SURGICAL TECHNIQUES IN THE TREATMENT OF MULTILEVEL ARTERIAL OCCLUSIVE DISEASE

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SURGICAL TECHNIQUES IN THE TREATMENT OF MULTILEVEL PERIPHERAL ARTERIAL OCCLUSIVE DISEASE (Abstract): Aim of the study was to report the surgical techniques for multilevel arterial lesions of the lower extremities and to evaluate the clinical outcomes. In patients with multilevel arterial disease, the treatment consisting of sequential surgical intervention on the same vascular axis is one of the methods indicated in order to obtain an adequate inflow and outflow. Material and methods: we have performed a non-randomized study during a 44-month period (January 2010 – September 2013) in a number of 58 patients treated by classical revascularization techniques. All the patients included in the study have been post-surgically surveyed at well-established intervals (1, 3, 6, 9, 12, 24 and 36 months) by: clinical examination, laboratory tests, Duplex ultrasound, and, as needed, CT Angiography. Results: the 6 months primary patency in each studied group (corresponding to the years of 2010, 2011 and 2012) was 95%, 93.33%, and 91.3%, respectively; the 12 months primary patency was 85%, 80%, and 82.6%, respectively. Clinical improvement has been noticed in 44 patients (75.86%). There have been registered 14 amputations (24.13% of the cases): 7 majors (thigh and below the knee), representing 12.06% of the total number of cases and 7 minors (toe or transmetatarsal), representing 12.06% of the total number of cases. Limb salvage rate for the patients in stage III and IV Leriche-Fontaine was 85.10%. Conclusions: the surgical techniques are a feasible option for the multilevel arterial disease, with favorable patency and limb salvage rates. Keywords: MULTILEVEL ARTERIAL DISEASE, SURGICAL REvascularization.

Multilevel involvement is typically observed in critical limb ischemia. Surgical interventions are a well-accepted strategy for revascularization in patients with critical limb ischemia due to multilevel arterial occlusive disease (1). A staged approach to multilevel arterial disease was the standard for numerous years, consisting of revascularization of the aorta or iliac artery followed by interval infrainguinal surgery. This approach was a rational strategy at a time when open surgical techniques were only performed in separate settings. Usually, the procedures are performed successively, although individual patient anatomy plays a part in the decision of whether to perform the two procedures simultaneously or not. The aim of the treatment is to obtain an improvement of both the inflow and the outflow.
The optimum treatment of multilevel arterial occlusive disease is often difficult to establish. There is often the need to decide if or when a concomitant or successive outflow procedure must accompany an inflow procedure. The most important decision factor is probably the severity of the distal ischemia. Both an outflow and an inflow procedure are necessary whenever there are large areas of tissue loss associated with the occlusive disease (2, 3).

**MATERIAL AND METHODS**

We have performed a non-randomized study in one center. The data was gathered retrospectively for a 20-month period (January 2010 – September 2011), and prospectively for a 24-month period (September 2011 – September 2013) for a number of 58 patients treated by surgical revascularization techniques at the Vascular Surgery Clinic, “St. Spiridon” Hospital, Iași, Romania.

The including criteria for the patients were: aged 18 and over, multilevel peripheral arterial disease in any of the Leriche-Fontaine stages, with uni- or bilateral pathology, and had an indication of revascularization by open technique (bypass or endarterectomy, with or without angioplasty). The study included 58 patients (female 3.4%, male 96.6%, mean age 62.6 years).

The patients were divided into two groups: 1 – included patients who had the surgical techniques done in one procedure; 2 – included patients treated in two successive procedures.

Peripheral arterial disease was localized at a minimum of two levels on the same vascular axis: aortic, iliac, and inguinal (involving the common, deep femoral artery and the origin of the superficial femoral artery), or infrainguinal (supra- or infra genicular).

All patients were pre-operatively evaluated by physical examination, blood tests, Duplex scan, angiography or CT angiography. Also, the risk factors and associated co morbidities were noted.

Postoperative surveillance at well-established time intervals (1, 3, 6, 9, 12, 24 and 36 months), consisted of: blood tests and Duplex scans, clinical examination (improvement of the claudication distance, amelioration of rest pain, healing of trophic lesions). We evaluated the primary and secondary patency of all procedures, initial technical success, complication rate, morbidity and mortality associated with each technique, amputation-free survival rate, symptomatic improvement, and the risk factors that influenced the postoperative outcome and recovery period.

The statistic analyses were performed in *SPSS, version 15.0* (SPSS Inc., Chicago, IL, USA). A p value of less than 0.005 was considered statistically significant. During the study, the primary and secondary patients were analyzed using the Kaplan-Meier estimator.

**RESULTS**

For the 58 patients included in the study, the open techniques consisted of an autologous or synthetic bypass graft and/or femoral endarterectomy. Twenty-five patients had concomitant revascularization procedures, and 33 had successive procedures (fig. 1).

![Fig. 1. The distribution of cases according to the sequence of revascularization procedures](image-url)
Most patients in the given cohort were in the fourth stage of disease (53.4%). Although we observed a better primary patency for this subgroup of patient, compared with those in the second and third disease stages, the difference wasn’t statistically significant. Inflow procedures followed by outflow procedures were the most often used ones, most of them being successive (58.69%), rather than simultaneous (fig. 2).

Synthetic grafts were used for most inflow procedures, whereas autologous material was the main choice for outflow procedures.

![Fig. 2. Yearly distribution of multilevel occlusive disease surgical repairs](image)

For the studied period of time, we constructed infrainguinal extension grafts for 27 aortobifemoral, 4 aortofemoral, one axilobifemoral and 19 iliofemoral bypasses. Three femoropopliteal bypasses required extension grafts and four common femoral artery endarterectomies required a redo with femoropopliteal bypasses.

The study included 13 graft thrombectomies using Fogarty catheters, 20 proximal anastomosis patch angioplasties and 6 vein Miller cuff angioplasties for distal anastomoses.

Elective procedures were performed for 77.58% of the patients and emergency procedures for the rest of 22.41% of the patients, with acute or subacute ischemia. The emergency procedures consisted of graft thrombectomies with or without simultaneous extension grafts. The initial technical success for all procedures was 100%.

We had no early artery or bypass occlusions (less than 30 days) and only one case with a postoperative local hematoma which required a reintervention for haemostasis and evacuation.

We had two graft infections (one case required an additional myoplasty, with favorable postoperative recovery at two years, and the other case required extraction of the infected synthetic graft and construction of a new bypass using the great saphenous veins).

We registered 13 late occlusions (after more than 30 days), which entailed follow-up procedures for reestablishing the patency.

There were 14 (24.13%) amputations recorded: 7 majors (thigh or below-knee), representing a rate of 12.06% of the total number of cases and 7 minors (toe or transmetatarsal), representing a rate of 12.06% of all cases. Limb salvage rate for the patients in stage III and IV Leriche-Fontaine was 85.10%. The amputation-free survival
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period ranged between 1 and 36 months, with an average of 16.33 months. Clinical improvements were noticed in 44 (75.86%) patients. The mortality rate for the entire studied period was 5%.

After six months primary patency in each studied group (corresponding to the years of 2010, 2011, and 2012) was 95%, 93.3%, and 92.3% respectively, comparable with those published in the literature (Shilagy). After twelve months primary patency was 85% in the 2010 studied group, 80% in the 2011 group of patients, and 82.6% for the 2012 group (fig. 3, 4, 5).

We did not find statistically significant differences between the averages of the primary patients of various disease stages. Most of the patients who benefited from simultaneous revascularization procedures were in Leriche IV disease stage.

As far as the connection between the type of revascularization procedure and the primary patency is concerned, the average primary patency for the successive procedures is the same as the one for simultaneous procedures. The primary patency did not differ between the elective and emergency procedures subgroups.

Fig. 3. The Kaplan-Meyer diagram of primary patency for the 2010 patient group

Fig. 4. The Kaplan-Meyer diagram of primary patency for the 2011 patient group
The difference in primary patency between the patients who benefited from synthetic grafts revascularizations and the ones with autologous material is statistically non-significant.

The statistical analysis identified the only risk factor which significantly influenced the primary patency in the studied group: arterial hypertension.

DISCUSSION

Critical ischemia due to multi-level arterial occlusive disease may necessitate both an inflow procedure and an outflow procedure, if limb salvage is to be accomplished. Direct surgical repair is the optimum choice for fit patients with a life expectancy of more than two years (4).

Simultaneous multi-level revascularization is a safe and efficient procedure for critical ischemia (5).

In a 15 years retrospective study published in 2014, Sharples and co. report on a single center experience with the treatment of multi-level occlusive disease using simultaneous aortoiliac and infrainquinal bypasses done between 1996 and 2011. Limb salvage rate was 96.9%, 85.7% and 75.9% at 30 days, one year and 5 years respectively. These results demonstrate that multi-level bypasses can be constructed with good long term results. For patients with critical ischemia and tissue loss due to both aortoiliac and infrainquinal occlusive disease, significant benefits exist if an initial multi-level revascularization procedure is accomplished (6).

Following their study on 121 patients (with 201 revascularized limbs) Horstmann and co. have concluded that combined aortofemoral and profound femoral artery reconstruction was desirable in treating multi-level occlusive disease and that infrainquinal extension grafts were needed only for critical ischemia (7).

Dalman and co. reported on a study of 62 patients that multi-level procedures offered a complete resolution of symptoms for a greater percentage of patients than single level procedures did (8).

Edwards et al agrees that multi-level aortoiliac and femoral occlusive disease necessitates profound femoral artery angioplasty or an outflow extension graft in order to secure pelvic and distal arterial perfusion (9).

For our surgical cases, the profound femoral artery (PFA) had the most important role. This was the distal anastomosis site for the inflow procedures, with or
without venous or arterial patch angioplasty in the case of 14 patients. Constructing an angioplasty enhanced anastomosis on the PFA for aortobifemoral bypasses yields superior early and long term patency, compared to a distal anastomosis on the common femoral artery (10). The profound femoral artery angioplasty proves very useful when the superficial femoral artery is thrombosed. We observed significant benefits throughout the study from utilizing it adequately. Using for distal anastomosis venous or arterial cuffs on the profound femoral artery decreases the rate of infrainfundibular extension grafts. We used simultaneous extension grafts for patients with tissue loss (Leriche IV disease stage) and critical ischemia due to type III aortoiliac disease.

In order to achieve secondary patency, graft repermeabilization was achieved with Fogarty catheters and extension grafts were constructed with distal anastomosis on the profound femoral artery or more distally. These procedures require extensive surgical experience. Adequate surgical exposure and use of the profound femoral artery is the key for aortoiliac disease surgical reinterventions (11).

CONCLUSIONS
In our study simultaneous or successive surgical procedures are a feasible option for multilevel peripheral arterial occlusive disease, with favorable patency and limb salvage rates. The observations of the current study indicate that the profound femoral artery plays an important role in conventional surgery.

REFERENCES