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MEDICAL REHABILITATION OF PATIENTS WITH AMPUTATING DEFECTS  
OF LOWER EXTREMITIES IN CONNECTION WITH OBLITERATING DISEASES:

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Abstract

Among the reasons, due to which amputations of limbs are performed, obliterating diseases occupy the second place after traumas. For this reason development of a complex of curative and social measures, which envisage breaking of a vicious pathologic circle of diseases off, making patients healthier, rehabilitation of anatomic limb defects, functional possibilities of an invalid and drawing him into the sphere of active everyday public activities is one of the most important task of health services and social security workers.

On the basis of results of numerous clinical, practical and instrumental methods of examination and treatment of patients with obliterating vascular diseases and ischemic limbs, three main nosologic entities were singled out: endarteritis, obliterating atherosclerosis and diabetic angiopathy.

Proceeding from clinical aspects and the results of objective examinations of 352 patients with amputating defects of lower limbs due to obliterating vascular diseases, structure of vascular pathologies, which led to amputation, character and course of process, arteriographic, rheovasographic changes in affected organ as well as changes of blood rheologic properties and immunologic activity of patients were traced. Doctor's tactics of patient preparation for operative treatment has been worked out, level and method of amputation, peculiarities of postoperative period conduction, early prosthetic fitting, special features of manufacturing and mastering of treatment- and -training prostheses and regular prosthetics have been substantiated. With all the intricacy of prosthetic fitting of amputees of this category they managed to supply with prosthetic appliances and taught walking 80% of patients under observation and in so doing a special attention was devoted to socio-psychological readaptation of invalids because it was an important link in the process of their rehabilitation and resocialization.

Introduction

Obliterating diseases have systemic diffuse progressive character and in spite of substantial successes obtained in conservative as well as surgical treatment often lead to lower extremity amputation at one or another level.

Such a wide range ( from 2,3% to 90% ) of amputations performed according to the literary data is indicative of a quite different approach of sur-

geons to the appraisal of indication for amputation of an extremity as a consequence of vascular diseases. And high percentage (30-60%) of stump reamputation points to the fact that not only indications for amputation were given irregular and careless substantiation, but the level of carrying it out was selected incorrectly as well.

While working the indications for extremity amputations through, we resorted to rigorously individual approach in each separate case, taking into consideration results of a combined examination of a patient, carried out by the use of clinical as well as special examination methods. In so doing general condition of a patient, character and spread of a necrotic process, extremity blood circulation condition, age, presence of secondary infection, severity of concomitant disease and its type were taken into account.

The following was considered by as an indication for extremity amputation: extremity ischemia of the Y-YI degree, i.e. when toes are affected by a necrotic process or when it spreads to foot and shin, addition of secondary infection against the background of an obvious mortification, severe intoxication of a patient with ulceronecrotic changes of an extremity, pronounced pain syndrom with obvious extremity ischemia progress and absence of effect due to the conducted conservative treatment and reconstructive-reconstituent vascular operations.

Since 1976 to 1983 there were 352 patients with amputating extremity defects under our observation in connection with obliteratin diseases. There were 328 men (83,2%) and 24 women (6,8%). 114 patients (33,8%) entered for primary amputation, 238 (66,2%) - for medical treatment and prosthetics purposes.

Patients' distribution in accordance with pathology process was as follows: 158 patients (45,2%) - obliterating atherosclerosis, 150 ( 42,3%) - obliterating endarteritis, 44 (12,5%) - diabetic angiopathy.

263 patients (74,4%) were in the working productive age. Typical is the fact that the overwhelming majority of patients with obliterating atherosclerosis and diabetic angiopathy was more than 50 years old (82,2%), while the age of 96,6% of patients with obliterating endarteritis was under 50.

Attention is drawn to the fact that one third of patients (104 persons) had quick progress in the course of disease. 39 of them (11,1%) lost an extremity during I year, 68 (19,3%) - during I to 3 years.

More malignant clinical course was observed with obliterating endarteritis.

52 (34,6%) of 150 patients lost their extremity during 3 years and 74 (49,3%) during more than 5 years.

With atherosclerotic occlusions of lower extremity blood vessels is observed slower chronic clinical course: during 3 years an extremity was lost by 44 persons (27,8%) only.

An analysis of clinical observation data demonstrated that unjustified long-term conservative medical treatment of patients with occlusion affections of extremity arteries at the necrotic stage led to patient intoxication, development of anemia, joining of secondary infection. A patient weakens, grows "heavy", his state becomes threatening for life and measures from the phase of struggle for an extremity develop into the phase of struggle for a patient's life. In such cases an amputation is made according to viable indications under extremely unfavourable conditions and it often leads to fatal outcome during the near postoperative period.

As the operative treatment, in general, was performed by us in the planned order, all patients obtained preoperative preparation with 8-10 day duration, if a patient's state permitted doing that. Sometimes with growing patient's intoxication, joining of secondary infection and rapidly spreading mortification, duration of preoperative preparation was shortened or amputation was performed in an urgent manner.

The results of performed researches have proven that a very important part in the course of obliterating diseases was played by hemorheology shifts, that microcirculation system changes are closely related with.

Due to increased erythrocyte aggregation blood viscosity raises that more often is the case with atherosclerotic affections.

In order to normalize blood rheology properties we organized a course of intravenous drop infusion of the solutions of polyglucin, rheopolyglucin, hemodeza with interchange. These solutions possess also disintoxication effect, exercise positive effect on the state of blood coagulation system (Weaken coagulative and strengthen fibrinolytic systems), decrease blood viscosity. In an effort to improve microcirculation processes we carried out an intravenous drop infusion of trental.

Ischemic patients of the Y-YI degree demonstrated severe disorders of blood coagulation system. It is quite normal that activation of coagulation mechanisms leads to new thrombi formation and ischemia of an extremity aggravates.

Blood coagulation system values were studied from the data of a coagulogram in the dynamics, that was necessary for selection of anticoagulant therapy as well as for studying of pathology process development. Examinations were performed before an operation and on the 1,5,10-th postoperative days.

On the first postoperative day blood coagulation properties increased even more and anticoagulant activity decreased. By the tenth postoperative day the coagulant and anticoagulant system activity begins to normalize.

In an effort to normalize disturbances of blood coagulant system we used anticoagulants with direct (heparin) as well as indirect effect (pelentan, acetanocoumarol/sintron/, phynilin, dicoumarol, neodicoumarin). Heparin is prescribed with small doses by 5000 U every 4-6 hours during 10-12 days, then indirect anticoagulants are applied.

At the same time we begin with detoxication desensitizing therapy and apply vasodilators, having direct effect on the nonstriated muscles of blood vessels, vitamins, sedatives.

Immunologic activity of patients is investigated before an operation also, because long-term unfavourable conditions of external and internal medium lead to adaptation break-down and allergization of vascular wall with a change of autoimmune reactions of an organism. 97 persons were subjected to immunologic examination, about 800 studies have been performed. The results of studies demonstrated that with obliterating diseases of extremities, immune forces of an organism get involved with pathologic process. Examined patients demonstrated significant shifts to the side of inhibition of specific and nonspecific reactivity of an organism.

For a specific treatment we have used staphylococcal anatoxin in increasing doses from 0,2 to 1,0 ml with the time interval of 2-3 days under control of immunologic status.

The most difficult and responsible task with patients suffering of obliterating affections of extremity arteries is a selection of extremity amputation level. The notion of amputation as a sanative operation became obsolete long ago as non-productive, demobilising and incompatible with the real state of things. At the present moment amputation is considered as a reconstructive-reconstituent operation, resulting in a new organ with new physiologic and functional features, destined to serve a man in all his life.

When selecting amputation level with occlusion affections of extremity vessels a surgeon has one principal task to solve: to select amputation level suitable for prosthetics and with guarantee of primary healing of a postoperative wound. There is a lot of different methods to define an extremity amputation level: according to clinical data, method of arterial hyperemia, method of exploratory incision, according to pulsation of arterial vessels, by definition of systolic blood pressure of an extremity, according to tissue oxygen tension of an extremity skin, according to arteriography data and some other.

When selecting amputation level we, along with the majority of authors, adhered to a combined approach, i.e. kept in mind both clinical data and the results

of special research methods.

When selecting level and method of amputation, preference was given to arteriography and thermography.

Primary healing of postoperative wound depends mainly upon extremity blood circulation. The most complete, reliable and suitable for visual analysis data on the state of blood circulation in an extremity may be obtained with the help of contrast arteriography. We examined 87 persons by this method, among them 39 persons with atherosclerotic affection of vessels, 36 patients with obliterating endarteritis and 12- with diabetic angiopathy.

By means of arteriography a vessel occlusion region and its length, character of vascular wall changes, degree of collateral circulation development and a source of its formation are determined. Studying of angiology examination data resulted in a discovery that occlusion of femoral artery at different levels was noted with 41,3% of patients, popliteal artery - with 9,3% and arteries of shin-with 36,6% of patients. Extremity amputation level was selected in the following way: with occlusion of iliac artery amputation was made at the upper third of the thigh, with the obliteration of femoral artery below the point of ramification of deep artery of the thigh and well developed collateral circulation, amputation was performed depending upon the degree of collateral circulation development. If a well developed collateral network was present at the region of knee joint, then, in spite of occlusion of artery vessel (femoral or popliteal artery) amputation was made at the upper third of shin and primary healing of postoperative wound was achieved. With occlusion of arteries of shin amputation was performed at the shin in correspondence with the level of occlusion and degree of collateral circulation development. Arteriography data were taken into consideration in combination with the results of other examination methods: reovasography, capillaroscopy and capillarography of stump skin, electric resistance thermometry and thermography.

By means of rheovasography we studied localization of an affection, functional state of blood circulation at the investigated portion of an extremity, circulation rate, state of vascular tension and elasticity of vascular wall as well as collateral circulation state.

With ischemia of the IV degree (pregangrenous state) rheogram looks like a low wavy line, while with the V-VI degree (gangrenous state) it appears as a straight line. As to the quantitative values, the primary attention is paid to rheography index. Substantial decrease of rheography index (up to 0,1) indicates abrupt disturbances of circulation. The extent of circulation disturbance may be judged by the skin temperature. With obliterating diseases a substantial drop of skin temperature is noted at the distal portions of an extremity. Temperature difference between thigh and foot can reach 8-10<sup>0</sup>C.

Thermography is a sensitive method of skin temperature investigation. This method, based upon ability to catch infra-red radiation of skin surface, permits to study heat field of a definite region of a body and get a clear pattern of skin temperature distribution on the screen of an infra-red imager. In the process of investigation a heat thermogram of common integument is reproduced on the screen of a television camera of an infra-red imager. Heat areas of a body look light-coloured, cold-dark-coloured. Intensity of light- and dark-coloured background is connected directly with skin temperature. Patients with obliterating endarteritis have lower heat radiation zones most commonly on feet and shins. Frequently they demonstrate a pattern of abrupt change of bright and dark shades "heat amputation" of an extremity, when satisfactory heat radiation in the area of things (light-coloured shade) is accompanied with saturated dark-coloured background in the area of shin. Transition of heat and cold background of glow with obliterating atherosclerosis is more gradual and thermoassymetry is more often observed. Patients with diabetic angiopathy more often demonstrate symmetrical extinction of glow in the area of feet during thermography investigation. Skin temperature investigation methods are used by us in combination with other methods in order to define an extremity amputation level. Based on investigations it was inferred that temperature difference of 6-8°C between proximal and distal portions of an extremity was an indication of circulatory decompensation, as a result of which amputation had to be performed at the above lying segment. An extremity amputation level should be above a temperature difference line. An important moment in the process of amputation is the method of cutting a skin flap out, on which subsequently depends possibility of rational prosthetics. When performing amputation we used a flap method only, according to which two skin flaps including subcutaneous fat and fascia are cut out. In case of amputation at the level of thigh two flaps of equal length are cut out: front and rear ones. The peculiarity of skin flap forming in the process of shin amputation consists in cutting out of long rear and short front skin flaps because posterior surface of shin is better supplied with blood. When cutaneous-fascia flaps had been cut out, muscles were dissected layer by layer. A bone was singled out from soft tissues. At the level of supposed saw cut periosteum was sharply incised and with the help of a raspator shifted distally aside, bone was sawn in two and the edge of saw cut rasped. In case of amputation at the level of shin, front edge of sawn tibia at the distance of 1,5-2 cm was made round and then rasped, artery vessels were stitched and tied up. When amputating because of vascular disease, thorough hemostasis plays an important part in the sense that formation of hematoma in case of insufficient hemostasis leads to squeezing of soft tissues and aggravating of their ischemic state. Nerve trunks

are thoroughly singled out from soft tissues. Perineurium of large nerve trunks was injected with 2-3 ml of 1-2% of novocain solution with streptomycin, then stitched and tied up together with the supply vessels. Nerve was sharply cut off. Then the posterior group of muscles was cut off. Antagonistic muscles were sutured over the saw cut under slight tension. In case of shin amputation uniaxial and ischemic muscles were dissected up to the level of the saw cut. Muscular-fascial flap of musculus gastrocnemius was fixed to periosteum along the front edge of saw cut of tibia and to the anterior group of muscles. Amputation was performed without application of rope. After myoplasty and angioplasty of a saw cut, subcutaneous fat was stitched with sparse catgut sutures and nodosal silk suture was put on the skin; rubber emissaries were set for 24-48 hours. Fixation was performed with the help of a posterior plaster splint with extension in a knee joint in case of shin amputation up to  $175^{\circ}$ .

By the end of an operation loss of blood was compensated.

The success of an operative treatment of patients with obliterating diseases depends mainly upon the methods of conducting of the postoperative period. Application of heparin was continued in order to prevent thromboembolic complications with application of indirect anticoagulants later on. For prevention of congestion pneumonia patients immediately after an operation were prescribed respiratory gymnastics, cups and mustard plasters. Vasodilative detoxicative desensitizing sedative vitamin therapy was continued with.

Great importance was attached to thorough care of postoperative wound. On the second postoperative day U.H.F. was prescribed for a distal portion of a stump, sutures are removed on the thirteenth-fifteenth postoperative day.

In the process of treatment of our patients we employed a method of active conduction of postoperative period with utilization of remedial gymnastics from the very first hour. Exercises were selected individually with gradual increase of loading. Great importance was attached to phantom-impulsive gymnastics that was began with on the second or third postoperative day.

Psychogenic gymnastics creates conditions for improvement of circulation in a stump, contributes to decrease of postoperative edema of a stump, increases muscular tension of remaining muscles of a stump, prevents formation of contractures, improves collateral circulation. Beginning the third or fourth day, if a patient's state permitted for, and circulation in the second extremity was compensated, patients were set on crutches. Active conduction of postoperative period and early raise of patients are reliable guarantees to prevent postoperative complications.

We have performed 121 amputations due to obliterating diseases of extremity vessels. 72 (59,5%) of them were amputations at the level of shin and 49 (40,5%) - at the level of thigh. An analysis of operative treatment results demonstrated that in case of amputations at the level of shin 80,6% of them healed with the first intention, 12,5% - with the second intention and 6,9% didn't heal at all. With amputation at the level of thigh 87,1% of them healed with the first intention, 8,1% - with the second intention and in 2 cases of amputation (i.e. 4,8%) there was no healing at all.

As it is known, obliterating diseases of extremity vessels do not bear an isolated character. As a rule, the whole vascular system of a man is affected. Thus becomes comprehensible such a high percent of concomitant pathology with patients of this category. We revealed concomitant diseases with 60,2 % of patients. The most frequent concomitant diseases were as follows: ischemic disease of heart, hypertensive disease, myocardial infarction in the medical history of a patient, neurasthenic syndrome. Affection of a patient with 2-3 concomitant diseases is a characteristic feature. It considerably complicates the rehabilitation process of patients of this profile.

Amputation resulted in qualitatively new organ-stump, which would fulfil the lost extremity functions. Upon our prosthetic skill depends future social and professional rehabilitation of a patient.

Preparation of a patient for prosthetic fitting begins from the moment of amputation when a surgeon creates a stump with consideration for further rational prosthetics.

It is known, that a stump is not adapted to bear load during the nearest time after amputation and is in need of a special preparation. In order to liquidate congestion effects in a stump after amputation is applied a whole complex of physiotherapeutic measures: massage, therapeutic physical training, thermal and electric procedures. One of the main stump forming appliances are provisional or treatment-and-training prostheses by means of which a stump edema is quickly liquidated, its dimensions are stabilized, stump muscles are strengthened, contractures in the joints are developed and a correct walking stereotype is finally worked out. The terms of a stump formation of patients with vascular pathology are much longer than of patients amputated due to trauma, therefore the terms of use of treatment-and-training prostheses are lengthened. Provisional and treatment-and-training prostheses are made of the same standard semifinished items which are used for regular prosthetics as well. Provisional is their reception socket only, which is changed as the stump strophy proceeds.

Treatment-and-training prosthesis reception socket is made of plaster. The



principal task when making a treatment-and-training prosthesis reception socket is thorough modelling of mounting seats and bony prominences. Taking into consideration, that stumps with vascular pathology remain painful for lengthy periods of time and are easily traumatized, an inner surface of a sleeve was "softened" with a layer of expanded polyurethane (5-10MM). When a stump form permitted to select a standard reception socket, made of laminated plastic, it was used for a treatment-and-training prosthesis of thigh.

Walk mastering with treatment-and-training prostheses was organized according to generally accepted methods but with strict limitation of duration and with control of both a patient's state and stump skin condition.

Walk mastering with treatment-and-training prosthesis of shin and shin stump formation continued for 1,5 -2 months, with thigh defects-up to 3 months and with bilateral amputations-4-6 months.

After successful mastering of walk habits with treatment-and-training prosthesis and stabilization of stump perimeter regular prosthetic fitting was performed.

Regular prosthetic fitting peculiarities with obliterating diseases depended upon an amputation level, character of postoperative wound healing, function of above lying joints, circulation state in the second extremity, age and general state of a patient.

For a shin stump was prescribed a prostheses-semiextremity with rigid total contact reception socket of laminated plastic or reinforced polyethylene as well as prostheses stamped of metal with subsequent plastic material spraying. For a shin stumps at the upper third a prosthesis with deep fit and seizure of a kneecup was made. In order to cushion a fit and absorb shocks at walk a prosthesis was supplied with inserts of foamed polyethylene or leather. In case of short painful shin stumps (less than 10 cm) a prosthesis of laminated plastic with sleeve on thigh with openings and a rest at tuber of the ischium was manufactured in addition, that allowed to reduce loading of stump tissues. A shin socket in this case was made suspended and mobile. Sockets, in case of individual intolerance of plastic material, were made of leather. All patients with unilateral or bilateral shin amputations were supplied with good prosthetic appliances and used them satisfactorily.

Patients with thigh stumps were supplied with light-weight prostheses, assembled of the unified units. Standard sockets made of polyamid varnish were generally used as thigh reception sockets. In a number of cases sockets were manufactured individually according to plaster negative. For prevention of congestive effects

in a stump an inserted bearing element was used. With long thigh stumps (according to Collender, Gritty-Schimanovsky) a prosthesis with cover splints was prescribed.

The most difficult group comprised patients with bilateral thigh amputation. With this pathology light-weight prostheses, made shorter by 10-12 cm with a lock in a knee hinge on the side of less functional stump were prescribed in order to increase stability and equilibrium. Stout elderly patients with bilateral amputation were prescribed with prostheses - supports.

Thus, with all the intricacy of prosthetic fitting of patients with limb defects due to vascular diseases we managed to supply with prosthetic appliances and taught walking 80% of patients. But the problem of patient rehabilitation in the broad sense is not solved by their mastering of walk and self-service habits. Rehabilitation of these invalids presents particular difficulties.

High emotional tension due to realization of a disease, constant danger to lose the second extremity, loss of the place in a body of workers, everyday difficulties bring about astheno-neurotic state of these patients.

Because of this, a great deal of work in the rehabilitation system of invalids with amputating defects of lower extremities should be dedicated to the problem of socio-psychologic readaptation. Rehabilitation of these patients is a process of resocialization of them, i.e. restoration not only personal, but social status of a patient as well.