THE ROLE OF ISOLATED PROFUNDAPLASTY IN ATTEMPTS TO LOWER THE LEVEL OF AMPUTATION IN CRITICAL LIMB ISCHEMIA

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The aim of the study was to verify the usefulness of isolated profundaplasty performed prior to amputation in attempts to salvage the knee joint in patients scheduled for the major amputation due to critical limb ischemia.

Material and methods. The study enrolled 46 patients treated between January 1992 and December 2005 due to critical limb ischemia who were primarily scheduled for major amputation. Arteriography performed in all studied patients disqualified these patients from attempts to reconstruct the lower leg arteries, but simultaneously provided information on possibilities for profunda repair. A few days prior to below-knee amputation, a profundaplasty was performed. The following parameters were evaluated: the course of wound healing in the groin and tibial stump, the rate of conversion of the transtibial amputation to an above-knee amputation and patency of the deep femoral artery 12 months postoperatively.

Results. One patient died within the first 30 postoperative days. Complications of wound healing in the groin requiring surgical debridement occurred in 7 patients. Early conversion to above-knee amputation was necessary in 10 cases due to lack of stump healing; this group included 6 patients with infected pedal tissue necrosis and 4 patients with reocclusion of the deep femoral artery. The cumulative proportion of survivors at 12 months with a preserved knee joint was 0.50, and that of those with a patent deep femoral artery was 0.47. No significant differences were found between profundaplasty methods regarding patency of the deep femoral artery and tibial stump healing. Similarly, no significant differences were found between diabetic and non-diabetic patients. It has been found that infection of pedal tissue necrosis had a significant negative influence on the patency of the deep femoral artery following the profundaplasty (p=0.02) and resulted in lower rates of salvage of the knee joint (p=0.0002)

Conclusions. 1. In the case when other methods of vascular reconstruction are no longer possible, an isolated profundoplasty performed prior to below-knee amputation creates a chance for stump healing and salvage of the knee joint for the patients with critical limb ischemia who have no infection within the foot. 2. Pedal tissue infection in the same group of patients should constitute an indication for primary above-knee amputation.

Key words: critical limb ischemia, profundaplasty, above-knee amputation

In the extreme cases of critical limb ischemia (CLI) when arterial reconstruction is no longer an option and the structure and function of the foot are inevitably destroyed with a life-threatening infection, the management of choice is a major amputation. In such cases, the treatment priority is to choose the lowest possible level of amputation that provides healing of the stump and allows preservation of the function of knee
Poor healing of the lower leg stump in patients with arteriosclerosis obliterans is a problem that still awaits solution. Only approximately 55% of these stumps heal within the first 100 days, and the rate of conversion to above-knee amputation is 9-25% (2, 4-7). The reports published some 30 years ago had recommended profundaplasty (PF) as a procedure that allowed preservation of the knee joint in some of the patients (8, 9, 10). The issue of reconstruction of the flow through the collateral network of the knee in the situation of inevitable amputation was neglected.

The aim of this study is to verify the use of isolated inflow profundaplasty preceding amputation in attempts to preserve the knee joint.

MATERIAL AND METHODS

A retrospective study enrolled 46 consecutive patients treated in the Department of Vascular and General Surgery and Angiology, Pomeranian Medical University, Szczecin, between January 1992 and December 2005. Pedal necrosis due to arteriosclerosis obliterans necessitated hospitalization and constituted the indication for the primary major amputation. Arteriography was performed in all patients; however, the results of the study excluded attempts at reconstruction of the lower leg arteries and simultaneously indicated the possibility of endarterectomizing the deep femoral artery (good inflow, 1/3 of the proximal part of the profunda artery stenosed >50%, visible collateral arteries, and occluded superficial femoral and popliteal artery). None of the patients underwent previous surgery or endovascular procedures.

The studied group enrolled 32 males and 14 females aged 58-83 years (mean 65 years). Coronary artery disease coexisted in 45% of patients, arterial hypertension in 37%, approximately 10% of patients previously experienced a stroke, 13% suffered from chronic respiratory tract diseases, 7% had renal insufficiency and 14 patients (30%) had diabetes. Necrosis associated with infection confirmed by microbiological studies was found in 14 patients, including 7 diabetic patients. Profundaplasty was performed 2-8 days (mean, 5 days) prior to the scheduled below-knee amputation; The Waibel method (a flap from the endarterectomized superficial femoral artery) was used in 17 patients; in 17 patients, a venous patch was used (saphenous vein), and in 12 patients a PTFE patch was used. The period between PF and amputation differed primarily due to organization issues. Two patients with the longest waiting time felt subjective improvement for a few days. The Ghormley method was applied to perform the lower leg amputation (long posterior musculocutaneous flap). The following parameters were evaluated: the course of healing of the postoperative wound in the groin and the stump, the rate of conversion from below-knee amputation to above-knee amputation, and patency of the common and deep femoral arteries over 12 months. The survival analysis included the Kaplan-Meier method, and the statistical evaluation was performed using the log-rank test and Cox proportional hazard model with application of STATISTICA 7.1 (StatSoft, Inc.) software. The differences were statistically significant at p<0.05.

RESULTS

One female patient died within 30 days following the profundaplasty and below-knee amputation, and the direct cause of death was a duodenal hemorrhage. Wounds in the groin healed by first intention in 39 patients; in 7 patients the wound healing was prolonged due to the marginal necrosis and subsequently required surgical debridement. The wound was infected in one case, and this patient required prolonged antibiotic therapy. Complications in wound healing developed in 3 cases with a patent profunda artery, and in 4 cases with a reoccluded artery. After profundaplasty, we didn’t observe an objective improvement of blood supply within the lower leg and foot. In 10 cases, the lack of progress in stump healing necessitated early conversion to above-knee amputation, including 6 patients with infected pedal necrosis and 4 with early reocclusion of the common and deep femoral arteries. The cumulative proportion of patients who survived 12 months with the salvaged knee joint was 0.50, and with the patent deep femoral artery this was 0.47. No significant influence of the profundaplasty method on these parameters was found (fig. 1). Similarly, no significant differences were found between the diabetic and non-diabetic patients (p=0.43 related to profunda patency, and p=0.55 related to knee joint salvage).
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The comparison of patients with and without features of infected pedal necrosis revealed that infection had a significant negative influence on patency of the deep femoral artery following profundaplasty ($p=0.02$) (fig. 2) and on the salvage and function of the knee joint ($p=0.0002$) (fig. 3). The risk of the thrombosis in the endarterectomised artery was 3.5 times higher, and the risk of conversion to the higher level of amputation, i.e. above-knee amputation, was 6.3 times higher in cases complicated by infection.

DISCUSSION

The diagnosis of critical limb ischemia is associated with poor prognosis for both limb salvage and patient survival. CLI affects elderly people who also suffer from other cardiovascular disorders (1, 11). In cases where effective revascularization of the endangered limb failed or is no longer possible, the rate of above-knee amputations performed within the year exceeds 40%, and the risk of death approximates 20% (1, 11, 12).

In cases of above-knee amputations, only 62-78% patients survive the first year (4, 6). Revascularization is the optimal management for CLI; however, major amputations comprise the core treatment in many patients from this group. Many arguments advocate attempts for amputations with salvage of the knee joint. Perioperative mortality following transtibial amputations is two-fold lower than in that following transfemoral amputations, and the 5-year-survival rates are 37% and 22%, respectively (1, 5, 6). The lower leg prostheses are more comfortable, safer, and walking requires less energy expenditure, allowing for a relatively early rehabilitation (2, 3). The ability to ambulate and use of prostheses is 2-3 times more frequent in below-knee amputations than in above-knee amputations (13). These optimistic data have not been confirmed by other authors. According to Nehler, only 32% of patients used prostheses after the below-knee amputations, compared to 42% of patients using prosthetic appliances after the above-knee amputations; however, only 49% of patients were ambulatory, and that rate was similar to that of above-knee amputees (4).

The latter observation is concordant with our data, since in our series, only four patients had used prostheses after below-knee amputations. More local complications are seen in below-knee amputations than in cases of higher level amputations (2, 4-7, 14). The influence of primary reconstructive arterial operations on healing of the tibial stump is a matter of di-

![Fig. 1. Cumulative profundaplasty patency of groups related to the operative techniques (PP-PTFE patch angioplasty, PW – angioplasty m. Waibel, PŻ – vein patch angioplasty)](image1)

![Fig. 2. Cumulative profundaplasty patency of infected and uninfected foot necrosis groups](image2)

![Fig. 3. Cumulative knee joint salvage of infected and uninfected foot necrosis groups](image3)
Discussion. According to some authors, the chances for healing after below-knee amputations are higher in primary amputations than after failed revascularization (3,15); however, according to other authors, these chances are equal (16). An increase in lower extremity blood flow in the deep femoral artery and collateral popliteal network is one of the methods that could augment stump healing and salvage of the function of the knee joint (8, 9, 10).

Isolated profundaplasty was previously considered as almost an alternative method of revascularization in lower extremities in cases of occluded femoro-popliteal segment. Currently, the contribution of profundaplasty to the treatment of critical limb ischemia is markedly diminished, because of the increased use of femorodistal bypass surgery (17, 18). Improvement is possible in the selected group of patients with less severe ischemia if precise criteria of patient qualification for profundaplasty based on segmental pressure measurements and arteriographic studies are followed (9, 10, 19-22). In the treatment of CLI, profundaplasty allows for only unsatisfactory rates of ulcer healing and relief of other pain (17, 19, 23).

In our research, we attempted to evaluate the usefulness of isolated profundaplasty in a selected, small group of patients who did not qualify for any effective arterial reconstruction surgery except for the deep femoral artery; moreover, pedal tissue necrosis was an indication for the major amputation. As expected, profundaplasty turned out to be a safe procedure, with only low rates of local complications. The method of profundaplasty did not influence early or late patency of the deep artery; this observation was concordant with other authors’ findings (22, 24-27). We did not confirm the adverse influence of diabetes on patency of the deep femoral artery and number of conversions to above-knee amputations. In the early postoperative period, there were 22% conversions of the amputations; these results were similar to those of other authors’ data (2, 4-7). The percentage of conversions was evidently lower in patients without any infections within the foot (12%) than in patients with infected pedal tissue necrosis (43%). The latter results also indicated that the chances for salvage of the knee joint significantly decreased in patients with infected foot necrosis. Regarding this latter observation, it seems that the decision for primary above-knee amputation in this group of patients is fully justified.

CONCLUSIONS

1. In the case when other methods of vascular reconstruction are no longer possible, an isolated profundaplasty performed prior to below-knee amputation creates a chance for stump healing and salvage of the knee joint for patients with critical limb ischemia and no infection within the foot.

2. Pedal tissue infection in the same group of patients should constitute an indication for primary above-knee amputation.

REFERENCES

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COMMENTARY

The number of studies on amputations of ischemic limbs is insignificant compared to abundance of papers on revascularisations and lately about endovascular treatment. This unpopular subject is important as it concerns each year several thousand people in Poland. Undertaking the problem of ischemic limb amputations alone deserves appreciation while the mature study presented by the Authors merits full recognition.

I shall now present two general remarks before proceeding to commentary proper. Outstanding surgeon and expert on vascular surgery, Professor Stanislaw Zapalski, during a discussion at one of the congresses where the reasons for failure of ischemic limb amputations were a major concern, expressed the view that apart from the commonly quoted reasons, we tend to forget about two which are not insignificant. Firstly, amputations are performed at the end of the whole operation schedule and, as a rule, they are carried out by the youngest, least experienced surgeons. These data are not quoted even in the most detailed reports on amputations. The second remark concerns the problem of terminology. In Prof Stanislaw Zapalski’s opinion, the correct term to be used for this operation should be shank amputation while in Malopolska region commonly used term is crural amputation.

In the text there is a striking statement “among our patients, during a one year follow up we found that only 4 patients’ were using crural prostheses” The benefits of a “saved” knee joint are limited, though patients mortality in the perioperative period following amputation of the shanks is twice lower than after thigh amputation while the percentage of survival after 5 years is 37% and 22% respectively.

The second conclusion that infection in the region of the foot should be an indication for
primary amputation has been documented convincingly juxtaposing reamputation rate of 12% in patients without infection and 43% with infection. For these reasons we proposed two-staged crural amputation for such patients (1).

The decision whether amputation should be preceded by an attempt to improve blood flow termed profundoplasty in this paper is extremely difficult when patients with impatent superficial femoral artery, narrowing of > 50% in proximal segment of artery profunda and peripheral insufficiency are involved.

The opinion of the Authors that “in the selected group of patients with less advanced ischemia it is possible to achieve improvement” which corresponds with the first conclusion that isolated profundoplasty offers a chance of healing the stump and saving the knee joint, ipso facto, the Authors living in the world overloaded with electronics and computers refer to irreplaceable experience and intuition of the surgeon. Early thrombus of the operated profunda femoris artery with the impatent superficial artery may, as it usually does, lead to serious difficulties with femoral stump healing.

I am inclined to share the opinion of the surgeons who express the view that in some patients the chances of achieving healing of crural (shank ?) stamps are greater after primary operation than after failed revascularisation. But in whom?

In this matter despite the great progress in medical science, it is the experience of the surgeon which determines adopted procedure. The analysed paper presents a thorough description and analysis of the mentioned problems thus inviting the Reader to reach own judgements about true events in our department clinic. It will be of great benefit if the Authors challenge these problems in their consecutive studies.

REFERENCES


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