Retroperitoneoscopic lumbar sympathectomy option in treatment of nonrevascularized peripheral arterial disease
Introduction

Oclusive peripheral arterial disease of the lower limbs (PAD) is a heterogeneous group of disorders with multifactorial etiology and clinical picture dominated by pain, with a wide variety of clinical and anatomical forms (etiopathogenic, morphological, topographical and evolutive), represented by atherosclerotic arteriopathy, vasospastic arteriopathy (Burger disease) and diabetic arteriopathy. They are still an important public health problem because of their debilitating aspect. This is partially due to the severe pain syndrome and evolutive trend of toward trophic lesion development (resulting in reduced functional capacity or even compromised integrity of the affected limb), as well as the frequent association of severe comorbidities (cardiovascular diseases, diabetes, etc.).

Treatment of PAD is a complex one, medical and/or surgical, with major goal to improve life quality of patient with disappearance or improvement of painful syndrome (claudication or rest pain) and preserve limb viability. Therapeutic arsenal now has a range of options: conservative therapy, revascularization procedures (surgical or endovascular) and indirect operations - so-called hyperemia interventions (lumbar sympathectomy)- each with specific indications, well coded and can be applied simultaneously or consecutively, depending on the clinical form and stage of evolution.

Lumbar sympathectomy proposed by Leriche and Wertheimer in 1924 and technically feasible for the first time in humans in 1925 by Julio Diaz by transperitoneal approach, has dominated vascular surgery for nearly 30 years and with vasodilators and anticoagulant medication was the only treatment option until the appearance of standardize reconstructive surgery, by open approach (enlargement patch angioplasty, trombendarterectomy and arterial bypass) or endoluminal (angioplasty balloon dilatation or stenting), which became the main treatment option for lower limb peripheral arterial disease, lumbar sympathectomy restricting greatly his indications. Gradually, lumbar sympathectomy has redefined and reclaimed place in the therapeutic arsenal of peripheral arterial disease, generally reserved for patients in which clinical and imaging exploration certified technical failure of revascularization and / or patients with severe comorbidities that make risky surgery a large-scale restoration of arterial flow, the objectives of sympathectomy is improving pain syndrome and delay as much as possible amputation.

Based on the current status of the problem summarized above, exploiting the experience almost unique in the field of Craiova Surgical I Clinic, I conducted a prospective study on a large enough group of patients, to allow meaningful statistical analysis to assess the place of lumbar sympathectomy by endoscopic approach (retroperitoneoscopic) in the therapeutic arsenal of peripheral arterial disease, objectives pursued being surgical technique, safety and efficacy of the method.

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1. ANATOMY AND PHYSIOLOGY OF SYMPATHETIC NERVOUS SYSTEM. CONTRIBUTION IN THE REGULATION OF VASOMOTILITY

Chapter on anatomy and physiology of the sympathetic nervous system includes data on definition, role and organization of the autonomic nervous system, and in physiology chapter are treated preferentially notions of blood circulation regulation and control of vascular tone and sanguine flow.

2. PERIPHERAL ARTERIAL DISEASE (PAD)

Peripheral arterial disease (PAD) chapter is a point making the problem and discusses the following topics:
- Classification etiopathogenetical, morphological and clinical of peripheral arterial disease
- Etiopathogenic factors involved in the genesis of acute and chronic limb ischemia
- Diagnosis and staging of peripheral arterial disease: clinical presentation and specific laboratory explorations functional and imaging
- Options and indications: conservative medical treatment, reconstructive surgery open and / or endolumenală, hyperemia surgery, etc..

3. MOTIVATION OF STUDY. MATERIALS AND METHODS

In a study conducted in Ireland and the UK, designed to evaluate the opportunity of lumbar sympathectomy, 75% of vascular surgeons questioned still considered that is a useful process. (57) This became even more evident with the introduction in practice of minimally invasive surgery techniques that make lumbar sympathectomy safer with minimal risks and important benefits for patients. (5) (7)

Based on the current status of the problem summarized above, exploiting the experience almost unique in the field of Craiova Surgical I Clinic, I conducted a prospective study on a large enough group of patients, to allow meaningful statistical analysis to assess the place of lumbar sympathectomy by endoscopic approach (retroperitoneoscopic) in the therapeutic arsenal of peripheral arterial disease, objectives pursued being surgical technique, safety and efficacy of the method.

The study was conducted on a total of 50 consecutive patients operated on in the Department of Surgery no. 1 of the Emergency County Clinical Hospital of Craiova, who underwent retroperitoneoscopic lumbar sympathectomy (RLS), the study group being a part of a total of 680 patients with PAD, hospitalized and treated in our clinic between 2007 and 2011., for which all the existing therapeutic options were used, tailored to each individual case, depending on the clinical anatomical form, topography, evolutive stage and biological potential of each patient.
4. ELEMENTS OF ETIOPATHOGENY

AGE. SEX. PLACE OF ORIGIN. OCCUPATION

Our study reflects the distribution of arterial disease according to age, its maximum incidence being between 50 and 70 years of age for atherosclerotic arteriopathy and less than 50 years for patients with thrombangeitis obliterans. Regarding diabetic arteriopathy, its maximum incidence is generally between 40 and 50 years of age. This finding is valid for both the entire group and the RLS group.

Marked male predominance was obvious in both in the group which includes all arteriopathies hospitalized and treated in the period analysed (586 men and 74 women, with a sex ratio of 1/7.9), and the RLS group (47 men and 3 women, with a sex ratio of 1/15.6).

Concerning the patient’s place of origin, we found no significant etiopathogenic differences, the urban/rural ratio being almost 1.

BIOLOGICAL BACKGROUND. COMORBIDITIES

PAD, especially degenerative one, is not isolated, but part of systemic degenerative diseases (atheromatosis and arteriosclerosis), most often with multiple involvement of the cardiovascular system. Therefore, the presence of comorbidities, mostly cardiovascular, provides an overview of the biological terrain in arteriopathic patients.

Based on this idea, the study of background as an etiopathogenic factor, focused primarily on the study of cardiovascular comorbidities and their role in the etiopathogenic determinism of PAD. From this point of view, the evaluation of medical history was performed for patients within the RLS group (50 patients), in correlation with the data from the entire group of patients enrolled in the study period, from 2007 to 2011 (680 patients).

Comorbidity assessment highlighted the presence of elevated blood pressure in 50% of the RLS patients, which is within the range of data obtained for the whole group (52.5%). The risk of developing PAD is 2.5 to 4 times higher in hypertensive than in normal individuals, with hypertension being found in 43% of patients with stage II arteriopathy.

Chronic ischemic heart disease (20% in RLS patients and 48.6% in the whole group), myocardial infarction (16% in the RLS group and 11.4% in the PAD group), and ischemic stroke (8% in the RLS group and 4.8% in the entire PAD group), certify the plurifocality of arterial lesions, our study confirming the data from the literature, according to which between 40% and 60% of patients with PAD also have concurrent coronary lesions, and 5% ischemic strokes.

Arrhythmias were present in 18% of the patients in the RLS group and 21% in the general group.

Diabetes, another major etiopathogenic risk factor was present in 26% of patients with PAD and 18% of patients with RLS, confirming the data from the literature according to which diabetes is present in 20-30% of patients with PAD, and about 30% of patients with carbohydrate metabolism disorders also show PAD. (67)(68)(69)

Smoking is one of the most frequent and important toxic factors involved (nicotine and carbon monoxide) in the etiopathogenesis of PAD; in our study 72.6% of patients in the
reference group and 70% of RLS ones were smokers. The pathogenic role of alcoholism is uncertain; however, alcohol consumption was present in 68% (34 patients) of the RLS group.

5. DIAGNOSIS. STAGING

THE CLINICAL PICTURE

The diagnosis of PAD is usually easy, arterial suffering generating a significant pain syndrome, which quickly directs the patient to the doctor. It is based on subjective and objective clinical signs, complemented by functional vascular explorations and specific imaging investigations, all contained in an algorithm leading to a complete clinical and anatomical diagnosis, allowing a good staging and choice of the best treatment options.

The onset of symptoms was generally slow, insidious, with extensive clinical suffering for periods ranging from several months to several years, with oscillating evolution but a slowly progressive worsening trend; 21 of our cases had a history of disease of 1 year or less, while the remaining 29 cases have been suffering even for more than 6 years.

The clinical picture was dominated by pain, one of the criteria constantly used for staging; it was present in all our cases with different clinical forms: intermittent claudication with a claudication index under 200 m (13 cases, 26%), or pain at rest and/or nocturnal (37 cases, 74%), with (24 cases, 48%) or without trophic lesions.

We found that on admission, before any therapeutic measures were taken, pain was significant, disabiliating, evaluated by patients between 7 and 10 on the VAS scale.

Paresthesia (66%), foreign body sensation in the affected extremity, initially felt in vicious positions, then following great efforts, low temperature, and finally in a resting position (54%), and functional impotence (12%), completed the subjective clinical picture of chronic limb ischemia.

In the studied cases we found no arterial pulsation in the posterior tibial and pedal arteries in 88% of cases (44 cases); in 16 (32%) cases we found no pulse in the popliteal artery, which, correlated with the presence of femoral pulse, was interpreted as a superficial femoral artery obstruction. Absence of femoral pulse was present in 8 cases, meaning high iliac obstruction.

Changes of the skin, hair, nails and muscles are common objective signs for peripheral obstructive arteriopathies expressing the degree of ischemia. Pallor, found in 46% of cases (23 cases) expresses chronic ischemia, cyanosis (13 cases, 26%) and tissue hypoxia translate into venous stasis, and erythema (10 cases, 20%) is usually the expression of inflammatory processes.

Changes of hair and nails (lack of hair, brittle nails, hyperkeratosis) were present in almost half of the cases studied (21 cases, 42%), and in over half the cases (28 cases, 56%) we found calf and crural muscle hypotrophy, the more important as the arterial suffering is in a more advanced stage.

Trophic lesions were present in a total of 24 (48%) patients, assigned as stage IV; single or multiple, unilateral or bilateral, trophic lesions were located in the fingers, forefoot or leg.
FUNCTIONAL VASCULAR EXPLORATIONS

Oscillometry - Oscillometric index values were below the normal range in all cases studied, consistent with the advanced stages of ischemia.

Skin thermography - The values for skin temperature were close to normal (26°C) only in 13 patients (26%); in 14 cases we recorded a moderate decrease in local temperature (2-3°C), and in the remaining 23 cases (46%) we recorded significant reductions in local skin temperature (≥ 4°C), in 8 of them, the difference being of 9°C.

Distal systolic index (DSI) or ankle-brachial index (ABI) - In our study, 27 patients (54%) had a distal systolic index (DSI) < 0.5, corresponding to a severe critical ischemia, while the remaining 23 patients (46%) had DSI values of 0.5 (21 patients), and 0.6 (2 patients), falling within the category of stage II and III ischemia.

IMAGING INVESTIGATIONS

Ultrasonography. Ultrasound complex examination, including two-dimensional echography and Doppler ultrasound was performed in all cases studied.

Angiography was performed in 6 of the 50 cases studied

CLINICAL FORMS. STAGING

The 50 cases studied included nearly all clinical etiopathogenic and topographical forms of obstructive arteriopathy of the lower limb. Thus, atherosclerotic arteritis held the largest share (34 cases, 68%), followed by diabetic arteriopathy (9 cases, 18%) and thrombangeitis obliterans (6 cases, 12%).

Most cases studied belonged to stage IV (24 cases, 48%), with continuous pain at rest and nocturnal, trophic lesions of varying extent and depth (calf ulcers, gangrene localized to one or more fingers or the forefoot), 13 cases (26%) belonged to stage III, with early or late onset nocturnal or rest pain, and 13 cases (26%) belonged to stage II B, with discontinuous claudication and a claudication perimeter under 200 m.
6. TREATMENT

Treatment of PAD is a complex one, medical and/or surgical, with major goal to improve life quality of patient with disappearance or improvement of painful syndrome (claudication or rest pain) and preserve limb viability.

Therapeutic arsenal now has a range of options: conservative therapy, revascularization procedures (surgical or endovascular) and indirect operations - so-called hyperemia interventions (lumbar sympathectomy) - each with specific indications, well coded and can be applied simultaneously or consecutively, depending on the clinical form and stage of evolution.

The choice of means and therapeutic algorithm must take into account that PAD is a lifelong disease that requires continuous treatment and follow-up of the patient (42), because, whenever it may occur worsening, which can lead to affected limb compromised.

During the studied period, from the 680 patients admitted and treated in the Department I of Surgery Craiova were used all currently available therapeutic means in chronic obstructive arteriopathy of the lower limbs.

CONSERVATIVE MEDICAL TREATMENT

Conservative medical treatment was a complex one, including a wide range of therapeutic means, depending on the associated etiopathogenesis form, head of obstruction, evolutionary stage of disease, age and organic associated flaws.

SURGICAL TREATMENT

Surgical treatment is available to revascularization that can be performed by classical or endoluminal interventions, indirect and hyperemia surgery (lumbar sympathectomy) and amputations.

RETROPERITONEOSCOPIC LUMBAR SYMPATHECTOMY

Based on the state of knowledge, prospective study conducted in this thesis on a total of 50 consecutive patients who underwent retroperitoneoscopic lumbar sympathectomy, aims to assess its place in the treatment of peripheral arterial disease, analyzing problems of indication, surgical technique, safety and efficiency.
7. RESULTS

Disappearance of rest pain and / or intermittent claudication, healing of necrotic lesions and amputation removal at least 6 months are considered in literature positive development and efficiency criteria. (60)

The assessment of pain intensity was performed using a visual analog scale (VAS), by which the patient evaluates pain intensity on a scale from 0 (no pain) to 10 (agonizing pain). Proceeding in this way we found that if preoperative significant pain, disability, assessed on the VAS scale from 7-10 was present in all patients (7 = 18 patients, 8 = 19 patients, 9 = 12 patients and 10 = 11 patients), it disappeared completely in 27 patients (54%), remained as minimal residual pain (1 VAS scale) to 21 (42%) of the patients and only 2 (4%) patients had residual pain intensity significantly (7 VAS scale).

Local skin temperature was measured preoperatively and postoperatively using an infrared digital thermometer placed near the lesion or big toe in patients without tissue loss, normal temperature is determined by literature at value of 27°C. The values for skin temperature were close to normal (26°C) only in 13 patients (26%); in 14 cases we recorded a moderate decrease in local temperature (2-3°C), and in the remaining 23 cases (46%) we recorded significant reductions in local skin temperature (≥ 4°C), in 8 of them, the difference being of 9°C. Postoperatively, we found a significant increase in local skin temperature in the vast majority of patients (48 = 96%); in 20 (40%) patients local skin temperature was normal, in 28 (56%) patients were close to normal values (25-26°C) and only 2 cases (4%) local skin temperature remained low, at the values recorded preoperatively.

There were no deaths, immediate postoperative mortality rate was 0. Number of days of hospitalization ranged from 2-7, with an average of 3.8.

Evaluated in this way, immediate postoperative evolution was favorable in 48 cases (96%), with significant warming of the foot, disappearance of pain and calf trophic lesions or postoperative wounds resulting from necrectomy or finger amputation tend to granulation, patients being discharged when the wound begins to grainy and can be treated in ambulatory optimal.

Immediate postoperative evolution was unfavorable in 2 cases (4%), which have recorded worsening ischemia with persistent pain on high intensity and extent of trophic lesions which required amputation of the thigh at 2 and 3 weeks after the primary operation.

For evaluation of remote results patients were monitored for 2 years, the main parameter followed being the rate preservation of the foot. Regular assessment at 6 months gave us the following information:

- 1 year 48 patients have been reviewed, 2 dying in the meantime (myocardial infarction 1 case and stroke 1 case). Preservation rate of the leg was 77.9%, 10 patients with unfavorable progressive development, which required amputation of thigh.
- 2 years remaining on track 36 patients, 28 with positive development, with a rate of 58.33% preservation of foot, 8 patients required amputation because of unfavorable local development.
8. DISCUSSIONS

Occlusive peripheral arterial disease of the lower limbs (PAD) is a heterogeneous group of disorders with multifactorial etiology and clinical picture dominated by pain, with a wide variety of clinical and anatomical forms (etiopathogenic, morphological, topographical and evolutive), represented by atherosclerotic arteriopathy, vasospastic arteriopathy (Burger disease) and diabetic arteriopathy. They are still an important public health problem because of their debilitating aspect. This is partially due to the severe pain syndrome and evolutive trend of toward trophic lesion development (resulting in reduced functional capacity or even compromised integrity of the affected limb), as well as the frequent association of severe comorbidities (cardiovascular diseases, diabetes, etc.).

Treatment of PAD is a complex one, medical and/or surgical, with major goal to improve life quality of patient with disappearance or improvement of painful syndrome (claudication or rest pain) and preserve limb viability. (12)

Therapeutic arsenal now has a range of options: conservative therapy, revascularization procedures (surgical or endovascular) and indirect operations - so-called hyperemia interventions (lumbar sympathectomy): each with specific indications, well coded and can be applied simultaneously or consecutively, depending on the clinical form and stage of evolution. The choice of means and therapeutic algorithm must take into account that PAD is a lifelong disease that requires continuous treatment and follow-up of the patient (42), because, whenever it may occur worsening, which can lead to affected limb compromised.

During the studied period, from the 680 patients admitted and treated in the Department I of Surgery Craiova were used all currently available therapeutic means in chronic obstructive arteriopathy of the lower limbs.

Arguments listed above have led many authors to reconsider the role and place of lumbar sympathectomy, based not only on clinical effects now demonstrated, but also from the fact that there are many situations where reconstructive surgery is ineffective or contraindicated, so that sympathectomy remains a beneficial option that deserves taken into account, even if everyone recognizes her palliation character. Thus, in a study conducted in 1994 by Baker and Lamerton (57) shows that 75% of vascular surgeons in the UK and Ireland questioned believes the procedure is still useful, in well-established indications.

Moreover, today, lumbar sympathectomy extended beyond vascular surgery indications being used to treat plantar hyperhidrosis and Sudeck atrophy.

There are now at least three technical ways of achieving lumbar sympathectomy: classic sympathectomy by open approach, chemical sympathectomy and sympathectomy by endoscopic approach, last appeared as result of the development of minimally invasive surgery and enlargement and improvement of endoscopic approach of retroperitoneal space.

Development of minimally invasive surgery pioneered the endoscopic approach of retroperitoneal space and led to the first attempts to perform lumbar sympathectomy in this way. In terms of actual surgical technique, the literature is quite poor; does not yet exist a standard technique, and usually works communicated refer to small series.

Minimally-invasive lumbar sympathectomy can be done laparoscopically, transperitoneal or retroperitoneoscopically.
Transperitoneal laparoscopic sympathectomy is more difficult and laborious; It involves entering the retroperitoneal space and lumbar sympathetic chain approach after splitting parietal-colic peritoneum, and dissecting to medial line of the right or left colon with posterior parietal peritoneum to the medial edge of the psoas, which does not offer the best visibility.

Retroperitoneoscopic lumbar sympathectomy as practiced today was possible after Gaur described first retroperitoneoscopic technique (93). Hourley (65) used retroperitoneoscopic lumbar sympathectomy to treat Sudeck atrophy and the technique described and published by him in 1995 can be considered standard procedure.

Kathouda (64) in 1997 and Watarida (54) in 2002 published 5 and 7 cases of retroperitoneoscopic lumbar sympathectomy performed for the treatment of peripheral arterial disease nonrevascularized, thus reopening the discussion on the place, role and effectiveness of the method in the therapeutic arsenal of peripheral arterial disease.

Based on the current status of the problem summarized above and especially the fact that although the feasibility of minimally invasive lumbar sympathectomy has been demonstrated, the results of the method have not yet been assessed on large series of patients, I conducted a prospective study on a large enough group of patients (50 consecutive patients), to allow meaningful statistical analysis to assess the place of lumbar sympathectomy by endoscopic approach (retroperitoneoscopic) in the therapeutic arsenal of peripheral arterial disease, objectives pursued being surgical technique, safety and efficacy of the method and immediate and remote postoperative results.

For correct results, we sought to be homogeneous study group, using the criteria for inclusion of the ankle – brachial index > 0.3 and/or finger systolic BP> 30 mmHg and positive response to vasodilator medication I considered mandatory, and to assess the effectiveness of the method in as many pathological circumstances we included in the study group a wide range of etiopathogenic forms (34 atherosclerotic arteritis, 7 with arterial flow restoration attempts, failed or compromised while, 9 diabetes arteritis without diabetic neuropathy, 6 Burger occlusive thrombangitis and 1 residual ischemia after embolectomy), in different evolutionary stages (13 stage IIb, 13 stage III and 24 stage IV with limited trophic lesions). The surgical technique used was that described by Hourley (65) and accepted as standard procedure.
9. CONCLUSIONS

1. Occlusive peripheral arterial disease of the lower limbs (PAD) are still an important public health problem because of their debilitating aspect. This is partially due to the severe pain syndrome and evolutive trend of toward trophic lesion development (resulting in reduced functional capacity or even compromised integrity of the affected limb), as well as the frequent association of severe comorbidities (cardiovascular diseases, diabetes, etc.).

2. Treatment of peripheral arterial disease is a complex one, medical and surgical, with indications who vary by risk, evolutionary stage, location of disease and functional status of vital organs.

3. The goals of treatment are to improve quality of life by amending painful syndrome, prevention or treatment of trophic lesions and restore and maintain functional capacity of the affected segment.

4. Therapeutic arsenal now has a range of options: conservative therapy, revascularization procedures (surgical or endovascular) and indirect operations, the so-called hyperemia intervention (lumbar sympathectomy), each with specific indications, well coded, which can be applied simultaneously or consecutively depending on the clinical form and stage of evolution.

5. Reconstructive surgery by open approach (enlargement patch angioplasty, thrombendarterectomy and arterial bypass) and endoluminal (angioplasty balloon dilatation or stenting) is today the main treatment option for PAD.

6. Lumbar sympathectomy maintains its place in the therapeutic arsenal of PAD, having basically the following indications:
   - Burger occlusive thrombangitis
   - diabetes artheritis without diabetic neuropathy
   - residual ischemic neuritis after revascularization
   - improvement of receiver bed after revascularization
   - impossible revascularization due to general contraindications (comorbidities that prevent large-scale operations)
   - impossible revascularization because of specific contraindications, local order, established based on imaging (ultrasound Doppler and / or arteriography)

7. Retroperitoneoscopic approach, whose feasibility has been tested in literature and certified in our study, make lumbar sympathectomy a simple operation, safe and effective, with the following advantages over other sympathectomy techniques:
   - is more precise and is performed under direct visual control of the sympathetic chain (14)
   - High definition and optical zoom offers high accuracy under dissection, which makes it very efficient and complete raising sympathetic ganglia (15)
   - learning curve is relatively short
   - intraoperative incidents and accidents rate and postoperative complications is reduced
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