der Replantation der Gliedmassen bei Hunden

Uratkow E. F., Laptschinskij A. G., Perestoronin S. A.,
Kaweschnikow A. I.

Die Methode der Elektrothermometrie benutzte man beim Studium der Dynamik der Hauttemperatur der replantierten und intakten Gliedmasse der Hunde während der 9—10 Wochen dauernden postoperativen Phase. Diese Arbeit steht in Verbindung mit der vorhergehenden Arbeit, die sich mit dem Studium von Materialien befasst hat, die in ein hundert Versuchen mit Gliedmassenreplantation gewonnen und zur Thermometrie während der ersten Tage nach der Operation benutzt wurden. Die Autoren beschreiben die Ergebnisse der biometrischen Analyse der Hauttemperatur in

replantierten Gliedmassen. Durch die Anwendung der Vergleichsmethode beim Studium der Hautthermoasymmetrie an ausreichend repräsentativem Material und durch die Anwendung der modernen Rechentechnik zur Bestimmung des Korrelations- und Variationskoeffizienten konnten wir gewisse Gesetzmäßigkeiten feststellen, die für die Klinik von theoretischer und praktischer Bedeutung sind.

Die postoperative Dynamik der Hauttemperatur der replantierten und intakten Gliedmasse widerspiegelt deutlich die Periodizität der Wiederherstellung der neurovaskulären Reaktionen. Die Dynamik der Wiederherstellung der synchronen Schwankungen in den Temperaturkurven, die über den Wiederherstellungsprozess der neurovaskulären Reaktionen des Mikrozirkulationssystems berichtet, zeigt, dass die symptomatische Reinnervation von Gefäßen, die in einer Zeitspanne von 3—5 Wochen nach der Operation zum Vorschein kommt, der somatischen Reinnervation der übertragenen Gliedmasse vorangeht.

Im Mechanismus der Bildung der Hauttemperaturasymmetrie der Gliedmassen spielt — neben dem Einfluss der Aussentemperatur — eine wichtige Rolle die spastische Reaktion der terminalen Gefäße der intakten Gliedmasse, die auf die Wirkung von humoral-toxischen Faktoren reagiert, die vom Charakter des Stoffwechsels und dem Zustand der Gewebe der transplantierten Gliedmasse abhängig sind. Dem Überlappen der Temperaturkurven mit dem Übergang der positiven Hautthermoasymmetrie zur negativen geht immer ein Anstieg in der positiven Hautthermoasymmetrie voran, die auch das erste Symptom der geschädigten Mikrozirkulation in der übertragenen Gliedmasse darstellt.

R É S U M É

Nouvelle étude sur la dynamique de la thermoasymétrie cutanée dans la période de restitution après la replantation des extrémités chez les chiens

Ouratkov E. F., Lapchinskij A. G., Perestoronin S. A.,
Kavechnikov A. I.

On a utilisé la méthode de l'électrothermométrie pendant les études de la dynamique de la température cutanée dans les extrémités replantée et intacte chez les chiens durant 9 à 10 semaines postopératoires. C'est l'article traitant les études des matériels sur la thermométrie pendant les premiers jours après l'opération, obtenus de 100 expériences avec les replantations des extrémités, qui est le point de départ de cette étude.

On a présenté les résultats d'une analyse biométrique des modifications de la température cutanée dans les extrémités replantées. En employant la méthode comparative pendant les études sur la thermoasymétrie cutanée dans le matériel suffisamment représentatif et la technique calculatrice moderne pour établir les coefficients de corrélation et de variation, nous avons été capables de vérifier certaines lois d'une grande importance théorique et pratique.

La dynamique postopératoire de la température cutanée des extrémités replantées et intacte reflète une périodicité évidente de la restitution des réactions neurovasculaires. La dynamique de la restitution des oscillations synchroniques des courbes thermiques, exprimant le processus de la restitution des réactions neurovasculaires du système microcirculaire, montre que la réinnervation sympathique des vaisseaux, qui apparaît dans la 3ème à 5ème semaine après l'opération, précède la réinnervation somatique de l'extrémité replantée.

C'est la réaction spastique des vaisseaux terminaux de l'extrémité intacte réagissant à l'action de facteurs humoraux et toxiques, qui dépendent du caractère du mé-

tabolisme et de l'état des tissus de l'extrémité transplantée, aussi que l'influence de la température externe, qui jouent un rôle important dans le mécanisme de la formation de la thermoasymétrie cutanée des extrémités. Le croisement des courbes de température accompagnant le passage de la thermoasymétrie cutanée positive à celle-ci négative est toujours précédé d'une élévation de la thermoasymétrie cutanée positive, qui représente le premier symptôme de la microcirculation lésée dans l'extrémité replantée.

RESUMEN

Nuevo estudio de la dinámica de la termoasimetria cutánea en el período de reconstrucción después de una replantación de las extremidades en los perros

Uratkov E. F., Lapchinskii A. G., Perestoroin S. A.,
Kaveshnikov A. I.

El método de electrotermometria fue usado en el estudio de la dinámica de la temperatura cutánea en una extremidad replantada y la intacta de los perros, es decir durante 9—10 semanas de la fase postoperatoria. Esta obra es una continuación de la previa que se refería al estudio de los materiales sobre la termometria durante los primeros días después de la operación que fueron obtenidos de un ciento de experimentos de replantaciones de las extremidades. Fueron presentados los resultados de un análisis biométrico de los cambios de la temperatura en las extremidades replantadas. El empleo de un método comparativo en el estudio de la termoasimetria cutánea (TAC) en material suficientemente representativo y el empleo de la técnica de contar moderna para determinar el coeficiente de correlación y de variedad nos facilitó comprobar ciertas leyes que tienen importancia teórica y práctica para la clínica.

La dinámica postoperatoria de la temperatura cutánea de una extremidad replantada y de la intacta refleja periodicidad evidente de la recuperación de las reacciones neurovasculares. La dinámica del restablecimiento de las diferencias sincrónicas de las curvas de temperatura que demuestra el proceso de la recuperación de las reacciones neurovasculares del sistema microcirculatorio prueba que la reinervación simpática de los vasos que aparece en 1 3^a—5^a semana después de la operación precede la reinervación somática de la extremidad trasladada.

En el mecanismo de la TAC de las extremidades junto con la influencia de la temperatura exterior un puesto importante está ocupado por la reacción espástica de los vasos terminales de la extremidad intacta que reacciona al efecto de los factores tóxicos del humor que dependen del carácter del metabolismo y de la condición de los tejidos de la extremidad trasladada. Un cruce de las curvas de temperatura con paso de la TAC positiva a la negativa siempre precede la elevación de la TAC positiva que asimismo es el primer síntoma de la microcirculación alterada en la extremidad trasladada.

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COEXISTENCE OF CONGENITAL AURICULAR DEFORMITIES WITH UROGENITAL ANOMALIES

J. KRUK, L. JEROMIN

Congenital auricular deformities and urogenital anomalies are part of various syndromes of congenital malformations described by many authors, such as the syndromes of Wolf, "Cri du chat", Smith-Lemli-Opitz, Patau, Edwards, Down, Turner, Ullrich-Feichtiger, Rubinstein-Taybie, and of the "Branchio-Skeleto-Genital Syndrome", and they also include non-classified cases of numerous autosomal disorders or occasionally occurring chromosomal aberrations [3, 5, 8, 9, 10, 20].

Etiopathogenesis of numerous developmental anomalies, particularly of those involving the remote systems and organs (e. g., external ear — genito-urinary tract), has not so far been explained. According to one of the hypotheses, miscellaneous anomalies are presumably being originated by the action of a noxious factor at the time when the simultaneous formation and intensive development of the nuclei of various less or more remote organs take place.

The auricle originates from the I and II branchial arches in the 4th week and over the entire period of embryonal life. At the same period there appear strings of nephrogenic cells from which — in complex processes of the migration of mesenchyma and of differentiation — the successive urinary organs develop. Histological differentiation of sex occurs in the 8th week of embryonal life. In the 12th week the auricle becomes similar in shape to that of a newborn. The helix "scrolls" at the foetal period (from the 4th to the 8th months). During extra-uterine life the auricle grows mainly up to 5—6 years of age, and at that time it also obtains a characteristic individual shape and position on the skull. After the age of 60 the auricle grows bigger and thicker.

In 1946 Potter observed 20 patients with complete renal agenesis. He noted that 2 of them had similar specific congenital facial deformities (of the eyes, nose, upper lip and ears). More attention has since been attached to patients in whom the main developmental disorders consist in the coexistence of auricular and urogenital anomalies. In 1957 Hilson investigated 23 patients with

urogenital anomalies associated with auricular deformities. 4 of these patients came from the families in which similar congenital malformations occurred also in other relatives. Similar observations were also made in 1960 by Haubrich and Newman who described 10 patients with auricular and urogenital anomalies.

Vincent, Ryan and Longenecker described 12 patients in whom the main congenital anomalies were urogenital malformations associated with auricular deformities. In some cases they also coexisted with anomalies of other organs and systems, such as heart and foot defects, cleft palate, and others.

Hooft et coll. performed intravenous pyelography in 71 children with auricular deformities. 39 of them revealed urinary tract malformations, although only 17 showed clinical signs on the part of this system. No constant relation was found by these authors between the type and intensity of the anomalies in both systems.

Ross et coll. observed 230 patients with hypospadiasis. In 5 cases the anomaly coexisted with auricular deformities.

The most frequent urogenital anomalies found by the above authors were the following: renal agenesis, tandem kidney, polycystic kidney, congenital uni- and bilateral hydronephrosis, displacement and asymmetry of the kidneys, double ureter, ureterocystic reflux, cystic malformations, hypospadiasis and phimosis.

Auricular deformities were as follows: large flaccid pinnae with flattened sculpture, protrusive auricles, the so-called convoluted auricles, square auricles, deformed shape of the upper pole or of the helix auriculæ, lower position of auricles. In some cases hypoplastic aural conchas or asymmetry of their size, shape or position were found.

The above clinical observations enabled interesting conclusions to be drawn and yielded some practical indications as well. Patients with auricular deformities and with urologic complaints, particularly if they are of familial occurrence, should be submitted to complex investigations of the urinary tract. Klosterhalfen [6] even elaborated a "map" of auricular deformities showing in what congenital syndromes and urinary tract anomalies what malformations of particular elements of the external ear should be looked for.

It seems, however, that the present state of knowledge of this subject does not permit to confirm the reliability of the above information.

THE AUTHORS' OWN INVESTIGATIONS

The aim of the present study was to verify the information about the coexistence of urogenital anomalies with disturbed structure and position on the skull of the auricles. Comparison was made between groups of patients aged from 5 to 60 years, treated in the years 1974—1975 in the Outpatient Urologic Department and in the Urologic Clinic of the Institute of Surgery of the Medical Academy in Łódź. 100 patients with urogenital anomalies detected by physical and pyelographic examinations and 100 controls with excluded developmental anomalies were submitted to investigations. 64 patients

of the investigated group revealed renal anomalies (renal agenesis, horse-shoe kidney, tandem kidney, crossed kidneys, incomplete torsion of the kidney, congenital hydronephrosis or polycystic kidney), 7 patients showed ureterocystic reflux, and 29 had malformations of the penis (hypospadiasis or phimosis).

The data referring to this subject are presented in Table I. In all the patients with urogenital anomalies and in the controls the size, symmetry, position and shape of the auricles were investigated. These elements were then assessed in comparison with anthropometric norms of the external ear [1, 2, 4], bearing in mind the simple statement that a "normal auricle" is the one that matches the face and the head. The observed abnormalities of the aural conchas may be considered as the so-called "minor" congenital anomalies. They were protrusive auricles (the auriculo-cranial angle greater than 40°), auricles asymmetric in shape, size or design, disturbed design of the helix or of the anthelix — mainly on the upper pole, abnormal shape of the antitragus or of the lobe (numerical data — see Table 1). No deformities of the tragus

Table 1.
Coexistence of urogenital anomalies with congenital auricular deformities — analysis of the investigated patients

Urogenital anomalies	Auricles		Deformity of				Auricles		Total
	protrusive	asymmetric	helix	anthelix	antitragus	lobe	abnormal total	normal	
Renal agenesis	1	1				1	3	3	6
Horseshoe kidney	2	2			1		5	4	9
Tandem kidney	5	7		1	3	1	17	15	32
Crossed kidneys								1	1
Incomplete torsion of kidney		1			1	1	3		3
Congenital hydronephrosis	1	1		1		2	5		5
Congenital polycystic kidney		2	1	1		1	5	3	8
Uretero-cystic reflux	2	1			1		4	3	7
Phimosis	10	2	1		3		16	3	19
Hypospadiasis	5	2					7	3	10
Total	26	19	2	3	9	6	65	35	100

were observed. Disturbances of the size of the auricles occurring only in the group of patients with urogenital anomalies consisted in 4 cases of protrusive ears in increased dimensions of the length and breadth of the concha, while in 2 cases of asymmetric auricles the dimensions of one ear were distinctly smaller than the average ones for a given sex. A low position of the auricles was not observed in any cases. Thus the main disturbances referred to the

shape of particular elements of one or both ears. In general, in the group of patients with urogenital anomalies 65 revealed disturbances of the shape of the auricles and 35 had normal conchas, whereas in the group of controls 28 had abnormal auricles and 72 did not show any auricular deformities (Table 2).

Table 2.
Congenital auricular deformities in the controls

Auricles		Deformity of				Auricles		Total
protru- sive	asym- metric	helix	anthelix	anti- tragus	lobe	abnormal total	normal	
10	2	5	2	3	6	28	72	100

The obtained differences show that the incidence of auricular deformities in patients with urogenital anomalies is over twice as high as in controls. The results of investigations were submitted to statistical analysis using the test of χ^2 essentiality for the four-area table. The analysis showed that the hypothesis about the coexistence of congenital auricular deformities with urogenital anomalies must be considered as proven [$\chi^2 = 27,514 > \chi^2_{0.001}$; Yule's coefficient $Q = 0,653$].

DISCUSSION

According to the observations of embryologists, epidemiologists and clinicians, detection of only one, even "minor" developmental anomaly should be an indication for looking for other even minimal congenital malformations. They usually do not constitute a therapeutical problem but may suggest the coexistence of occult congenital anomalies (7). Patients with urologic complaints who have abnormalities of the shape, size or position of the auricles should be suspected of urinary tract anomalies and determined to perform intravenous pyelography. This may be of major importance in children whose hospitalization for preforming intravenous pyelography is often objected to by their parents. Cases of familial occurrence of anomalies should arouse particular suspicion.

CONCLUSIONS

1. The incidence of congenital "minor" abnormalities of the shape, size, symmetry and position of the auricles was over twice as high in patients with urogenital anomalies as in persons without malformations of the genitourinary tract. No significant correlations were found between the type, intensity and side in both organs.

2. Detection of any auricular deformities in adults should be an indication for the examination of the genitourinary tract, especially in cases of urologic

complaints or of their familial occurrence. In small children (under 5 years of age) only marked deformities or significant neoplasia of the external ear are reliable owing to unfinished growth of the auricles.

SUMMARY

The size, shape and position of auricles in 100 patients with congenital urogenital anomalies and in 100 controls were studied. It was found that the incidence of congenital minor anomalies in the shape, size, symmetry and position of the auricles was twice as high in cases of urogenital anomalies as in controls. No significant correlations were revealed between the type, intensity and side of congenital anomalies in both organs.

ZUSAMMENFASSUNG

Koexistenz angeborener Ohrenmuscheldeformitäten und urogenitaler Anomalien

Kruk J., Jeremin L.

Die Autoren untersuchten die Dimensionen, die Form und Position der Ohrenmuschel bei 100 Patienten mit angeborenen Urogenitalanomalien und bei 100 Kontrollpersonen. Es wurde festgestellt, dass die Inzidenz von kleineren angeborenen Defekten in der Form, den Dimensionen, der Symmetrie und Lage der Ohrenmuschel bei Patienten mit Urogenitalanomalien zweimal so hoch ist, als bei den Kontrollen. Es wurden keine signifikanten Korrelationen hinsichtlich des Typs, der Intensität und Seite der angeborenen Anomalie dieser Organe beobachtet.

RÉSUMÉ

Coexistence des déformations congénitales du pavillon de l'oreille et des anomalies urogénitales

Kruk J., Jeremin L.

On a examiné les dimensions, la forme et la position du pavillon de l'oreille chez 100 malades, atteints des anomalies urogénitales congénitales, et chez 100 personnes d'un groupe de contrôle. On a constaté que l'incidence des défauts congénitaux moins graves quant à la forme, les dimensions, la symétrie et la position de l'oreille était deux fois plus fréquente chez les sujets, affectés des anomalies urogénitales, que chez ceux du groupe de contrôle.

On n'a pas remarqué de correlations significantes concernant le type des anomalies congénitales des organes mentionnés, leur intensité et la moitié du corps à laquelle elles étaient situées.

RESUMEN

Coexistencia de deformidades congénitas del pabellón y de anomalias urogenitales

Kruk J., Jeremin L.

Fueron estudiadas las dimensiones, la forma y posición del pabellón de la oreja en 100 pacientes afectados con anomalias urogenitales congénitas y en 100 personas

de un grupo de control. Fue constatado que incidencia de defectos congénitos menores en cuanto a la forma, las dimensiones, la simetría y posición de la oreja era dos veces más grande en los pacientes afectados con anomalías urogenitales que en los del control. No fueron observadas correlaciones significantes en cuanto al tipo, intensidad y lado de la anomalía congénita de los órganos mencionados.

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AVULSION INJURY IN PATIENTS RECEIVING CONTINUOUS CORTICOSTEROID THERAPY

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Minor trauma often produces an avulsion injury to the skin and subcutaneous tissue of patients who are on continuing corticosteroid therapy. Early grafting and sufficient immobilization of the grafts by the dressing in the first few days and gradually mobilization after the fourth or fifth day decrease the morbidity of these patients.

Steroids are used for the chronic treatment of patients with numerous disorders such as rheumatic diseases, severe asthma, autoimmune disorders, leukemias, malignant disorders and skin disorders. The large group of people who are on continuing steroid therapy are susceptible to an avulsion skin injury by relatively minor trauma. The following report will discuss a typical avulsion injury in a patient receiving corticosteroids.

DISCUSSION AND TREATMENT

The complications of a long term therapy with systemic or local corticosteroids include: cutaneous atrophy through the loss of fat and dermal tissue [1], reduced resistance to the infection [2], impaired wound healing by inhibition of the early inflammatory response [3, 4], decrease fibroblastic proliferation and growth, decrease in the total production of collagen, and inhibition of the activity of the mast cells [5, 6, 7].

Patients who are receiving chronic treatment with corticosteroids should be advised to report to their doctors if they experience an avulsion injury. Proper early treatment will decrease the morbidity for these patients. The treatment of an avulsion injury to a patient who is on continuing corticosteroids therapy is as follows: The wound should be cleaned with normal saline solution and if the skin flap is small and viable, adhesive tape (Steri-strips) may be used to hold the flap. For larger wounds the area is locally anesthetized with 1% Lidocaine (xylocaine). The flap is excised and defatted if necessary (usually in patients who are on continuing corticosteroid therapy the flap is paper thin). The flap and wound then are washed

with normal saline solution and are debrided. If the exised flap is viable it will be reappplied to the denuded area as postage stamp size pieces of skin grafts. If the injured flap is partially destroyed during the accident the viable tissue will be used by the expander mesh skin grafts with a ratio of g:3 (8, 9). If the flap is badly contused a split thickness skin graft will be taken from another area in order to cover the wound. The wound will be covered with Xeroform gauze dressing, a plain gauze pad, and an elastic bandage for immobilization of the skin grafts. The extremity should be kept elevated to promote adequate venous and lymphatic drainage and to avoid any effusion under the grafts. Tetanus toxoid is given if indicated. Steroid therapy is maintained at the same level or is tapered off if possible. The dressing is usually changed on the third or fourth day after surgery and redressed after evaluation of the viability of the skin grafts. On the fourth or fifth day gradual ambulation may be started (10). A rapid return to normal function is especially critical for rheumatoid patients because a prolonged period of inactivity can have an aggravating effect on their joint stiffness. The patient may be discharged to his home when he is sufficiently ambulatory for self care. If at three to four weeks healing is progressing well, patient may return to work. Occasionally infection may occur in the wound. Low grade fever, odor or redness around the margins of the graft between the second and fourth postoperative day support the diagnosis of infection, a culture will aid in identifying the organism and appropriate sensitivity studies will help in selecting the proper antibiotic. Local wound care should include debridement of any necrotic tissue in the wound and frequent moist, normal saline soaks. Mechanical cleanliness is essential to good wound care. When the wound is clean a split thickness skin graft is applied with the same dressing and care previously described.

SUMMARY

In patients receiving long-term corticosteroid treatment even a small trauma may result in various degrees of skin and subcutis avulsion. Great attention is to be devoted to timely primary treatment as general corticosteroid therapy is conductive to changes in the skin and subcutis, to reduced healing capacity, and to increased risk of infection. The author has had good results using the above method involving the use of skin grafts either from the avulsed skin or from other parts of the body.

ZUSAMMENFASSUNG

Mit Avulsion verbundener Unfall bei Patienten, die mit den Kortikosteroiden behandelt werden

Kalisman M.

Bei Patienten, die einer langzeitigen Kortikosteroidtherapie unterzogen werden, kann auch ein kleines Trauma zur Avulsion von Haut und Unterhaut verschiedenen Umfanges führen. Der frühzeitigen Erstbehandlung muss grosse Aufmerksamkeit geschenkt wer-

den, da die allgemeine Kortikosteroidtherapie zu Veränderungen in der Haut und Unterhaut führt, die Heilfähigkeit herabsetzt und das Risiko der Entfaltung einer Infektion steigert. Mit dem beschriebenen Verfahren, bei dem wir ein aus der abgerissenen Haut oder an einer anderen Körperstelle gewonnenes Transplantat benutzen, haben wir gute Ergebnisse.

R É S U M É

Traumatisme d'avulsion chez les malades traités par les corticostéroïdes

Kalisman M.

Chez les malades, traités longtemps par les corticostéroïdes, il est possible que même un petit traumatisme entraîne une avulsion de peau et de couches sous-cutanées dont l'étendue peut être différente. Dès les premiers soins, il faut veiller au traitement avec une grande attention, parce que le traitement général par les corticostéroïdes provoque des modifications de la peau et des couches sous-cutanées, la faculté diminue de guérir et le danger augmenté de propager l'infection.

C'est en utilisant la greffe cutanée, prise soit de la peau arrachée, soit d'une autre partie du corps, que nous avons obtenu de bons résultats.

R E S U M E N

Traumatismo avulsivo en los pacientes tratados con corticoesteroides

Kalisman M.

En los pacientes tratados largo tiempo por corticoesteroides es posible que hasta un trauma pequeño conduzca a una avulsión de la piel y de la capa subcutánea en varia extensión. Hay que prestar gran atención al tratamiento primario temprano, porque terapia total por corticoesteroides conduce a cambios de la piel y de la capa subcutánea, a disminución de la curativa y eleva el peligro de que se desenvuelva la infección.

Tenemos buenos resultados con el procedimiento descrito en que empleamos un trasplante cutáneo sea de la piel arrancada o tomado de otra parte del cuerpo.

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RECONSTRUCTION OF BILATERAL HOLD OF HAND ON THE ACCOUNT OF DIGITS ON THE SAME HAND

V. V. AZOLOV

Surgical manuals, dealing with the formation of one digit on the account of digits on a damaged hand, play a special role among variability of reconstructive operations that tend to renew the lost function of the hand. That includes: pollicization, displacement and transplantation of digits on the same hand.

Genuine pollicization was proposed by French surgeon Guermonprez (1886).

Further development of methods dealing with functional renewal of bilateral hold of the hand on the account of digits on the same hand is closely linked with B. V. Parin (1944), V. N. Blokhin (1950), N. N. Blokhin (1950), G. D. Shushkov (1956), Bunnell (1944), Hilgenfeldt (1950), Littler (1952) etc.

Both, loss of the thumb which plays the main role in bilateral hold of the hand and existence of defective digit on the same hand become indicators requiring pollicization and transplantation of digits. Transformation of a healthy digit can be carried out when the patient demands it very urgently, taking into account his profession.

Torsive osteotomy is recommended when radial edge of the hand is heavily damaged and in case of inborn loss of thumb with metacarpus.

We happened to renew the function of bilateral hold of the hand on the account of digits on the same hand in 43 hands of 42 patients from 6 to 63 years old, both sexes.

Overwhelming number of patients (35 out of 42) were in the most productive age — from 15 to 45. 6 children under operative treatment suffered from inborn defects or underdevelopment of the thumb.

Only one patient was more than 60 years old. We transplanted defective digit III on the stump of digit I, since this patient lost his profession of cabinet maker, due to the functional loss of bilateral hold of the hand. This example means the patient's age is not so important in the decision whether to carry out this kind of operation or not.

32 patients were operated on due to posttraumatic and recent defects in digit I. 10 patients suffered from the loss of digit I on one hand and severe anatomical defects and deformations on the opposite extremity. That is, 2 patients had a stump of hand in the opposite hand, 1 patient — stump of forearm, 2 patients — stump of arm, 5 patients — severe contractures of hand and digits.

We used following 43 operative actions with the aim of functional renewal of bilateral hold of the hand: pollicization — 17, transplantation of digits II — 15, of digit III — 1, of digit IV — 2, of digit V — 1, torsive osteotomy (transposition) — 7.

Torsive osteotomy of metacarpus of radial edge of digit near to the defect renews the function of bilateral hold of the hand to a high degree but the cosmetic results remain doubtful. In case of inborn loss of the thumb with

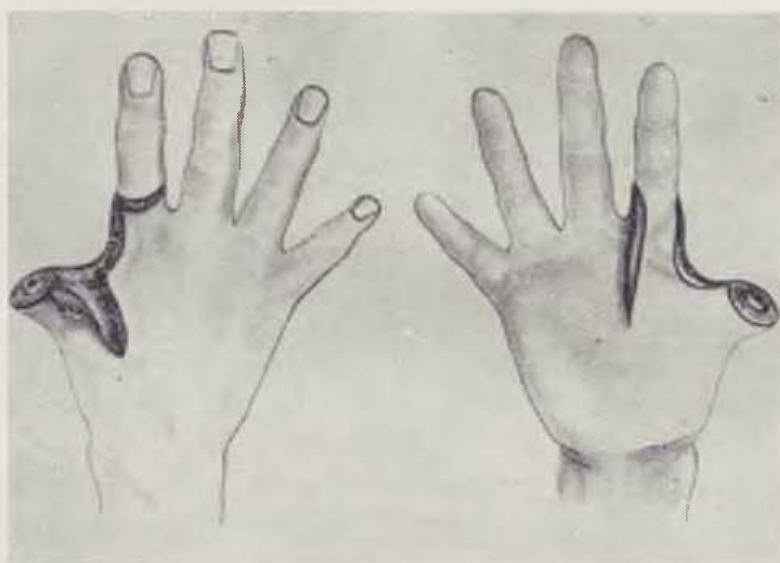


Fig. 1. Scheme of transplantation of index according to the Author's method.

a) line of skin cuts

metacarpus, this operation will provide successful functional and cosmetic results.

In case of total loss of digit I and marked defect of its radius, the operation to be recommended is pollicization of index which provides relatively good functional results, though results from the cosmetic point of view cannot satisfy either surgeon or the patient.

Transplantation of index provides the best functional and cosmetic results.

Hilgenfeld [1950] and Pitzler [1972] do not consider venous drainage important enough during the transplantation of digits on the hand. However, when we transform digits II-V with the aim to renew the bilateral hold of the hand, we pursued to a certain degree marked circulatory disturbances in transplanted organ which were fundamentally linked with disturbance of venous escape.

We are of the opinion that normalization of venous blood flow inside the digit transplanted to another place, especially in first days after operation, is the prerequisite for the surgical action to be successful.

On the basis of the stated, we worked out the way of index transplantation which can preserve not only palmar but also dorsally radial neurovascular bundle of the transplanted organ (Fig. 1).

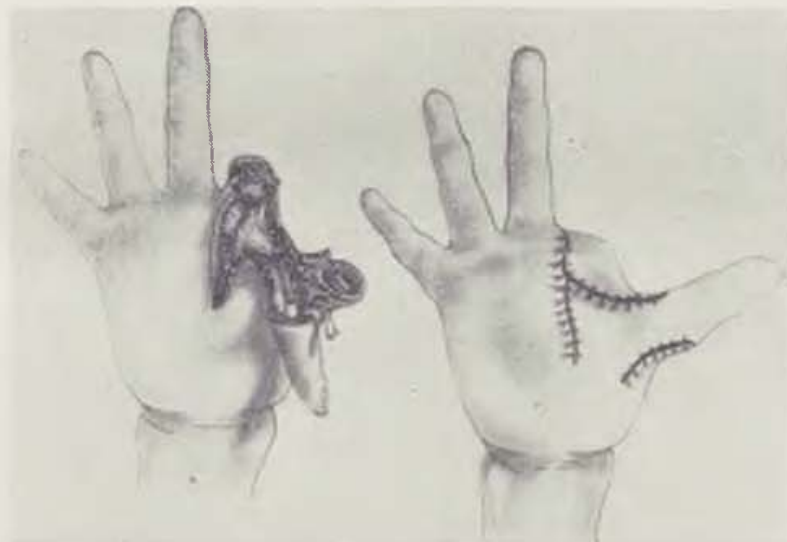


Fig. 1b) period of mobilization of anatomical formations and line of sutures

Scars are removed from the top of the stump I of metacarpus by cutting. We cut the skin on the ridge of index from 2/3 of its perimeter. Cut continues on the top of first gap between digits, up to the wound in the front part of the stump of first digit. In the project of the inner part of the first radius we could see the cut continues to its foundations on the dorsal surface of the hand.

The cut of the index is connected on the palmar surface with the linear cut comming in the direction of the foundations of radius I.

These cuts can help us not only to preserve palmar anatomical formations of the transplanted digit but also to put into practise the mobilization and transposition of radial portion of dorsal neurovascular bundle which includes venous vessels and also to determine extensors of digits I and II.

Serious difficulties in transplantation of digits usually appear when it is necessary for bony fragments to be connected under the angle of rotation of $125-130^{\circ}$ which enables to secure the jerking hold by the tops of digits.

Existing surgical proceedings (Hilgenfeldt, 1950; Littler, 1952; G. D. Shushkov, 1956, etc.) take into account formation of complicated saws under corresponding angle and suppose inner and outer fixation. If the angle of rotation is not estimated well, it is necessary to make another saw on the account of shortening the segment of digit or metacarpus, that leads to worse functional and cosmetic results.

To remove these complications we connect bony fragments by introduction the proximal end of phalanx of transplanted digit into the remote part

of accepting metacarpus, after they were previously elaborated by cylindrical milling and turning instruments.

This method to connect the ends of bones does not necessitate the angle of rotation to be estimated and fixation of bones appeared to be solid enough, so that supplementary immobilization was not required. This enabled to start analysing the moveability of the joints in the transplanted digit in the soonest possible postoperational period, thus to secure optimal functional results. (Fig. 2).

Transplantation of digit IV in the damaged bone secures good functional and cosmetic results. (Fig. 3).

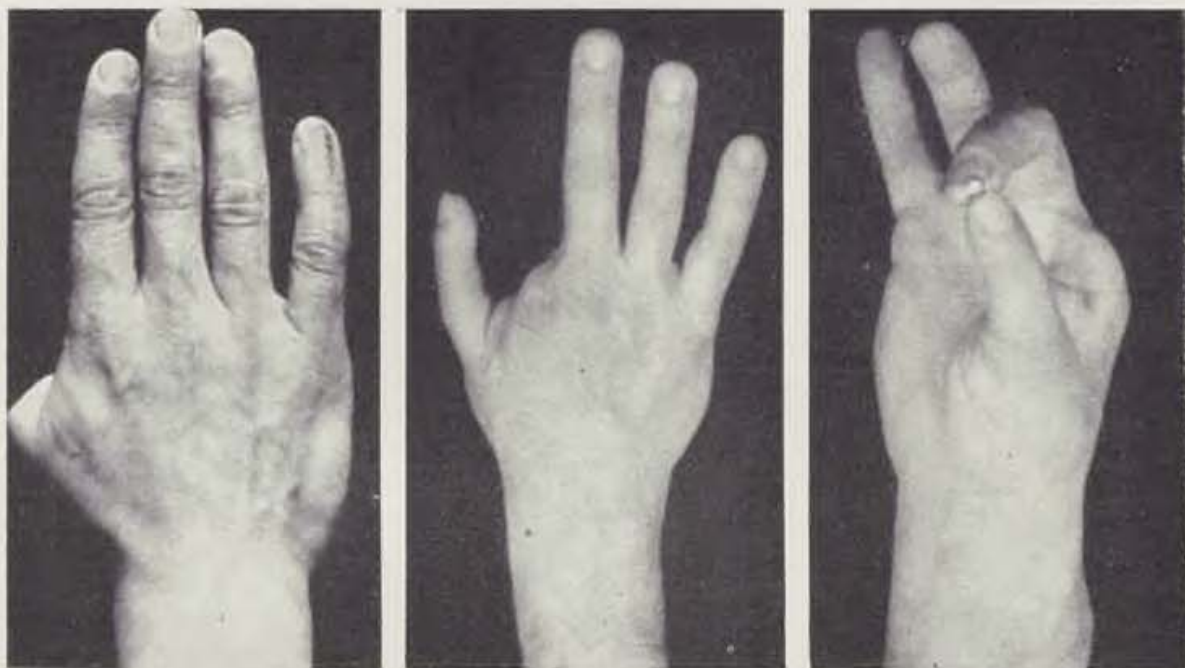


Fig. 2. Photography of the right hand of patient L. a) before operation, b) after transplantation of digit II on the stump of I according to the author's method, c) functional result

In many cases it is possible to use the smallest, functionally "valueless" digit V to renew the lost digit I. This proposal was not widely spread among specialists for capacity of this digit V is too low for the complete compensation of the lost digit I, and furthermore there is a high risk that heavy circulatory disturbances in transplanted organ will appear because it is necessary to mobilize the nutrient pedicle in a remote distance and to expose it to a considerable flexion.

However, this kind of operation, in extraordinary cases, can be performed on the background of prophylaxis and therapy of circulatory disturbances (Fig. 4, a, b, c). In our research practice we did not meet any serious complications that would lead to death of transplanted digits.

Given references (E. P. Roslova, 1973; Ionescu et al., 1975) together with our observations give us the reason to think that similar operations can be

performed, aiming at good and both immediate and later results when urgent help is provided.

These circumstances prove that exaggerated death risk of transplanted digits is not well-founded.

39 patients were observed in long-term period from 5 months to 28 years. When evaluating the final state of operated hand by given method, we took into account the anatomical, functional and cosmetic results that were divided into good, satisfactory and bad.



Fig. 3. Photography of the right hand of patient I. a) before operation

Anatomically physiologic and functionally cosmetic state of the extremity before operation is determining during the evaluation of treatment results in long-term periods.

Anatomical results : 1) good — no scars limiting the function are on the operated hand, marked consolidation of bony fragments which are in the right position, digit is under the angle of $125-130^{\circ}$;
2) satisfactory — existence of scars limiting the function were caused by operation, bony fragments and segments of the digit are not in the right position;
3) bad — no adhesion of bony fragments, existence of rough scars caused by operation, digit is situated on the same level with other digits, necrosis of remote part or of the whole digit.

Functional results: 1) good — satisfactory volume of joint moving in the transplanted digit (not less than half of the volume of initial state), the right hold of subjects by the tops of digits, total preservation of initial sensitiveness

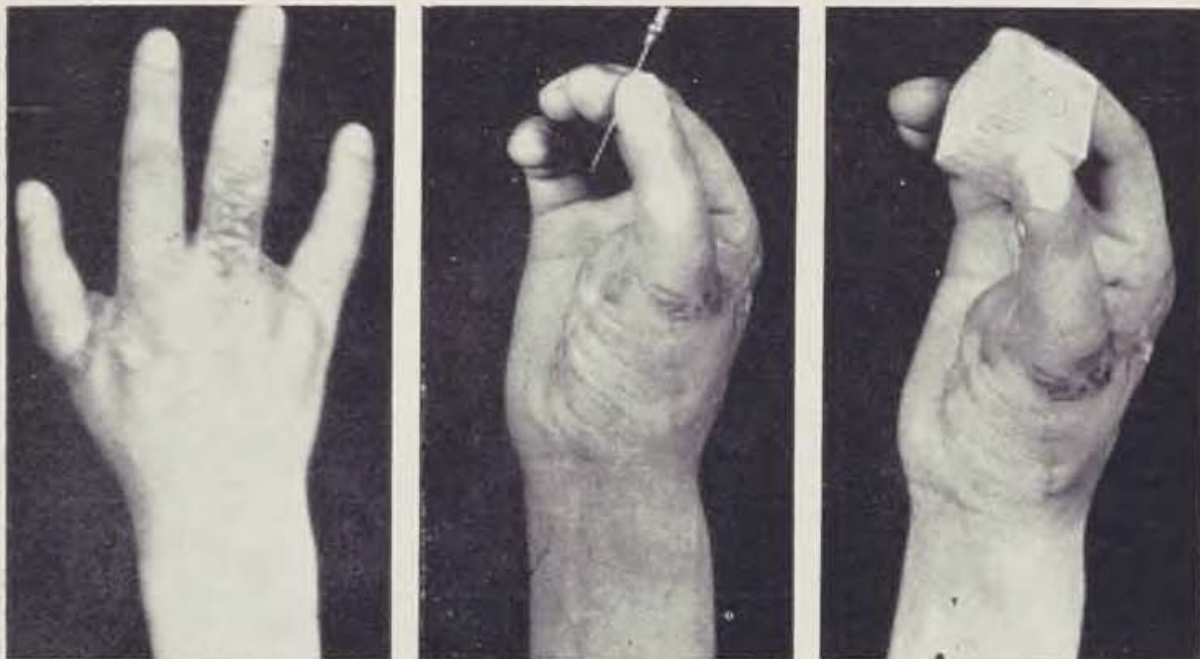


Fig. 3b) result of transplantation of digit IV on the stump of I, c)+d) functional result

on the palmar surface of the digit; 2) satisfactory — volume of joint moving in the transplanted digit is reduced more than half in comparison with the initial state, worse sensitiveness after the operation; 3) bad — loss of the function of bilateral hold, serious disturbance of sensitiveness caused by the operation.

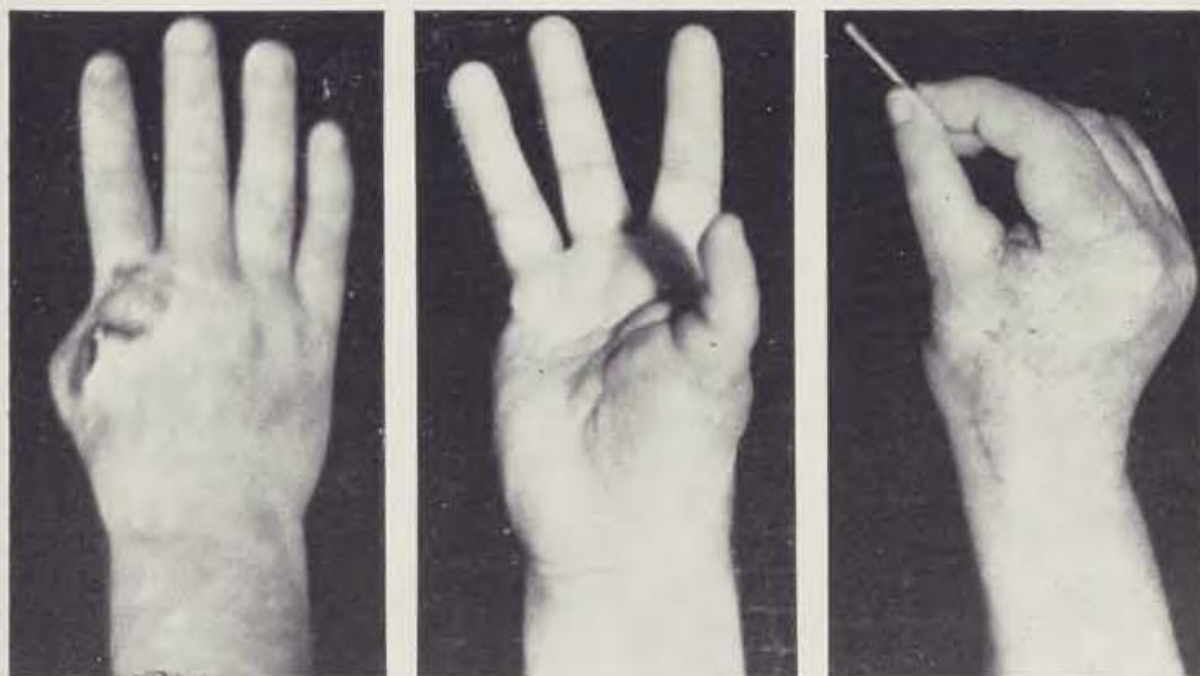


Fig. 4. Photography of the right hand of patient S. a) before operation, b) after transplantation of digit V on the stump I. c) function of the operated hand

Cosmetic results: 1) good — hand gets normal appearance or it is much better when compared with the initial state; 2) satisfactory — hand looks much more aesthetically after the treatment by correction is possible to improve the appearance; 3) bad — operative treatment will even more damage already damaged hand.

Late results which depend on the operative method are presented in the Table.

Table
Results of the renewed function of the hand due to transplantation of digits on the same hand

Character of operation	Result								
	anatomical			functional			cosmetic		
	good	satisf.	bad	good	satisf.	bad	good	satisf.	bad
Pollicization	11	5	—	13	3	—	9	7	—
Transplantation of digit II	13	1	—	13	1	—	11	3	—
III	—	1	—	1	—	—	—	1	—
IV	2	—	—	2	—	—	2	—	—
V	1	—	—	1	—	—	1	—	—
Torsive osteotomy	—	5	—	1	4	—	—	5	—
Total	27	12	—	31	8	—	23	16	—

On the basis of data shown in the Table, it is obvious that the amount of good functional results is higher a little bit than that of anatomical results. Though perfectly renewed anatomy of the damaged organ securing to a high degree the good functional results, compensational possibility of a human hand is so high, that in many cases its function appears to be much richer and more heterogenous than one would expect due to anatomical defect.

It means we can use any digit on the damaged hand to renew the lost digit I. Under the same conditions, given surgical operations enable in short-term period to receive reliable, functional and cosmetic results.

Death risk of transplanted digits is exaggerated, elaborated method of transplantation of index creates optimal conditions to secure viability of the transformed organ.

L. B.

SUMMARY

The author has got experience of renewing the function of the bilateral hold of the hand on the account of digits on the same hand in traumatic (33 cases) and inborn (10) defects of digit I in 42 patients. Various operational

methods were used in order to renew the function of the bilateral hold of the hand: pollicization (17), transplantation of digits II-V (19) and torsive osteotomy of metacarpus of digit near to the defect (7).

The method of transplantation of index on the stump of first digit is elaborated, which improved the conditions of healing the transformed organ. Author shows that death risk of transplanted digits is exaggerated and it is possible to use any digit of the damaged hand for the reconstruction.

Renewing of digit I on hand on the account of transplantation of digits on the same hand is most effective of any other existing methods of surgical actions.

ZUSAMMENFASSUNG

Wiederherstellung des beiderseitigen Griiffs der Hand zuungunsten der Finger derselben Hand

Azolo V. V.

Der Autor der Arbeit hat Erfahrungen mit der operativen Wiederherstellung der Funktion des beiderseitigen Griiffs des Handtellers zuungunsten der Finger derselben Hand bei traumatischen (33) und angeborenen (10) Defekten des ersten Fingers bei 42 Patienten. Es wurden verschiedene Operationsverfahren zur Wiederherstellung der Funktion des beiderseitigen Griiffs des Handtellers benutzt: Pollizisierung (17), Übertragung der Finger II-V (19) und torsive Osteotomie des Metakarpalknochens des mit dem Defekt angrenzenden Fingers (7).

Es wurde ein Verfahren zur Übertragung des Zeigefingers auf den Stumpf des ersten Fingers durchgearbeitet, das die Bedingungen für das Anwachsen des transformierten Organs verbessert hat. Der Autor weist darauf hin, dass das Risiko des Absterbens der übertragenen Finger überschätzt wird und dass man jeden beliebigen Finger der geschädigten Hand zwecks ihrer Wiederherstellung verwenden kann.

Die auf der Grundlage der Übertragung des Fingers derselben Hand durchgeführte Wiederherstellung des Fingers I wird als die wirksamste unter den gesamten existierenden chirurgischen Operationsverfahren betrachtet.

RÉSUMÉ

Reconstruction de la fonction préhensile de la paume, réalisée de deux côtés, aux dépens des doigts de la même main

Azolo V. V.

L'auteur de l'article possède des expériences avec la restitution opératoire de la fonction préhensile de la paume, exercée de deux côtés, aux dépens des doigts de la même main dans les défauts traumatiques (33) et congénitaux (10) de 1er doigt chez 42 sujets.

On a réalisé de différents procédés d'opération pour renouveler la fonction préhensile de la paume: l'adaptation à la fonction du pouce (17), la transplantation du 2ème au 5ème doigt (19) et l'ostéotomie à torsion de l'os du carpe du doigt voisin du défaut (7).

On a élaboré une méthode de la transplantation de l'index au moignon du 1er doigt, qui a amélioré les conditions favorables à la prise de l'organe transformé. L'auteur montre que le risque de la nécrose des doigts transplantés est surestimé et

qu'il est possible d'utiliser n'importe quel doigt de la main lésée dans le but de la reconstruction.

La reconstitution du 1er doigt par la transplantation d'un doigt de la même main est considérée comme le plus efficace de tous les modes d'opération connus.

RESUMEN

Reconstrucción de la función prensil de la palma en detrimento de los dedos de la misma mano

Azolov V. V.

El autor tiene experiencia con la reconstrucción operativa de la función prensil bilateral de la palma en detrimento de los dedos de la misma mano en defectos traumáticos [33] y congénitos [10] del dedo I en 42 pacientes. Fueron empleados varios procedimientos de operar con el fin de reconstruir la función prensil bilateral de la palma: policización [17], traslado de los dedos II-V [19] y osteotomía torsiva del hueso del metacarpo del dedo junto al con el defecte [7].

Fue establecido el método de trasladar el índice al muñón del primer dedo que mejoró las condiciones de adhesión del órgano transformado. El autor demuestra que al riesgo de necrosis de los dedos trasladados se le atribuye demasiada importancia y que se puede emplear cualquier dedo de la mano averiada con el fin de la reconstrucción de la misma.

La reconstrucción del dedo I a base de un traslado de un dedo de la misma mano se considera la más eficaz de todos los métodos quirúrgicos existentes de operar.

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SIMPLIFIED METHOD FOR ELABORATION OF TISSUES EXCISED FOR REPLANTATION DURING RADICAL OPERATIONS OF ELEPHANTIASIS

I. P. VEDIAYEV, I. I. ANTONOV, B. B. KHARITONOV

Surgical method for the treatment of advanced forms of elephantiasis is considered at present to be generally esteemed and the most effective, i. e. radial excision of pathologically changed tissues with further replantation of specially elaborated skin.

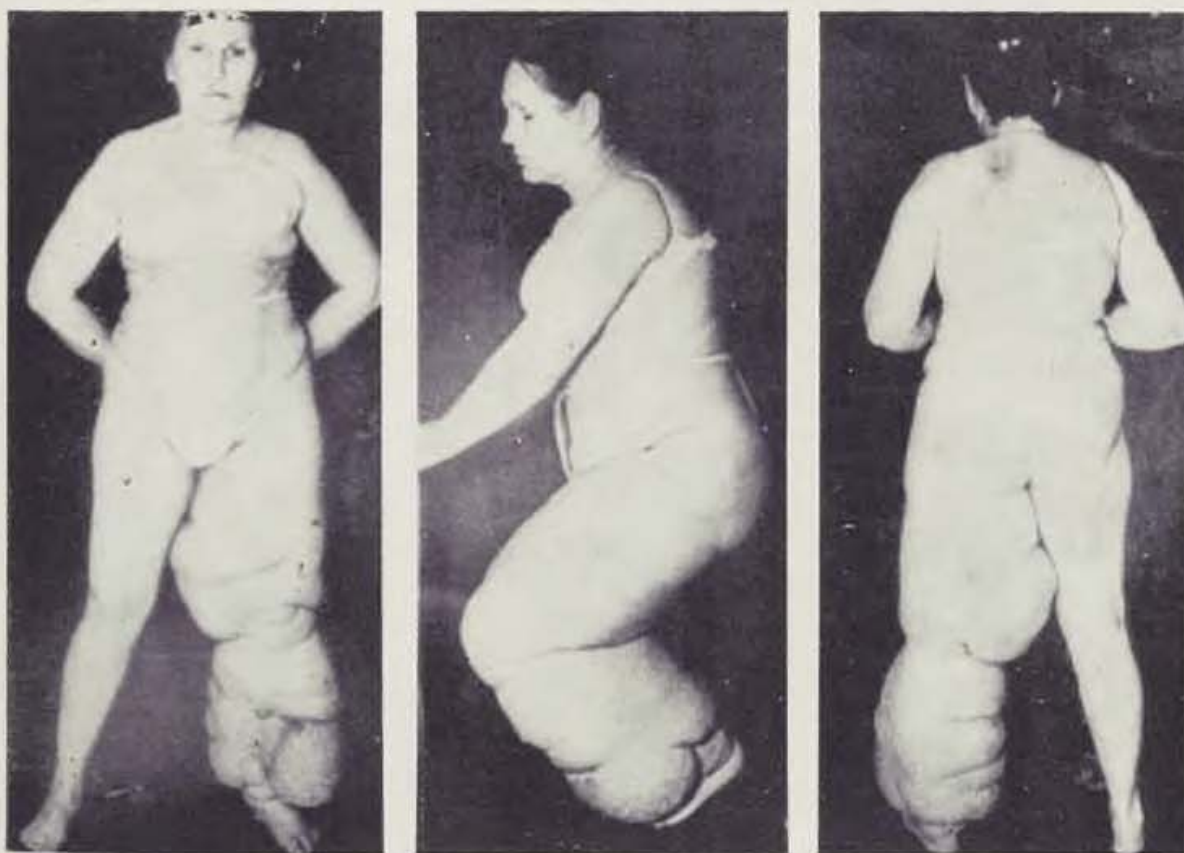


Fig. 1. Patient K., 54 years old, before operation

Due to many details of the technique of this complex operative action, there is no unity of opinions among surgeons. This concerns first of all the methods of elaboration of excised tissues. A lot of special dermatomes and their supplementary instruments were proposed for this purpose (P. M. Medvediev, 1964; A. A. Troshkov, 1963; Barinka, 1968, etc.), which are not always available to all clinical institutes.



Fig. 2. Lower extremity after excision of pathological tissues

That is why the skin replantation is carried out in the form of separate grafts or stripes. This imperfection increases to a high degree the traumatism and duration of the operative action and is inevitably reflected in the functional and cosmetic results of the treatment.

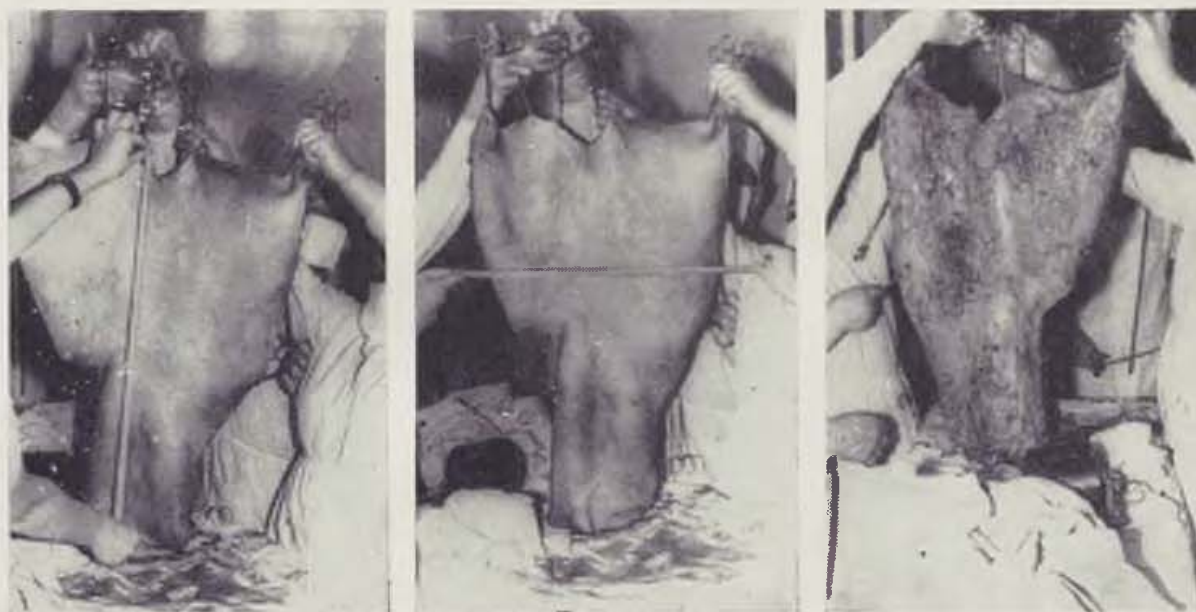


Fig. 3—5. Block of excised pathological tissues



Fig. 6. Final elaboration of skin graft

Authors introduced, during the operation of advanced forms of elephantiasis (Fig. 1), the simplified method for the elaboration of excised tissues using of which is available to all surgical institutes equipped with dermatome produced by "Krasnogvardeiets" factory. Its principle is following.

The fundamental operating group of surgeons (3 men), by means of one longitudinal and two transverse cuts, removes pathologically changed tissues from the whole extremity in the form of one graft together with the deep

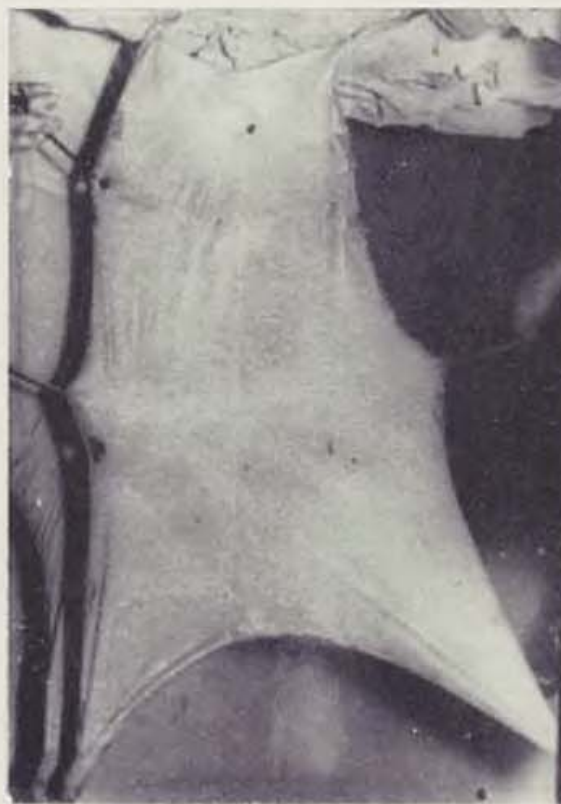


Fig. 7. Skin graft after elaboration

fascia and hands it over to the second operating group of surgeons (3 men) for further elaboration (Fig. 2—5).

Elaboration of excised tissues is carried out in two stages.

First stage is preparatory; the maximum of the changed fatty tissue is removed. This is done by dermatomic knives incorporated into the handle of any cylindrical or semicylindrical instrument on which the block of excised tissues is shifted. It is possible to use the drum of dermatome for this purpose. 10—12 kilograms of changed fatty tissue can be removed. After this elaboration the block of excised tissues has just 3 mm layer of fat.

Second stage represents the final elaboration of tissues, partially deprived of fat, by means of dermatome "Krasnogvardeiets". Skin graft is shifted on the drum, so that the fatty tissue is removed up to the reticular layer of the skin (Fig. 6).

General endurance of both stages, when excised tissues are elaborated, is not more than 30 minutes and it corresponds to the period when the fun-

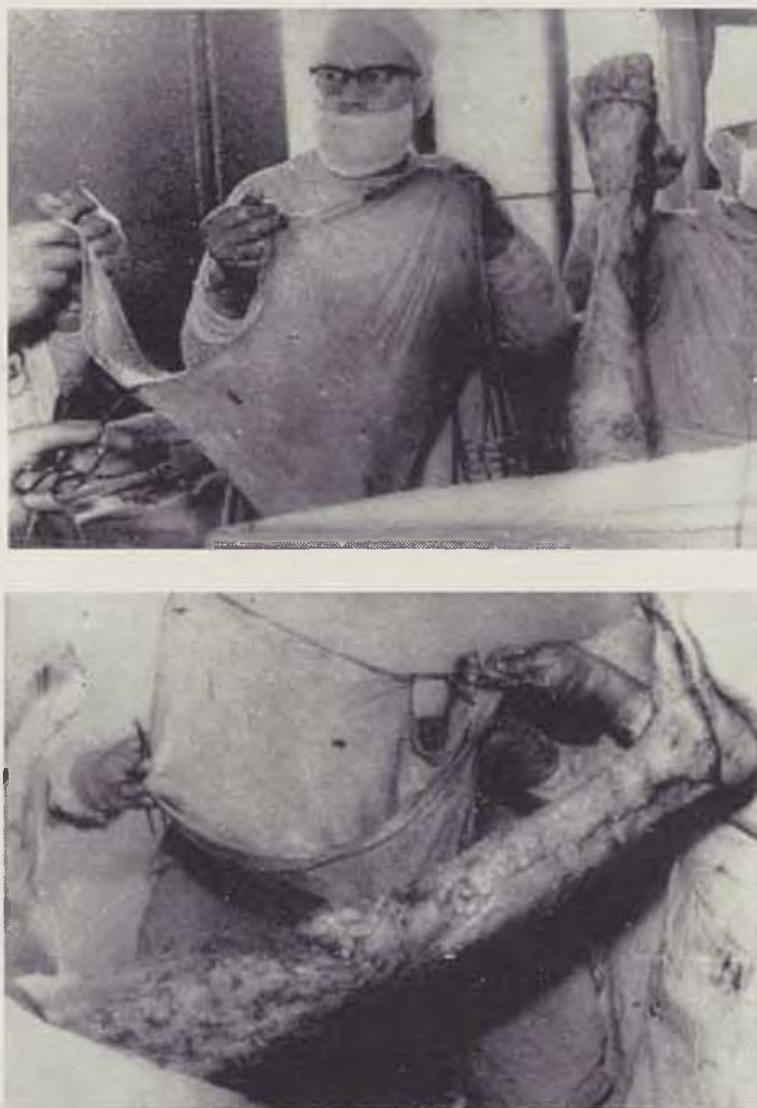


Fig. 8, 9. Skin graft after elaboration

damental operating group completes hemostatsis. Received skin graft is immediately replanted on the wound surface of the extremity and is fixed by silk sutures on its back surface (Fig. 7—9).

Rare scarification is done for the drainage of wound secretion. Operation is completed with cotton wool and gauze bandage which is adjusted in layers. The extremity is fixed by gypsous splint and is placed in the elevated position.

Parts of the elaborated skin which were not used are usually preserved and could be used in case of imperfect healing of the replant.

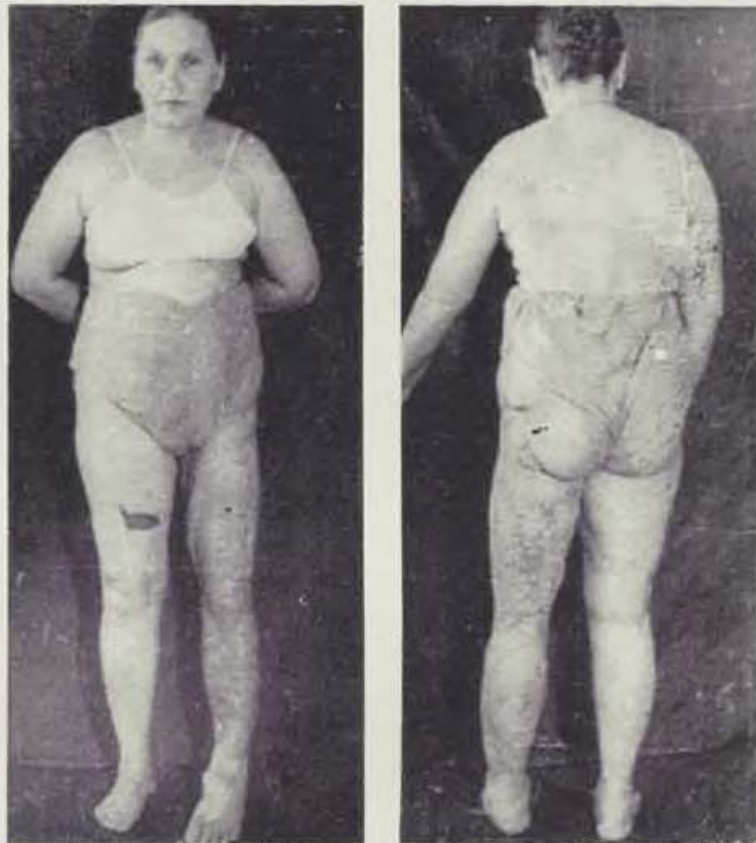


Fig. 10. Patient K. after operation

Endurance of the operation of advanced forms of elephantiasis did not exceed $2\frac{1}{2}$ —3 hours.

According to the mentioned methodology, the excised tissues were elaborated in 18 patients with advanced forms of elephantiasis of lower extremities. In all cases the transplant adhered well and good functional and cosmetic results appeared (Fig. 10). It gives us the right to recommend described method of elaboration of excised tissues for practical using.

L. B.

SUMMARY

Article deals with the simplified method of elaboration of pathological tissues excised in the form of one skin graft due to the operation of elephan-

tiasis. 2 groups of surgeons participate: first — excises one block of pathological tissues from the whole extremity and prepares the wound surface for replantation; second — by means of simple dermatomic knife and dermatome "Krasnogvardeiets" removes the changed fatty tissue up to the reticular layer of the skin. The whole extremity is covered by the entire skin transplant.

General endurance of the operation of advanced elephantiasis is not longer than 2½—3 hours.

We achieved good functional and cosmetic results in 18 patients with advanced elephantiasis by using described method of elaboration of excised tissues.

Large accessibility of the skin elaboration method of excised tissues, the fact that it is not traumatic and reduces the endurance of the operation, enable us to recommend it in case of radical actions, due to advanced elephantiasis.

ZUSAMMENFASSUNG

Vereinfachtes Verfahren für die Verarbeitung abgeschnittener Gewebe zur Replantation während radikaler Operationen der Elephantiasis

Wedjajew I. P., Antonow I. I., Charitonow B. B.

In der Arbeit beschreibt man ein vereinfachtes Verarbeitungsverfahren pathologischer Gewebe, die in Form eines einheitlichen Hautlappens bei radikalen Operationen der Elephantiasis herausgeschnitten wurden. An der Operation beteiligen sich zwei Teame von Chirurgen — das erste schneidet einen einheitlichen Block pathologischer Gewebe von der ganzen Gliedmasse ab und bereitet die Wundoberfläche zur Replantation — das zweite entfernt mit Hilfe des üblichen Dermatommessers und des Dermatoms „Krasnogwardejets“ das geschädigte Fettgewebe bis zur Retikulärschicht der Haut. Die gesamte Gliedmasse deckt man mit dem einheitlichen Hauttransplantat.

Die Gesamtdauer der Operation der fortgeschrittenen Elephantiasis ist nicht länger als 2,5—3 Stunden.

Bei 18 Kranken mit fortgeschrittener Elephantiasis gewannen wir bei der Anwendung des oben beschriebenen Verarbeitungsverfahrens abgeschnittener Gewebe gute funktionelle und kosmetische Ergebnisse.

Die breite Zugänglichkeit des Verarbeitungsverfahrens abgeschnittener Gewebe, die Tatsache, dass es nicht traumatisch ist sowie der Fakt, dass es die Operationsdauer verkürzt, geben uns das Recht, dieses Verfahren bei radikalen Operationen der fortgeschrittenen Elephantiasis zu empfehlen.

RÉSUMÉ

Méthode simplifiée du travail avec des tissus coupés, destinés à la replantation, pendant les opérations radicales de l'éléphantiasis

Vedyayev I. P., Antonov I. I., Kharitonov B. B.

L'article présente une méthode simplifiée du travail avec des tissus pathologiques coupés en forme d'un lambeau cutané d'une seule pièce pendant les opérations radicales de l'éléphantiasis. Ce sont deux équipes de chirurgiens qui prennent part à l'opération: la première coupe le bloc d'une seule pièce des tissus pathologiques de l'extrémité entière et prépare le surface de la plaie à la replantation; la deuxième

enlève le tissu adipeux lésé jusqu'à la couche réticulaire de la peau à l'aide du dermatome habituel et du dermatome „Krasnogvardeyec“. L'extrémité entière est couverte par la greffe cutanée d'une seule pièce.

La durée totale de l'opération de l'éléphantiasis très évoluée ne dépasse pas 2,5 à 3 heures. Chez 18 malades, atteints de l'éléphantiasis avancée, on a obtenu de bons résultats fonctionaux et cosmétiques en utilisant la méthode ci-dessus mentionnée de l'élaboration des tissus coupés.

C'est l'accessibilité facile du mode d'élaboration des tissus coupés, le fait de ne pas provoquer de traumatisme et la possibilité de réduire la durée de l'opération, qui nous donnent le droit de le recommander pour les opérations radicales de l'éléphantiasis évoluée.

RESUMEN

Método simplificado de tratar los tejidos recortados para una replantación durante operaciones radicales de elefantiasis

Vediayev I. P., Antonov I. I., Jaritonov B. B.

En esta obra se presenta un método simplificado de tratar los tejidos patológicos recortados en la forma de un lóbulo cutáneo de una sola pieza en operaciones radicales de elefantiasis. Dos equipos de cirujanos participan en la operación: el primero — recorta un bloque de una sola pieza de tejidos patológicos de toda la extremidad y prepara la superficie de la herida para la replantación — el otro — mediante un cuchillo de dermatomia y mediante el dermatomo „Krasnoguardieyec“ quita el tejido adiposo alterado hasta la capa reticular de la piel. Toda la extremidad se cubre con un injerto cutáneo de una sola pieza.

La duración total de la operación de elefantiasis progresiva no sobrepasa 2,5—3 horas.

Hemos obtenido buenos resultados de función y cosméticos en 18 pacientes afectados con elefantiasis progresiva al usar el método de tratar los tejidos recortados el que mencionamos más arriba.

Gran alcance del método de elaborar los tejidos recortados, el hecho de que no provoca traumatismo y reduce la duración de la operación nos da el derecho de recomendarlo en operaciones radicales de elefantiasis progresiva.

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TISSUE RESPONSE TO PROPLAST IN AN EXPERIMENT

J. ŠMAHEL

Proplast*) is a porous synthetic material recently developed for implantation purposes. Its chemical composition is that of teflon fluorocarbon polymer in combination with carbon fibres. Proplast has the appearance of black, solid sponge and can be cut to whatever size is required. The diameter of its pores, 100—500 μ , facilitates connective tissue penetration and implant stabilization. In view of its consistency, Proplast is recommended particularly for solid tissue augmentation.

Tissue response to Proplast has been the subject of several experimental studies, in the course of which the material was implanted to fill defects or bone cavities [6—9], into the subcutis [3, 7], or used as coating in metal prostheses [4, 5, 8]. The implants were invariably well tolerated, though there were differences as to connective tissue penetration or foreign body reaction. Osteoid tissue formation was observed in bone implantation. Proplast impregnation with blood, plasma, or saline solution [1, 2] proved to have no effect on connective tissue penetration into the implant material.

The present communication is concerned with response to Proplast in subcutaneous implantation.

MATERIAL AND METHODS

42 female rats, strain SIV 50, weight 160—180 g, were used for the experiments. A transverse skin incision was made in the sacral region of the animal's depilated back, and a subcutaneous tunnel was dilated cranialward by means of blunt scissors. No bleeding was involved in the tunnel formation. A Proplast plate 4 mm thick was used for cutting out blocks sized 12 X 12 mm. Each animal had one such block introduced into the subcutaneous tunnel, and the skin incision was subsequently closed with a stitch. The implants complete with the adjacent tissue were then removed for histological examina-

*) Proplast^R, Vitek, Inc., Houston, Texas

tion at 2 weeks, 1, 2, 3, 4, 6, and 8 months after implant operation. 6 animals were supplied for each term. The material was fixed in formalin and embedded in paraffin, using standard techniques. Histological sections made along the implant midline were stained with haema-toxylin-eosin, according to van Gieson and according to Kossa for calcium.

RESULTS

There were no clinical complications during the experiment. The implanted blocks retained their original size and consistency and were freely movable against the dorsal fascia. Movability against the skin was considerably reduced as from the first month after implantation. The black coloration of Proplast could just be seen in thin-skinned animals.



Fig. 1. Capsule and peripheral part of the implant 2 months after operation, van Gieson, X130

The implants were enveloped in a connective tissue capsule, the differentiation of which started in the second week after operation. One month after the implantation, the capsule consisted of cellular, richly vascularized connective tissue with its fibres running parallel to the surface of the implant. After two months, the capsule was formed by a layer of mature collagen

connective tissue [Fig. 1] with numerous, rather thick vessels at its circumference. The capsule showed no more structural changes in the subsequent development.

Connective tissue penetration into the implant began in the second week after implantation. This process was always most pronounced at the narrow, cut sides of the block, while at the larger areas formed by the surface of the Proplast plate the connective tissue invasion was relatively inhibited. The invading connective tissue showed a visible gradient of maturation [Fig. 1]. Near the capsule, the collagen fibres were thicker and present in bundles, while in the direction towards the implant the connective tissue was very thin, with fine fibres and an abundance of capillaries. Fibroblast and histiocytes were the principal cells there, and there were no inflammatory infiltrates. In the initial stages, the centres of the implants were mostly empty or with only a few isolated fibrin fibres and mononuclear cells. There were considerable individual differences as to the degree of connective tissue infiltration of the implants. In some implants the process took 3 months, in others as long



Fig. 2. Expansion of Proplast pores due to connective tissue invasion 6 months after implantation, H + E, $\times 75$

as 6 months to complete. The above mentioned gradient of maturation was also evident in blocks of Proplast removed 8 months after implantation as these were completely permeated with connective tissue. As from the sixth post-implantation month, connective tissue formed major islets in some parts of the Proplast implant, displacing its lattice-work [Fig. 2].

Proplast caused foreign body reaction. During the first two months of the implantation, giant cells and macrophages kept concentrating almost exclusively at the inner wall of the capsule. However, as the implant material was gradually invaded by mature connective tissue, giant cells began to

appear all through the implant (Fig. 3). Some of the giant cells enveloping the Proplast lattice-work contained clear vacuoles. Foreign body reaction was at its highest between months 2 to 6 after implantation, but it proved



Fig. 3. Giant cells at Proplast lattice-work 6 months after implantation, H+E, $\times 260$

to be less pronounced in blocks withdrawn 8 months after the operation. There were no visible signs of Proplast structure break-down.

Kossa's reaction failed to prove any calcium being deposited in the implants.

DISCUSSION

Preferential connective tissue invasion along the narrow sides of implanted blocks was also found in other studies (1, 2) and was probably due to the structure of the Proplast plate which the blocks were cut out of. The plates, a few millimetres thick, are made of thin Proplast sheets moulded together by thermoplasty. Arem and Madden (1) showed that this kind of technology was conducive to pore compression and reduction over the larger areas of Proplast plates. The dependence of connective tissue penetration on the size of implant pores is a well-known factor (6). Connective tissue infiltration of the blocks also showed considerable individual variability. This variability might be caused by different reactivity of organisms or by non-standard porosity of the implant material. The size of the implanted block and the actual implantation site are other factors determining the rate of connective tissue infiltration of the implants as follows from comparison with studies by other authors (1—3, 6—8). The expansion of Proplast pores due to connective tissue invasion, observed 6 months after implantation, suggested that in cases of long-term implantation the Proplast structure might be influenced by the pressure and pull of fibrous tissue.



Foreign body reaction was found in all the implanted blocks but there was no evidence of their disintegration at any time during the period of experimentation. The relative regression of this reaction after the 6th post-implantation month may have been due to two factors: fibrous connective tissue is less reactive and its expansion in the Proplast pores resulted in a reduction of the area of contact between the foreign body and the tissue. There is considerably more difference as to other authors' data on the incidence of foreign body reaction. Arem and Madden (1) in their studies of subcutaneous implantation of Proplast in rats noted the peak of this reaction in the 4th and its regression in the 6th weeks. Janeke et al. (7) implanted Proplast subdermally and subperiostally in cats and dogs. The number of giant cells in the implants kept diminishing in proportion to connective tissue maturation, but they were found scattered as long as 9 months after implantation. Schenk et al. (9) found no foreign body reaction when they implanted Proplast into the frontal sinuses of their experimental dogs. There seems to be no plausible explanation for the above different observations. The significance of foreign body reaction in long-term Proplast implantation will have to be explored in more experiments.

J. H.

SUMMARY

An experiment on rats was arranged to study tissue response to subcutaneously implanted Proplast within 8 months of implantation.

Proplast proved to be a resistant material free from causing any inflammatory reaction. The implants were enveloped in a thin-walled capsule and gradually invaded by connective tissue. In the later post-implantation stages, there was Proplast pore expansion due to fibrous tissue.

Proplast caused foreign body reaction which was at its highest between months 2 to 6 after implantation. The reaction did not result in any detectable implant disintegration at any time during the period of experimentation.

Long-term Proplast tolerance and resistance need exploring in more experiments.

ZUSAMMENFASSUNG

Gewebsreaktion auf Proplast im Experiment

Šmahel J.

Im Experiment an Ratten studierte man die Gewebsreaktion auf subkutan implantiertes Proplast im Zeitraum von acht Monaten nach der Implantation.

Proplast erwies sich als ein resistentes Material, das keine Entzündungsreaktionen ausgelöst hat. Die Implantate wurden von einer dünnen Kapsel umgeben und langsam vom Bindegewebe durchgedrungen. In späteren Stadien nach der Implantation kam es zur Ausweitung der Proplastporen durch fibröses Gewebe.

Proplast löste eine Fremdkörperreaktion aus, die zwischen dem 2. bis 6. Monat nach der Implantation am deutlichsten war. Während der Versuchszeit führte diese Reaktion zu keiner deutlichen Desintegration der Implantate.

Die langzeitige Toleranz und Resistenz von Proplast ist durch weitere Versuche zu überprüfen.

R É S U M É

Réaction des tissus à Proplast dans l'expérience

Šmahel J.

Dans l'expérience sur les rats, on a étudié la réaction des tissus à Proplast implanté sous-cutanément jusqu'au 8ème mois après l'implantation.

Proplast s'est démontré comme un matériel résistant qui n'a provoqué aucune réaction inflammatoire. Les implants ont été entourés d'une capsule fine et lentement infiltrés par le tissu fibreux.

Proplast a provoqué une réaction au corps étranger, la plus remarquable entre le 2ème et 6ème mois après l'implantation. Pendant la période d'expérience, cette réaction n'a pas causé de désintégration évidente des implants.

D'autres expériences s'imposent pour vérifier la tolérance de longue durée et la résistance de Proplast.

R E S U M E N

Reacción de los tejidos a Proplast en un experimento

Šmahel J.

En un experimento en las ratas fue estudiada la reacción de los tejidos a Proplast implantado subcutáneamente hasta ocho meses después de la implantación.

Proplast se mostró ser material resistente que no provocaba ninguna reacción inflamatoria. Los implantes fueron rodeados por una cápsula fina y poco a poco impregnados por el tejido. En los períodos ulteriores después de la implantación se producía dilatación de los poros de Proplast por el tejido fibroso.

Proplast a provoqué une réaction au corps étranger, la plus remarquable entre le 2° hasta el 6° mes después de la implantación. Durante el tiempo de experimentos esta reacción no conducía a desintegración visible de los implantes.

Tolerancia de largo tiempo y resistencia de Proplast tiene que ser probada por nuevos experimentos.

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PARTIAL HAND AMPUTATION — A CASE REPORT

E. PANEVA - HOLEVICH, P. TRICHKOVA, B. POPOVA, B. BADEVA, S. BANKOV

In the past few decades, a great number of case reports on hand salvage procedures after severe injuries with concomitant lesion of the main vessels have been published in the literature. In some of the cases, because of the extensiveness of damage, vascular suture was not resorted to. With regard to this the exclusively high capacity of collateral circulation in this particular area has been repeatedly discussed (Barsukov, Paneva and others). Along with that there is an ever increasing number of reports on patency restoration of the major vessels in heavy cut injuries using microsurgical techniques despite the incomplete blood supply interruption. Presumably, in this fashion not merely the hazard of ischemic necrosis of hand portions is obviated, but also a more adequate trophicity and functional repair is provided for (Kleinert and Kutz, Susumi Tanai, Eger and co-authors, O'Brien, Buck-Gramcko).

The problem regarding the other hand structures (tendons and nerves) which play a decisive role in the functional outcome of treatment has been insufficiently elucidated.

In the present report a case with partial amputation of the hand at wrist level, posing difficult problems insofar as emergency surgery is concerned, is described.

CASE REPORT: male patient T. V. V., aged 30, with occupation — truck driver. Six hours before admission to the clinic, during the repair of a heavy-freight truck suddenly the engine fell down, and the patient's hand was severed by a sharp metallic edge. He was immediately sent to the district hospital wherefrom he was referred to us as an emergency case for replantation.

The physical examination performed disclosed disarticulation between the first and second row of carpal bones without other noteworthy skeletal damage (Fig. 1). The hand was suspended on a narrow soft-tissue bridge on the ulnar aspect with breadth approximately 2.5 cm. On wound inspection it was established that n. ulnaris and a. ulnaris were intact, but the distal parts of the hand were livid and relatively cold, probably owing to arterial spasm. All the other structures (flexor and extensor tendons, median nerve, radial artery and superficial branch of the radial nerve) were divided. The thenar muscula-

ture was crushed and lacerated, while the skin wound displayed moderate contusion of the edges [Fig. 2].

The patient was conscious with evident signs of shock (skin paleness, cold sweat, skin temperature 36° , arterial pressure 70/30 mm Hg, heart and pulse rate 120/min, volume of circulation 21 per cent deficient, compensated metabolic acidosis). Following appropriate resuscitation (transfusion of 900 ml single-group blood, 1500 ml water-saline glucose solution and plasma substitutes) the hypovolemic state was overcome, and the blood pressure raised to 120/80 mm Hg.

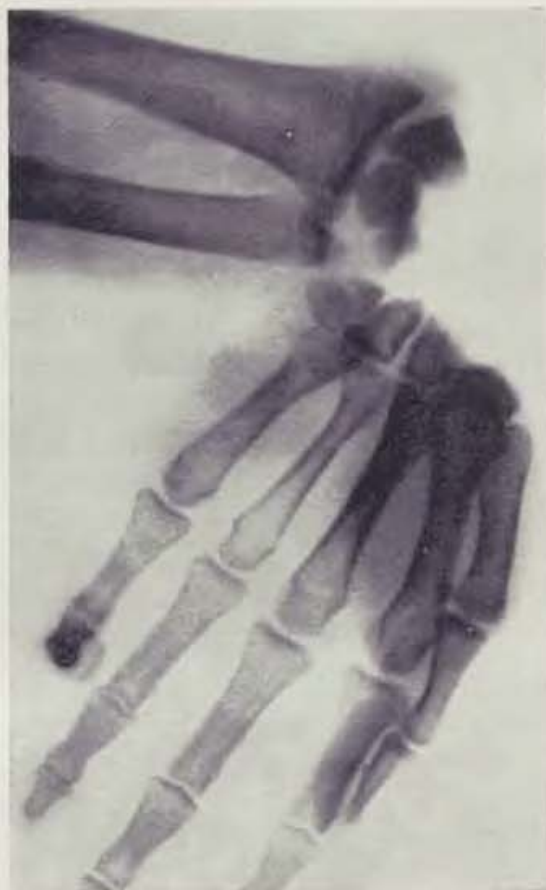


Fig. 1. X-ray of the patient's hand on admission. Disarticulation between the two carpal rows can be seen

Operation was performed under general anesthesia in combination with axillary plexus block. Pulsations of the ulnar artery appeared after periarterial block of the axillary vessels, and the hand became warmer. Blood began to escape from the distal ends of the dorsal veins. The crushed skin edges were economically excised. Skeletal fixation was secured using three Kirschner wires. Thereafter, repair of the volar tendons was undertaken. A removable wire suture was placed separately for the deep and superficial flexors of the digits. Coaptation of tendon ends was achieved by means of very fine \square -shaped sutures with 5-0 atraumatic thread [Fig. 3]. The long flexor tendon of the thumb was reconstructed with a Cuneo suture. Using fine cat gut sutures the

muscle bellies of the thenar were reattached as far as possible. Next the ends of the median nerve were located, and following economical freshening under operating microscope, the sensory and motor fascicles were identified. A fascicular perineural suture with 10-0 atraumatic thread was placed, supplemented by several epineural sutures (6-0 atraumatic thread).

The radial artery ends which were retracted and thrombosed were discovered at the snuff-box level. After removal of the thrombi and washing the lumina with novocain solution, microvascular suture was performed. The extensor tendons of 2-5 fingers and the long abductor of the thumb were sutured using a buried unremovable suture. No repair of the long extensor of the thumb was done since the pull of its tendon caused compression of the radial artery at the site of suture.

Using a microvascular suture two of the superficial dorsal veins were also repaired. Recovery of the venous return through them was immediately achieved. Reattachment of the skin edges was accomplished with 4-0 atraumatic threads, and two fine glove drains were inserted (Fig. 4 — a, b, c, d). Next an elastic compression bandage was applied. Wrist and fingers were immobilized in physiological position with a dorsal plaster cast splint. The operation lasted for 5 hours and 30 minutes. During the postoperative period the elevated position of the limb was maintained. The patient underwent anticoagulant therapy for 21 days (direct anticoagulants, blood platelet anti-aggregants) and antibiotic treatment with broad spectrum antibiotics. The post-operative period ran an uneventful course. Initially, a slight swelling occurred,

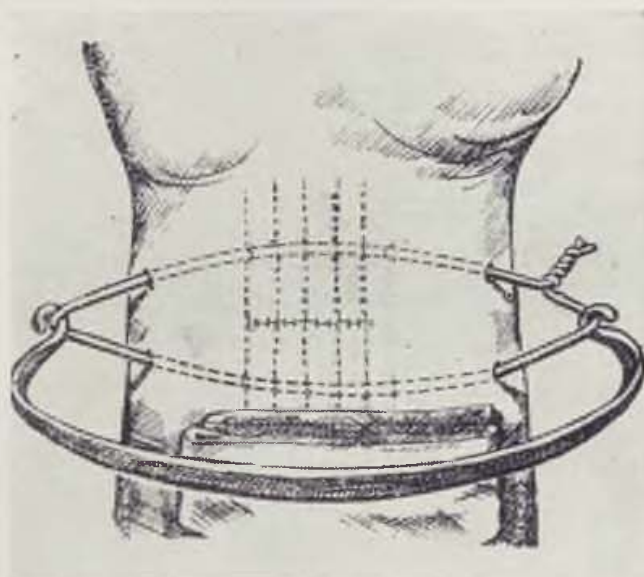


Fig. 2. Photograph of the hand just prior to operation. — Fig. 3. Scheme of the superficial and deep flexors' suture



Fig. 4a, b. Appearance of the hand after the intervention

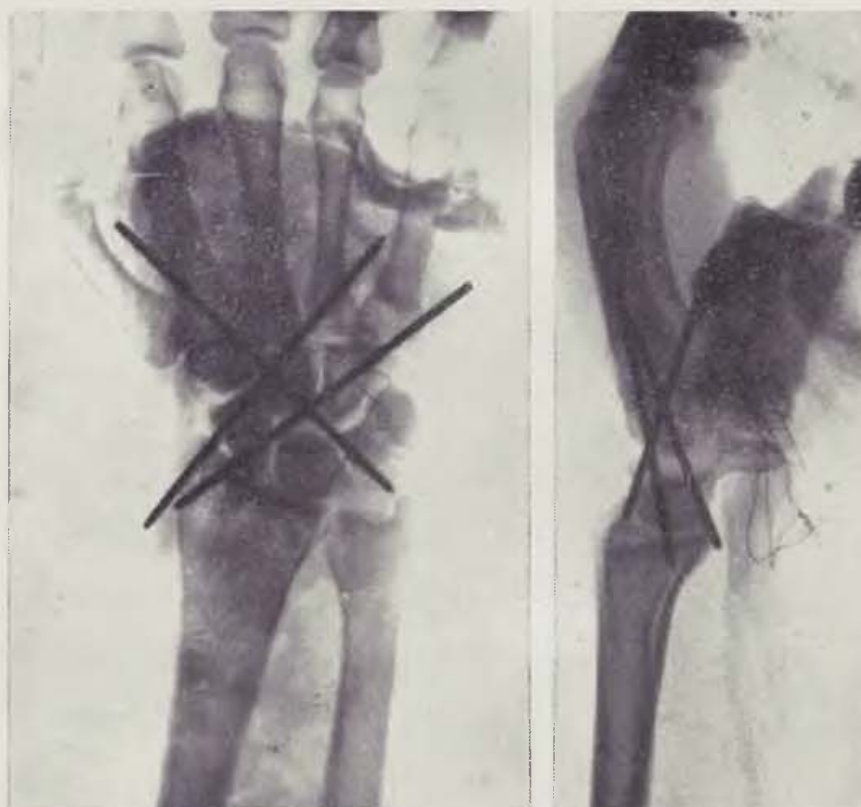


Fig. 4c, d. X-ray after the intervention. The Kirschner wires for bone fixation are visible, as well as the two wires used for tendon suture

gradually subsiding by the 15th day. Within 25 days of intervention, the splint was removed and slight active movements were allowed, and within 36 days the patient was transferred to the rehabilitation clinic. The data of hand examination upon admission to the rehabilitation unit were the following: Active movements of the digits were still heavily restricted; the EMG study showed evidence of complete low lesion of the median nerve. Rheographic indicators — lowered. The relative pulse rate of the index finger was 0.38 per cent. Skin electroconduction within the autonomous median nerve zone was strongly reduced, and corresponded to complete denervation.

The complex rehabilitation program carried on over a period of 34 days comprised remedial exercises, underwater exercises, ultrasound, occupational therapy and the like. The patient was discharged for proceeding the treatment under domiciliary conditions with considerable improvement of the range and strength of active motions. Hand dynamometry showed 15 kg power grip between fingers and palm. The blood supply of the hand, respectively of individual fingers, was within normal limits, demonstrated by the rheographic control. Skin electro-conduction was improved despite the fact that sensitivity in the median nerve zone and opposition of the thumb were only partially restored. Once again the patient was able to use his hand in performing daily self-care activities. At the last follow up examination four months after the intervention, a further improvement of the result attained was recorded. Flexion and extension of the four ulnar fingers was virtually complete. The deep and superficial flexors have achieved independent function. The thumb was in moderate flexion contracture at the interphalangeal-joint level. Opposition



Fig. 5a, b, c. Photographs four months after the operation showing full flexion and extension of the distal thumb phalanx and incomplete opposition

between the first and second digit was partially restored. Actually, sensitivity impairment in the autonomous zone of the median nerve persists. Reconstruction of the long extensor of the thumb by suture of the divided ends or transfer of the proper extensor of the index finger is forthcoming. Although rehabilitation is still in course, the patient has already resumed his previous job as a driver (Figs. 5 — a, b, c).

DISCUSSION

The first point raised in connection with the case reported above is whether a risk for the blood supply of the fingers exists. The arterial flow in case of conservation of one of the major arteries (in this instance *a. ulnaris*) is beyond any doubt practically sufficient for the normal blood supply of the distal hand portion. It is well known from the literature that even in damage of either of the major blood vessels (*a. ulnaris* and *a. radialis*), no risk worth mentioning is present provided *a. interossea volaris* is intact. However, in the patient described above *a. interossea*, as well as all dorsal anastomoses of the vessels were severed. In situations like this a late thrombosis of the ulnar artery due to intima contusion would interrupt the arterial flow to the hand — an eventuality by no means excluded in such a heavy trauma. Hence we believe that the suture of *a. radialis* is fully justified. At the check-up examination pulsations in the snuff-box area were palpable. We abstained from performing arteriography to preclude additional hazards.

Restoration of the venous return, physiologically effected mainly by the route of dorsal veins, proved a much more serious problem. It has been demonstrated that even in completely intact volar vessels, the extensive division of the superficial dorsal veins of the hand leads to a considerable edema as the result of venous stasis. In the concrete case the vein accompanying *a. ulnaris* (the only intact venous vessel) could scarcely secure a sufficient venous return. Therefore we feel that the suture of both superficial dorsal veins has contributed greatly to the restoration of the venous return and prompt overcoming of the initial swelling.

The issue about the sequence of reconstruction steps during intervention on the various structures may be also discussed. Regarding the skeleton the general principle requiring its stabilization prior to any intervention on vessels, tendons and nerves holds true in our patient, too. However, osteosynthesis should be done without any delay in order to obviate prolongation of the operative time, and moreover, it should be as atraumatic as possible to avoid the creation of additional risks. The passing of several Kirschner wires through the carpal bones proves a feasible method in this case. The next question is why the vascular suture was placed after reconstruction of the flexor tendons and median nerve. Such an objection is fully warranted theoreticalwise. Our motives were of technical nature, having in mind the fact that arterial flow was never jeopardized. Proceeding from the latter conditions we felt that it would be rather difficult to work on flexor tendons and median nerve without running the risk of disrupting the delicate suture of *a. radialis* at

the snuff-box level. It was much more difficult to avoid the hazard of tearing the suture of the thin superficial veins during work on the volar and dorsal structures. Only after reconstruction of the extensor tendons, it was possible to suture the superficial veins with wrist flexed in moderate dorsal flexion.

In terms of tendons, firstly, the question could be posed about the justification of primary repair in such a heavy injury. Our experience with several similar cases shows that atraumatic primary suture at the level indicated invariably provides for a better outcome. Even in case of adhesion following tenolysis, performed several months later, the active movements are usually regained. The multiplicity of tendon lesions necessitates a rather special tendon suture technique. The proposed wire suture, blocking simultaneously the four tendons is assumed as suitable for the purpose since it is time-saving and comparatively atraumatic. It might be disputed whether or not it is enough to repair the deep flexor as recommended by many authors for this particular level. The young age of the patient encouraged us to attempt repair of both flexors. The policy outlined proved feasible in this case. Concerning the extensors of the fingers, in our opinion, the classical buried suture is preferable.

The problem of performing primary suture of the nerves in incomplete amputations is likewise disputable. We support the viewpoint that primary suture is superior provided all up-to-date requirements have been met. Although full restoration of nerve conduction is not achieved as yet (only 4 months have elapsed since the operation), the clinical and functional assessment gives us sufficient reason to assume that some regeneration may be expected. In the absence of adequate conditions, the nerve suture should be postponed with one month.

SUMMARY

This is a report on a case with partial hand amputation at carpal row level where repair of one arterial vessel, two veins, the median nerve and all flexor and extensor tendons is performed. A discussion is made of the essential points in the operative tactics employed, e. g. sequence of repair of the various structures, securing venous return, necessity to suture the second major vessel provided the other one is intact, simultaneous reconstruction of the superficial and deep flexors etc.

ZUSAMMENFASSUNG

Teilamputation der Hand — Beschreibung eines Falles

Panewa-Holevich E., Trichkova P., Popowa B., Badewa B.,
Bankow S.

Es wurde der Fall einer Teilamputation der Hand auf der Karpalebene beschrieben. Wiederhergestellt wurden eine Arterie, zwei Venen, der mittlere Nerv und die gesamten Sehnen der Flexoren und Extensoren. Die Autoren diskutierten die Reihenfolge der Restitution einzelner Strukturen, die Sicherung des venösen Kreislaufes, die Unerschlichkeit der Suture eines zweiten grösseren Gefässes falls ein Gefäss erhalten



geblieben ist und die gleichzeitige Wiederherstellung der oberflächlich und tiefer liegenden Flexoren, usw.

RÉSUMÉ

Amputation partielle de la main — description d'un cas

Paneva-Holevikh E., Trikhkova P., Popova B., Badeva B.,
Bankov S.

On décrit un cas d'amputation partielle de la main au niveau du carpe. On a reconstruit une artère, deux veines, le nerf médian et tous les tendons des fléchisseurs et des extenseurs. On discute les moments essentiels de la technique d'opération, comme par exemple la succession de la restitution des structures différentes, la nécessité d'assurer la circulation veineuse, l'indispensabilité de la suture du 2ème grand vaisseau, si l'un est conservé, la reconstruction simultanée des fléchisseurs superficiels et plus profonds etc.

RESUMEN

Amputación parcial de la mano — descripción de un caso

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Bankov S.

Fue descrito un caso de una amputación parcial de la mano en el nivel del carpo. Fueron reconstruidos 1 arteria, 2 venas, el nervio medio y todos los tendones de los flexores y extensores. Se discuten los momentos fundamentales de la técnica operativa usada así como la sucesión de la restitución de las estructuras particulares, la necesidad de asegurar la circulación venosa, de suturar el otro vaso mayor si uno de ellos está conservado, reconstrucción simultánea de los flexores superficiales y de los puestos más profundamente.

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CLINICAL FORMS OF ENDOTOXINAEMIA IN EXTENSIVE BURNS

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Necrectomy, débridement, and instrumentation on the lower urinary tract are, clinically speaking, the most frequent causes of gram-negative (septic) shock in patients with extensive burns. The interval between the operation and the appearance of shock signs may be anything from 30 minutes up to 11 days. However, in a number of cases the predisposing factor may not be detected at all, the onset proper being insidious. According to our practical experience, initial early hypotension follows tremor with the temperature rising above 39 °C. Late hypotension develops after the temperature has dropped below 37.5 °C. Consciousness turns into stupor or even coma. Oliguria may be transient or it may persist while N-urea and creatinine in the serum keep rising until death which occurs usually due to respiratory failure. X-ray of the lungs may be entirely negative, but there are also findings showing specification in both lung wings and pronounced dilatation of the hili. Similarly, an ECG examination may reveal subendocardial and subepicardial ischaemia (ST segment depression and T-wave inversion), though curves with no pathological finding are also known to exist.

The development of shock is in connection not only with the vasomotor system but also with vascular contents. Complications arise characterized by a breakdown of haemostasis followed by sudden bleeding. This is known as disseminated intravascular coagulopathy.

In any assessment of individual cases of septic shock or endotoxinaemia, attention need be devoted to certain anamnestic, clinical, and laboratory data, and also to the problem of treatment as well as to certain chronological connections.

- ... burn depth and extent
- ... age, sex, personal history
- ... surgical operation or other shock predisposing factors
- ... proof of infection:
 - cultivation from burned areas, from the urine, from the sputum (sensitivity to ATB)
 - haemoculture prior to death at postmortem
- ... duration of sepsis
- ... clinical signs:
 - consciousness, respiration, pulse, tremor, temperature, degree and duration of hypotension
 - diuresis
 - icterus
 - bleeding time
- ... laboratory investigation:
 - blood count: erythrocytes, leucocytes, thrombocytes, acid-base balance and blood gases
 - mineralogram
 - N-urea and creatinine
 - urine: protein, urobilinogen
 - transaminase and bilirubinaemia
 - ELFO proteins
 - immunoglobulins (IgG, IgA, IgM)
 - GGT and cathepsin and lacticodehydrogenease (isoenzymes L1-5)
- ... LIMULUS test
- ... ECG and X-ray
- ... therapy:
 - antibiotics (early use)
 - alpha-blockers
 - corticosteroids
 - fluid replacement
 - transfusion of blood and blood derivatives
- ... postmortem finding

Over the past three years, the following groups of patients have been followed up at our unit:

— a group of severely burned patients where the average extent of the surface area burned was 50 % and where the clinical and laboratory pictures suggested the presence of gramnegative sepsis, but where haemocultures were negative,

— a group of patients with deep burns extending over 15—20 % of the body surface where sudden changes in the clinical and laboratory pictures altered the anticipated development.

In thirteen from among thirty-two burned patients treated at our unit, a diagnosis of endotoxinaemia was established, using the LIMULUS test* [Koníčková, 1974].

... The group of nineteen patients, in whom the test was negative, includes two extensively burned persons, in whom the development of gram-negative sepsis with a sudden fatal turn suggested endotoxinaemic shock (no endotoxinaemia, however, could be proved by means of the LT). It was only subsequently learned that in these two particular patients the LIMULUS test had been carried out without the necessary dilution of the plasma. This may have affected the results as the inhibitory effect of plasma proteins has not been eliminated [Koníčková, 1975].

Regarding the proved fact of endotoxin affinity for leucocytes and thrombocytes [Nowotny, 1969], a comparative study was undertaken with a view to ascertain the concentration of endotoxin in the thrombocyto-leucocytic lysate such as would yield positive results. The conclusion was reached that it was possible to prove the presence of endotoxin in dilutions two hundred times less than its levels in positive LIMULUS tests in the plasma.

... The group of thirteen burned patients, where the LIMULUS test was positive, was examined for manifestations of endotoxinaemia. Distinctions were made according to five different forms of clinical development:

1. Proof of a positive LIMULUS test is of particular significance in cases where the clinical signs are hardly detectable (inexplicable transient hypotension, disorientation, tachypnoea) while the patient is under regular observation. Sometimes, however, nothing short of laboratory investigation can diagnose changes typical of endotoxinaemia: decreased pCO_2 (manifestation of hyperventilation), decreased pO_2 (manifestation of shock hypoxia), persevering anemia without external signs of loss of blood, reduced numbers of thrombocytes, haemocoagulation factor disorders. This so called laboratory form of endotoxinaemia was ascertained in the group under observation in only one patient with less extensive burns. He is one of the two patients who survived from among the thirteen burned with positive LT test.

2. An example of an inextensive burn with positive endotoxinaemia with signs of peracute development of endotoxin shock with pulmonary localization is the case of a young man who suffered early 3rd-degree hypotension, loss of consciousness and tachypnoea (48/min) 12 hours after urinary bladder catheterization. Complex treatment brought some partial improvement in terms of haemodynamics and return of consciousness while tachypnoea and dyspnoea persisted. Biochemical investigation revealed metabolic acidosis and hypoxia (hypoxic and anaemic). In spite of controlled respiration and doses of Hydrocortisone (1500 mg i.v.) and SOLU-MEDROL (1000 mg i.v.) death occurred after signs of respiratory failure (diffuse oedema of the lungs, hepatization, bilateral adrenal necrosis, septic tumour of the spleen). Significantly enough, *E. coli* could be proved as early as 72 hours after the accident both on the burned

* The principle of this method is in the gelation of amoebocytic lysate *Limula* in the presence of endotoxin.

areas and in catheterized urine as this microbe is the commonest cause of endotoxin shock (LIMULUS test was positive).

3. A different course of endotoxaemia was observed in an elderly patient with a burn of medium extent, in whom the clinical picture showed the development of a two-phase pulmonary artery embolism. The positivity of the LIMULUS test helped to explain some of the clinical and laboratory signs which suggested not just mere embolization into the branches of the a. pulmonalis but also a haemocoagulation disorder of the disseminated intravascular coagulopathy type. On day 9 after the accident, when massive mixed infection was found (*Proteus*, *Pseudomonas*, *E. coli*, *Achromobacter*), necrectomy and heterotransplantation were performed on the assumption that this would help prevent gram-negative sepsis, but the effect proved to be the opposite as it was exactly this operation that turned out to have been the cause triggering off the endotoxin shock. Postoperative bleeding was massive and persistent. Within just under 4 hours, there was a sudden onset of third-degree hypotension (early), dyspnoea and tachypnoea (70/min), and loss of consciousness. Cyanosis, coolness in acral parts, and bloody sputum discharging from the nose suggested the diagnosis of pulmonary artery embolism. When examined biochemically, respiration alkalosis turned into metabolic acidosis with hypoxia while the ECG revealed visible signs of right ventricular overexertion and myocardial ischaemia. After 10 hours, the patient regained consciousness (following resuscitation) and his blood pressure had become stabilized. During the next three days, there appeared signs of microembolization of the skin (red nettle rash), oliguria with increased N-urea and creatinine, anaemia, prolonged bleeding time, and reduced coagulation time. 4 days after the first episode, there was once more a sudden onset of hypotension with tachypnoea (48/min) and dyspnoea with death occurring within a few minutes. Autopsy showed pulmonary artery embolism and thrombosis of deep femoral veins, interstitial nephritis and pericarditis (petechiae in the kidneys and skin).

4. A case of extensive burns with massive *E. coli* colonization of the burned areas can serve as an example of the development of endotoxin shock after antibiotics. In view of the patients' temperature rising in excess of 40.5 °C, Chloramphenicol, 1g/4 hrs. i.m., was started, but after the 4th gram, hypotension, tachypnoea, tachycardia, vomiting, and diarrhoea developed with temperatures continuing to rise above 41 °C. There was subsequently some improvement and so, in an effort to remove the necrotized tissues as soon as possible, necrectomy and heterotransplantation were performed. However, within 4 hours of the operation, tremor, diarrhoea, sudden tachypnoea (72/min.), tachycardia (212/min.), and 3rd-degree hypotension had developed and death occurred in spite of immediate resuscitation. Autopsy revealed oedema of the lungs, steatosis of the myocardium, steatosis of the liver, and thrombosis of the iliac vein.

5. The most frequent form of endotoxin (gram-negative, septic) shock in the group under observation is shock as a terminal condition in patients with extensive burns, in whom the causes of gram-negative sepsis cannot be re-

moved. Patients falling into this category show (according to our practical experience) massive colonization by *Pseudomonas aeruginosa* on the burned areas, positive cultivation from intravenous cannulae, and also proof of the presence of this microbe in haemocultures.

Unlike other surgical or internal patients, those with extensive burns have a number of operations performed daily, each of which could in itself prove to be the cause triggering of endotoxin shock: these are, in particular, necrectomies and transplant operations, but also complicated redressing, introduction of catheters, and last but not least, some of the nursing manipulations such as difficult bed-clothes changing.

For that reason it is absolutely essential to know the bacteriological findings on the burned areas well before necrectomy, to keep an eye on microbial colonization underneath the hetero- and homotransplants, and to arrange regular bacteriological checks of the urine in cases where a catheter need be kept in position permanently.

CONCLUSION

Although it proved possible to demonstrate the presence of endotoxaemia by direct laboratory means, clinical observation continues to be the main principle of diagnosis, with laboratory investigation remaining a mere supplement of the former. The laboratory picture shows considerable variability. As regards the LIMULUS test as such, this appears to be a valuable method even though it poses considerable technical and material demands and, due to its many pitfalls, is hardly well suited for routine use. J. H.

SUMMARY

Two groups of severely burned patients were kept under clinical and laboratory observation: a) a group of extensive burns involving an average of 50 % of the surface area with the clinical and laboratory pictures suggesting gram-negative sepsis but with haemocultures giving negative results, b) a group of burns (deep ones) involving 15—20 %, where sudden changes in the clinical and laboratory pictures altered the anticipated course. Laboratory investigations, using the LIMULUS test, confirmed the diagnosis of endotoxaemia in thirteen patients who showed five clinically distinct differing from each other with regard to both the causative factor and subsequent development and postmortem finding: in the so called laboratory ("biochemical") form of endotoxaemia the clinical course proved to be favourable; in the rest (pulmonary form, disseminated intravascular coagulopathy type, endotoxin shock provoked by the administration of antibiotics, the form of endotoxin shock as a terminal condition in those extensively burned where the causes of gram-negative sepsis proved impossible to remove), the development was terminal. Therefore, it appeared essential to diagnose the causes of endotoxin shock including bacteriological findings on the burned areas prior to necrectomy as well as underneath the hetero- and homografts, and to maintain regular bacteriological urine tests. The LIMULUS test proved to be a valuable diagnostic means, though is placed considerable technical and material demands on the attending staff.

RÉSUMÉ

Formes cliniques de l'endotoxinémie chez les personnes avec les brûlures étendues

Königová, R., Koníčková, Z.

Dès 1973 on a observé du point de vue de la clinique et du laboratoire deux groupes de personnes grièvement brûlures dont l'étendue moyenne était de 50 p.c., où le tableau clinique et celui de laboratoire montraient une septicémie gram-négative, les hémocultures étant négatives; le groupe avec des brûlures profondes d'une étendue de 15 à 20 p. c., où les modifications immédiates du tableau clinique et celui de laboratoire troublaient le cours prévisible. Les résultats de laboratoire ont confirmé le diagnostic de l'endotoxinémie par le Limulus teste chez treize personnes brûlées chez lesquelles on pouvait différencier cinq formes différentes. Celles-ci différaient non seulement par le moment provoquant, mais aussi par leurs cours et par les résultats de l'autopsie: dans la forme soit disante laboratoire (biochimique) de l'endotoxinémie, le cours était favorable, dans toutes les autres (forme pulmonaire, forme d'une coagulopathie intravasculaire disséminée, choc d'endotoxine provoqué par une application des antibiotiques, forme d'un choc d'endotoxine qui est le phénomène terminal chez les brûlés d'une vaste étendue où il est impossible de supprimer la cause de la septicémie gramnégative) le cours était léthal. Il faut connaître les moments qui provoquent le choc d'endotoxine, y compris les constats bactériologiques sur les surfaces avant la nécrotomie, sous les hétero- et homogreffes. Le contrôle bactériologique régulier de l'urine et même très important. Limulus teste présente une ressource d'une grande valeur pour le diagnostic qui, d'autre part, est exigeante quant à sa technique et son matériel.

ZUSAMMENFASSUNG

Klinische Formen der Endotoxinämie bei umfangreich Verbrannten

Königová, R., Koníčková, Z.

Seit dem Jahre 1973 wurden klinisch und laboratorisch zwei Gruppen von Schwer- verbrannten verfolgt: einerseits eine Gruppe von umfangreich verbrannten Patienten mit einem durchschnittlichen Verbrennungsumfang von 50 %, wo das klinische und laboratorische Bild auf eine gramnegative Sepsis deutete, die Hamokulturen jedoch negativ waren, andererseits Verbrannte mit einem Verbrennungsumfang von 15—20 % (tief), wo die akuten Veränderungen des klinischen und Laborbildes den erwarteten Verlauf gestört haben. Laboratorisch wurde die Diagnose der Endotoxinämie mit Hilfe des Limulus-Tests bei dreizehn Verbrannten bestätigt: klinisch konnte man fünf unterschiedliche Formen differenzieren, die sich voreinander sowohl durch das auslösende Moment als auch durch den Verlauf und Sektionsbefund unterschieden haben: bei der sogenannten laboratorischen (biochemischen) Form der Endotoxinämie war der Verlauf günstig, bei allen übrigen (Lungenform, Form einer disseminierten intravasculären Koagulopathie, durch antibiotische Therapie hervorgerufener Endotoxinschock, Form des Endotoxinschocks als terminale Erscheinung bei umfangreich Verbrannten, wo die Ursache der gramnegativen Sepsis nicht beseitigt werden kann) war der Verlauf lethal. Man muss die auslösenden Umstände des Endotoxinschocks einschliesslich der bakteriologischen Befunde auf den Flächen vor der Nekrektomie, unter den Hetero- und Homotransplantaten kennen, ebenso wichtig ist die regelmässige bakteriologische Kontrolle des Harnes. Der Limulus-Test ist ein wertvolles diagnostisches Hilfsmittel, technisch und materiell ist er jedoch aufwendig.

RESUMEN

Formas clínicas de endotoxemia en los pacientes con quemaduras extensas

Königová, R., Koníčková, Z.

Desde 1973 dos grupos de pacientes gravemente quemados fueron observados por tests clínicos y por los de laboratorio: por una parte un grupo de pacientes con quemaduras extensas con el promedio de la afección de 30 % donde el cuadro clínico y el de laboratorio señalaban sepsis gram-negativa, pero las hemoculturas eran negativas, por otra parte los pacientes con la extensión de la afección de 15—20 % (profunda), donde los cambios abruptos del cuadro clínico y del de laboratorio alteraron el transcurso esperado. Los tests de laboratorio comprobaron el diagnóstico de endotoxemia mediante el test de Limulus, es decir en trece pacientes, en los cuales clínicamente se podían diferenciar cinco formas distintas que diferían como en la causa provocante tanto en el transcurso y hallazgo de disección: en la dicha forma de laboratorio (bioquímica) de endotoxemia el transcurso fue favorable, en todas las demás (la forma pulmonar, la forma de coagulopatía intravascular diseminada, el choque endotoxino provocado por la aplicación de antibióticos, la forma de choque endotoxino como fenómeno terminal en los pacientes con quemaduras extensas, donde la causa de la sepsis gram-negativa no se puede eliminar) el transcurso fue letal. Es necesario conocer las circunstancias que provocan el choque endotoxino incluso los hallazgos bacteriológicos en las áreas antes de la necrectomía, debajo de los hetero- y autotrasplantes, igualmente necesario es el control bacteriológico regular de la orina. El test de Limulus es un medio diagnóstico de mucho valor pero exigente en cuanto a la técnica y al material.

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SECONDARY DEFORMING OSTEOARTHRISIS OF TEMPOROMANDIBULAR JOINT IN CHILDREN

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Deforming osteoarthritis of temporomandibular joint is usually discovered on the faces of old people. This kind of illness is characterized by primary degenerative affection of the tectorial articular cartilage and is considered to be a result of responsive morphological reaction of the joint on too strong functional burdening [N. A. Rabukhina, 1966, 1974; I. A. Shekhter et al. 1968]. Primary cartilaginous osteoarthritis of temporomandibular joint in adolescents is not described so completely. [Arnaudow, 1962, 1963; Horejš and Miček, 1966; Hofer, 1968; Künzel and Toman, 1974, etc.]

Secondary deforming osteoarthritis is a final anatomic result of different heavy and chronic processes of a joint due to which the cartilaginous elements are more or less affected and ankylosis does not occur [S. A. Reinberg, 1964]. The illness develops in childhood and adolescence that means the period in which skeleton grows.

Diagnosis of secondary deforming osteoarthritis can be determined by the X-ray examination of the joint if following symptoms occur: deformities of articular parts of the bones, appearance of osseous vegetation on their surface and narrowing of articular fissure.

Secondary deforming osteoarthritis affects the movability of the joint.

Classifications of illnesses of temporomandibular joint in children do not mention osteoarthritis. At the same time majority of instructional manuals and monographs dealing with stomatology do not describe it as well [A. I. Yevdokimov and G. A. Vasiliev, 1964; Y. I. Bernardskii, 1972, 1973; G. P. Ioannidis, 1974; A. T. Titova, 1975]. Individual instructional manuals on stomatology describe only general characteristics of this kind of illness [Hofer, 1968; Künzel and Toman, 1974]. Some studies deal with one or several clinical cases only [Straith and Lewis, 1948; Horejš and Miček, 1966; Chalmers and Blair, 1974; Hecker et al., 1975].

Clinics of the department of paediatric stomatology of N. A. Semashko's Moscow Medical Institute of Stomatology carried out a research and treatment of 70 children from the age of 20 months to 17 years who suffered from affected mobility of temporomandibular joint. 66 children were sent to the clinics with diagnosis of ankylosis of temporomandibular joint. Mobility of the joint was preserved to a certain different degree in 28 children of this sample. Our present work concentrates on the analysis of information dealing with 52 children who were not operated on before coming to the clinics.

The common clinical symptom of these children was a slow reduction of mandibular mobility deteriorating every year. Following changes emerged in all 52 cases during roentgenologic research: different changes of affection of articular capitulum, shortening and deformities of articular process, changes in the outer contours of mandibular bone on the side of affected joint linked with underdevelopment of jaw-bone. Irrespectively of the age, the length of articular process was shorter than the coronoid process (Fig. 1, 2). By shortening of the process jaw-bone was moved up and the contours of mandibular notch got to the same level as zygomatic bone or higher.

Shortening of the process could develop due to the affection of articular capitulum or articular capitulum and upper parts of articular process. Besides the shortening, deformity of the process appeared as a result of osseous production on the side of mandibular notch and to a smaller extent on the back side of the ramus.

On the basis of further clinical and roentgenologic research of the sick, examined children were divided into 2 independent groups.

First group was represented by patients with complete loss of articular function, with X-ray photograph of genuine osseous ankylosis, that means: partial or complete loss of articular fissure between articular surfaces, loss of subchondral lamella of bone, transition of osseous structure of the articular process into the temporal bone (Fig. 1).

Oseous ankylosis was discovered in 11 cases, 8 cases at the age of 2 years 2 months to 4 years and 3 cases at the age of 9 to 15 years.



Fig. 1. — Genuine osseous ankylosis of temporomandibular joint after birth injury. Child A., 2 years 6 months, affection of the right joint. Complete immobility of the jaw-bone developed at the end of first year



Fig. 2. — Secondary deforming osteoarthritis of temporomandibular joint

Fig. 2 a) a fragment of orthopantomogram of child K., 6 years, affection of 2 joints after injury at the age of 8 months. Mouth can be opened at 0.5 cm



Fig. 2 b) roentgenogram of patient C., 13 years, affection of the right joint after otitis media suppurative and mastoiditis. Illness started at the age of 1 year. Mouth can be opened at 0.5 cm



Fig. 2 c) roentgenogram of patient O., 2 years 10 months, affection of the left joint after haematogenous osteomyelitis of a newly born child. Mouth can be opened at 1.3 cm



Fig. d) roentgenogram of patient T., 5 years, affection of the left joint after haematogenous osteomyelitis of a newly born child. Mouth can be opened at 1.0 cm

3 children suffered from ankylosis caused by birth injury of the joint, 3 cases resulted from the fracture of both articular processes at the age older than 3 years, 4 cases by haematogenic osteomyelitis of newly born children, 1 case caused by otitis media suppurative.

Second group was represented by 41 patients. X-ray photograph of this group did not show any osseous growing together of articular surfaces. In 32 subjects the mandible preserved its capacity to move vertically. This enabled mandible a certain degree of lowering from maxilla [0,3—3,0 cm between central incisors]. 9 cases suffered from total immobility the jaw-bone.

In 23 children the illness was caused by articular injury (in 12 cases birth injury), in 9 cases — haematogenic osteomyelitis of articular process, in 6 cases — otitis media suppurative and mastoiditis. In 3 cases the cause of illness was not determined.

To diagnose the articular illness of this group appeared to be difficult.

Roentgenograms of all children from the second group showed heavy osseous affection of the articular process: loss of articular capitulum and deformity of articular process.

For a long time we considered the clinical-roentgenologic photograph of illness in this group of children to be incomplete osseous ankylosis (N. N. Kasparova, 1970, 1971) due to often use of roentgenogram of mandible in lateral projection when diagnosing temporomandibular ankylosis. Diagnosing of illness was carried out on the basis of strong osseous changes of destructive and productive character revealed in articular process which enabled to determine osseous pathological process. X-ray photograph of sick children with mobile mandible did not correspond to the general understanding of fibrous ankylosis. Unevenness of light, in some places interrupted fissure located between particular surfaces, led us to a suggestion that surfaces are partially grown together and reducing mobility of the joint. At the same time we admitted when mandible moved down that there was possibility of mechanical bow of small young and fine osseous structures which allowed to perform vertical moves.

Further study of roentgenograms from various angles and by various methods contributed to finding out fundamentally new results.

Tomograms of the joint, orthopantomograms and cinemaroentgenograms proved in the second group of children the articular fissure was preserved, located between the bone of shortened and deformed articular process and osseous boundaries of cranial basis but unevenly narrowed. We carried out the research of articular fossa. This fact forced us to give up the diagnosis determining osseous ankylosis of the joint.

In 6 children under examination before being operated on during the period of 1—1½ year, we succeeded in tracing the increase of the volume of osteogenesis of a sick articular process by roentgenology. A newly created bone filled articular fossa and was gradually taking articular tubercle in, thus more and more reducing mobility of the mandible. Due to functional burdening the

relief of temporal bone started to change: articular fossa became less deep, articular tubercle flattened. Long time illness caused that the boundary of temporal bone in certain parts had the same form as the contours of articular process crippled by illness (Fig. 2, d, e). In some cases the articular surfaces flattened to such a degree in which articular fissure nearly took a form of a direct line (Fig. 2, e).



Fig. 2, e) roentgenogram of patient F., 12 years, affection of the left joint after fracture of the articular process, diagnosis determined when 3 years old after falling down.
Complete immobility of the mandible

Existence of 2 most important symptoms of the illness — entire, uneven, narrowed articular fissure and the change in form of osseous articular elements — was a reason for including illness of the children into the group of osteoarthrosis.

In all children with clear cause of illness, osteoarthrosis developed secondarily after heavy osteoarthritis had been caused by a heavy injury of the joint or after heavy osteomyelitis of articular elements. That is why we consider the illness a secondary deforming osteoarthrosis.

Detachment of secondary deforming osteoarthrosis of temporomandibular joint at the clinics for illnesses of articular parts in children's bones and the effort to reveal their causes of further development will enable us to study the process of illness in more detail and to elaborate the prevention from states causing immovability of the jaw-bone.

It is necessary to differentiate secondary deforming osteoarthrosis of children with immobile jaw-bone from osseous ankylosis and cases with preserved mobility of the joint from fibrous ankylosis and from adolescent deforming osteoarthrosis.

Strong osseous deformities of articular surfaces do not appear in case of fibrous ankylosis, contours of articular ends of bones are preserved. S. A. Reinberg [1964] wrote that a roentgenologist cannot help a clinician to

distinguish fibrous ankylosis and contracture thus emphasizing "roentgeno-negative" form of illness.

Adolescent deforming osteoarthritis is considered primarily a cartilaginous form of articular illness, the beginning of which corresponds with the period of intensive growth changes of supportive and locomotor system [girls at the age of 11—16, boys — 14—18]. Due to this illness the length of articular process does not change, the contours of capitulum and neck are clearly visible in X-ray photograph of the articular process. Osseous changes are characterized by defects of the boundaries of subchondral lamella of bone, by appearance of centre of subchondral resorption and sclerosis of the bone [resulted from chronic osteoarthritis], by flattening of upper parts of capitulum by the rise of small parts of hyperstosis on the surface of capitulum, by uneven narrowing of articular fissure on the account of degenerative changes of articular cartilage. Osseous boundaries of articular fossa and tubercle can be levelled. From clinical and roentgenologic point of view mouth being open the articular capitulum is in the position of usual subluxation or luxation.

L. B.

SUMMARY

Secondary deforming osteoarthritis of temporomandibular joint usually remains hidden behind the diagnosis of ankylosis in majority of children. Roentgenologic research of 52 children suffering from the illness of temporomandibular joint enabled us to form independent groups representing 2 illnesses: genuine osseous ankylosis with a typical growing together of articular process and temporal bone (11 cases) and secondary deforming osteoarthritis of temporomandibular joint (41 cases). Diagnosing of secondary deforming osteoarthritis is based on 2 symptoms: preservation of incessant light fissure between articular surfaces and deformity of articular process on the account of osteogenesis.

Majority of children [32] suffering from secondary deforming osteoarthritis were able to move the jaw-bone vertically to a certain different degree [from 3 to 0.3 cm between central incisors] with mouth being open.

Further study of clinical roentgenologic photograph of secondary deforming osteoarthritis of temporomandibular joint will give us a opportunity to work out the prevention system from the states which can cause immobility of mandible.

RÉSUMÉ

Ostéoarthrose secondaire déformante de l'articulation temporale inférieure maxillaire chez les enfants

Kasparova, N. N., Yevdokimova, V. M.

Sous le diagnostic de l'ankylose, on trouve chez la plupart des enfants malades une ostéoarthrose déformante secondaire de l'articulation temporale inférieure maxillaire qui n'était pas diagnostiquée. La recherche radiologique de 52 enfants souffrant de la maladie de cette articulation nous a rendu possible de diviser les maladies en

deux groupes indépendants: la véritable ankylose osseuse qui est caractérisée par des synostoses du l'apophyse articulaire avec l'os temporal [11 malades] et l'ostéoarthrose déformante secondaire de l'articulation temporale inférieure maxillaire [41 malades]. Le diagnostic de l'ostéoarthrose déformante secondaire est établi à la base de deux symptômes radiologiques: c'est la conservation d'une fente claire ininterrompue entre les surfaces articulaires et puis la déformation de l'apophyse articulaire qui se fait au détriment de la création des os.

La plupart des enfants [32] avec une ostéoarthrose déformante secondaire étaient capables de faire les mouvements verticaux du maxillaire dans une mesure différente (de 3 à 0,3 cm entre les incisives médiales à bouche ouverte).

La recherche ultérieure des images clinique et radiologique de l'ostéoarthrose déformante secondaire de l'articulation temporale inférieure maxillaire facilite une élaboration détaillée de la prévention des états qui peuvent aboutir à l'immobilité du maxillaire inférieur.

ZUSAMMENFASSUNG

Sekundäre deformierende Osteoarthrose des Temporomandibulargelenks bei Kindern

Kasparova, N. N., Jevdokimova, V. M.

Unter der Diagnose der Ankylose bleibt bei den meisten Kindern die sekundäre, deformierende Osteoarthrose des Temporomandibulargelenks unerkannt. Röntgenologische Untersuchung von 52 Kindern mit Erkrankung dieses Gelenks ermöglichte es uns, zwei Erkrankungen in selbständige Gruppen einzuteilen: echte Knochenankylose, für die die Synostosen der Knochenfortsätze mit dem Schlafbein [11 Kranke] charakteristisch sind, und sekundäre deformierende Osteoarthrose des Temporomandibulargelenks [41 Kranke]. Die Diagnose der sekundären deformierenden Osteoarthrose bestimmt man auf der Grundlage von zwei röntgenologischen Zeichen: Bestehen der ununterbrochenen hellen Spalte zwischen den Gelenksoberflächen und Deformation des Gelenksfortsatzes auf Kosten der offenbarten Knochenbildung.

Die Mehrzahl der Kinder [32] mit der sekundären deformierenden Osteoarthrose war fähig, vertikale Kieferbewegungen in verschiedenem Ausmass (von 3 bis 0,3 cm zwischen den mittleren Schneidezähnen mit offenem Mund) durchzuführen.

Weitere Untersuchung des klinischen und röntgenologischen Bildes der sekundären deformierenden Osteoarthrose des Temporomandibulargelenks wird uns ermöglichen die Prophylaxe von Zuständen zu erarbeiten, die zur Immobilität des Unterkiefers führen können.

RESUMEN

Osteoartrosis deformante secundaria del artículo mandibular inferior temporal en los niños

Kasparova, N. N., Jevdokimova, V. M.

En la mayoría de los niños bajo la diagnosis de anquilosis queda no diagnosticada la osteoartrosis deformante secundaria del artículo mandibular inferior temporal. Una investigación radiográfica de 52 niños que padecían de la enfermedad de este artículo nos facilitó apartar las dos enfermedades en grupos separados, es decir: osteoartrosis verdadera, la cual se caracteriza por osteodesmosis de la apófisis articular con el hueso temporal [11 pacientes] y por osteoporosis deformante secundaria del artículo mandibular inferior temporal [41 pacientes]. La diagnóstico de la osteoporosis

deformante secundaria se hace a base de dos síntomas radiográficos: buena conservación de la fisura clara continua entre las superficies articulares y la deformación de la apófisis articular en detrimento de la manifestada formación ósea.

La mayoría de los niños [32] con osteoartrosis deformante secundaria eran capaces de hacer movimientos verticales del mandibular en vario grado (de 3 a 0,3 cm entre los incisivos centrales con la boca abierta).

Nuevas investigaciones del cuadro clínico y radiográfico de la osteoartrosis deformante secundaria del artículo mandibular inferior temporal nos facilitará elaborar la prevención de las condiciones que puedan conducir a la inmovilidad del mandibular.

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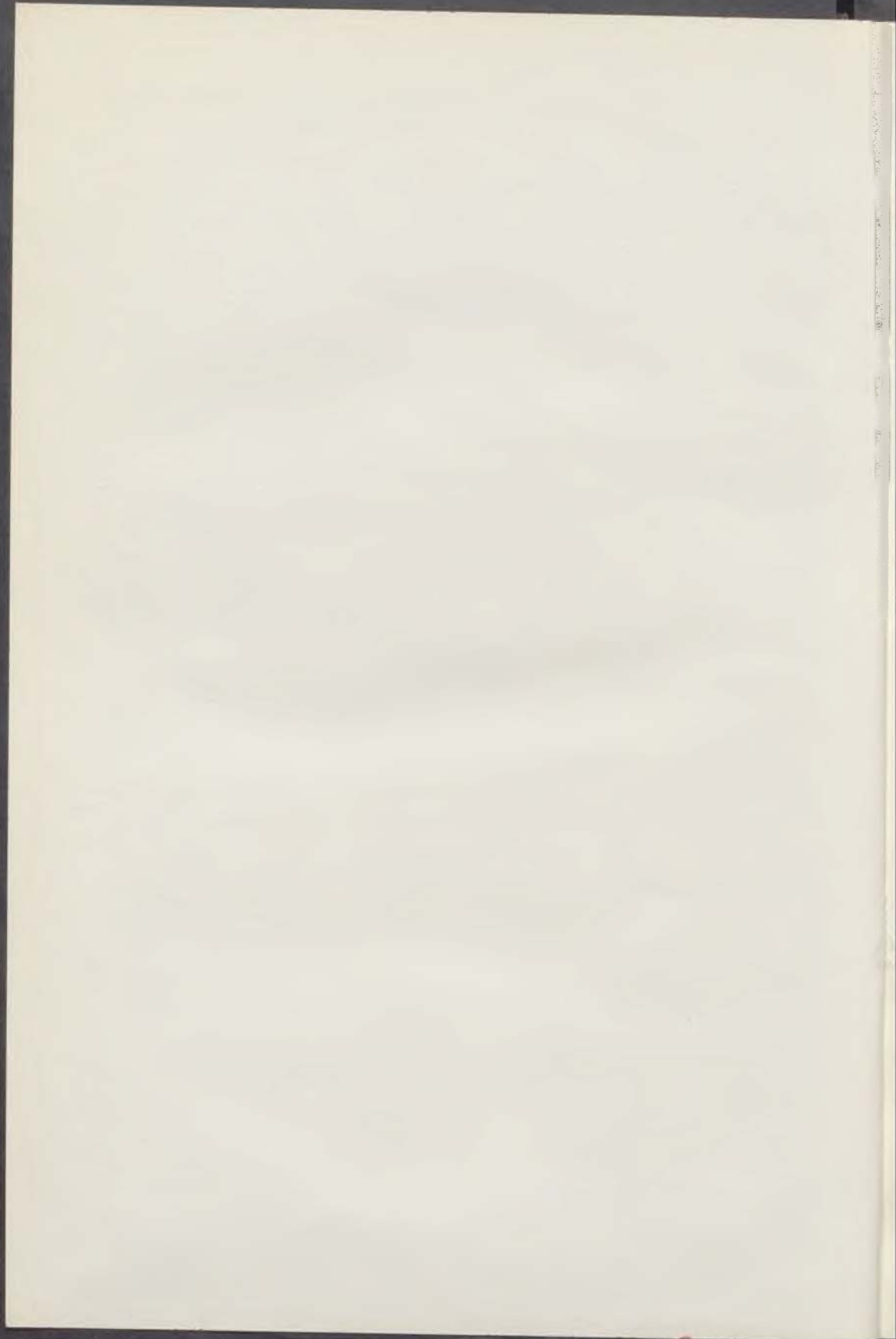
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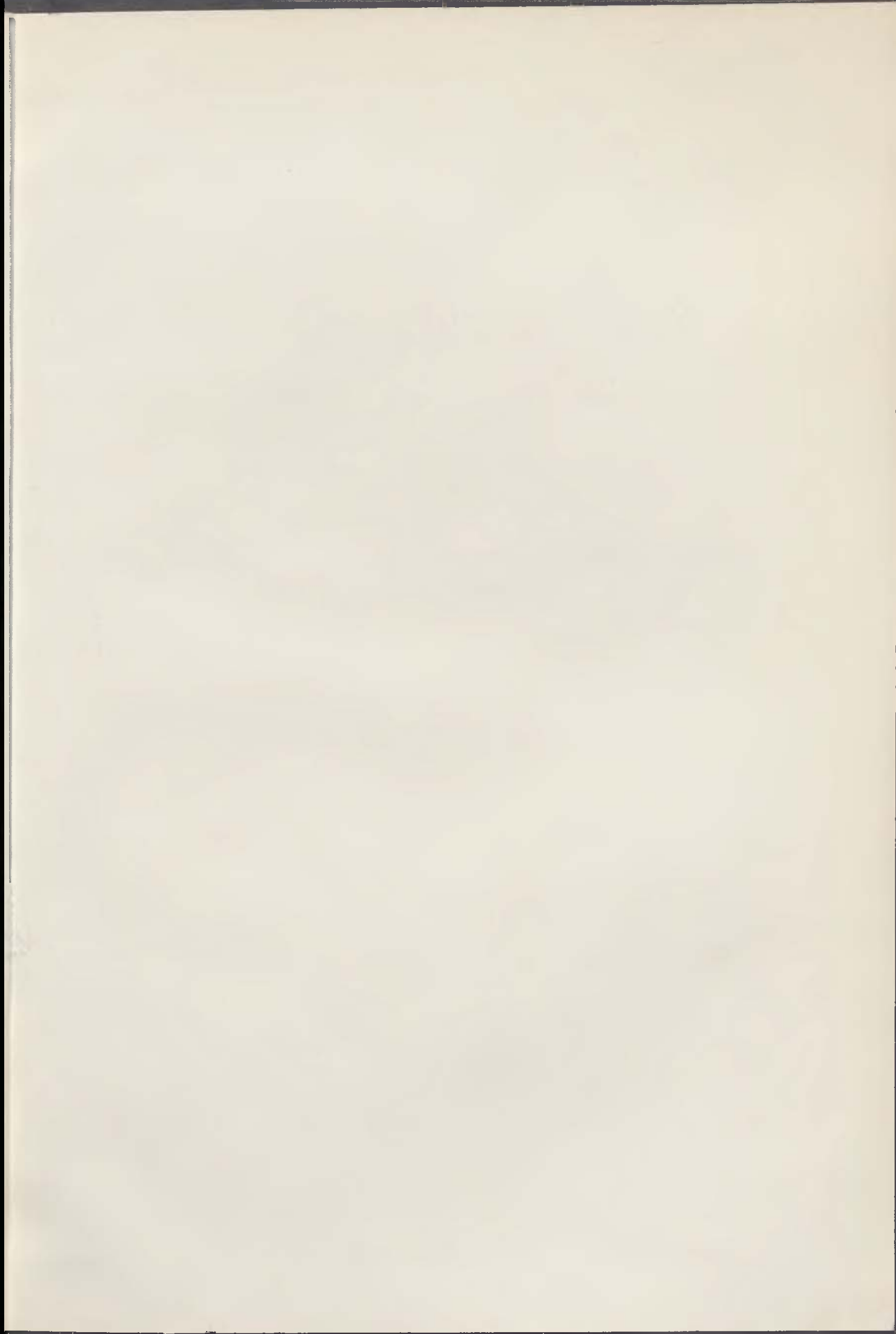
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