RHEOLOGICAL THROMBUS EXTRACTION IN POSTOPERATIVE
THROMBOSIS OF THE POPLITEAL-TIBIAL SEGMENT AFTER
ENDOVASCULAR METHODS OF REVASCULARIZATION

Ihor. K. Venher¹, Sviatoslav Ya. Kostiv¹, Sergii N. Didenko², Nadiia. I. Tsiupryk¹, Dymytriy. V. Khvalyboha¹

¹ – I. Horbachevsky Ternopil National Medical University, Ternopil, Ukraine
² – Clinical Hospital «Feofaniya» State administrative department, Kyiv, Ukraine

Summary

Introduction. The use of endovascular methods of revascularization of the atherosclerotic stenotic-occlusive process of the femoral-distal arterial bed leads in 1/4 of the primary surgical interventions to the need for repeated surgical intervention, in 6-32 % of cases it is complicated by the development of thrombosis of the reconstruction segment, restenosis of the surgical intervention segment [6, 7].

Aim. The main goal of the study was to improve the results of endovascular methods of revascularization of multi-level stenotic-occlusive femoral-distal arterial bed by performing rheological thrombus extraction with the Angiojet system in postoperative thrombosis of the popliteal-tibial segment.

Materials and methods. 164 patients with multilevel stenotic-occlusive atherosclerotic lesions of the femoral-distal arterial bed were under observation. Thrombosis of the popliteal segment was diagnosed in 17 (73.9 %) cases in patients with endovascular angioplasty of one of the tibial arteries, in 6 (26.1 %) cases with endovascular angioplasty of two arteries of the tibial segment. Surgical treatment of thrombosis of the popliteal segment was performed by the method of minimally invasive rheological thrombus extraction using the Angiojet device (Possies, USA).

Results. A patient with a multilevel stenotic-occlusive process of the femoral-distal arterial bed at clinical stage 3 (according to WIFI classification) had a two-level endovascular angioplasty of the infrainguinal arterial channel. Rheological thrombus extraction from the popliteal-tibial segment using the Angiojet system was used in 14 (60.9 %) patients who underwent two-level endovascular angioplasty of the femoral-distal arterial bed. Rheological thrombus extraction from the popliteal-tibial segment with the Angiojet system was used in 9 (34.8 %) patients who underwent revascularization of the infrainguinal arterial bed by the hybrid revascularization method.

Conclusions. 1. Endovascular methods of revascularization of multilevel stenotic-occlusive femoral-distal arterial bed are complicated in 14.0 % of observations by the development of postoperative thrombosis of the popliteal-tibial segment.
2. The effectiveness of the application of rheological thrombus extraction by the Angiojet system of postoperative thrombosis from the popliteal-tibial segment after endovascular methods of revascularization of multilevel stenotic-occlusive femoral-distal arterial bed is at the level of 82.6 %.

Keywords: rheological thrombus extraction system, thrombosis, revascularization, angioplasty

INTRODUCTION

Atherosclerotic lesions of the arterial bed of the lower extremities rank close behind coronary heart disease, being second in the structure of cardiovascular diseases [1]. At the same time, stenotic-occlusive lesions of the infrainguinal arterial bed in 35-64.7 % of cases lead to the development of ischemia, which threatens the amputation of the lower limbs [2, 3]. Treatment of patients with multilevel atherosclerotic lesions of the arterial bed of the lower extremities remains a rather complex and, in many cases, an unsolved problem [4, 5]. The use of endovascular methods of revascularization of the atherosclerotic stenotic-occlusive process of the femoral-distal arterial bed leads in 1/4 of the primary surgical interventions to the need for repeated surgical intervention, in 6-32 % of cases it is complicated by the...
development of thrombosis of the reconstruction segment, restenosis of the surgical intervention segment [6, 7].

AIM

Thus, the main goal of the study was to improve the results of endovascular methods of revascularization of multi-level stenotic-occlusive femoral-distal arterial bed by performing rheological thrombus extraction with the Angiojet system in postoperative thrombosis of the popliteal-tibial segment.

MATERIALS AND METHODS

164 patients with multilevel stenotic-occlusive atherosclerotic lesions of the femoral-distal arterial bed were under observation. 73 of them underwent two-level endovascular angioplasty of the infrapopliteal arterial bed, and 91 had hybrid revascularization of the femoral-distal arterial bed. In the early postoperative period, 26 (15.9 %) cases of thrombosis of the revascularization segment were diagnosed. Of these, thrombosis of the popliteal segment was detected in 23 (88.5 %) patients, thrombosis of the femoral-popliteal segment – in 3 (11.5 %) cases.

Thrombosis of the femoral-popliteal segment was established on the 3rd, 4th, and 9th days of the postoperative period. Thrombosis of the femoral-popliteal segment developed in one case after two-level endovascular angioplasty of the infrapopliteal arterial channel, in two cases – after hybrid revascularization of the femoral-distal arterial channel. In all observations of thrombosis of the femoral-popliteal segment, the IIa stage of acute arterial occlusion (AAO) was formed (according to Rutherford classification). In the treatment of thrombosis of the femoral-popliteal segment, an open method of elimination of the thrombosed segment with the formation of an autogenous femoral-popliteal shunt was used.

Postoperative thrombosis of the popliteal segment was diagnosed in 23 patients: in 14 (60.9 %) of them – after two-level endovascular angioplasty of the femoral-distal artery, in 9 (39.1 %) – after hybrid methods of revascularization. Postoperative thrombosis of the popliteal segment was diagnosed on the first day of the postoperative period in one (4.35 %) case, on the 3rd-5th day – in 11 (47.83 %) cases, on the 8th-11th day – in 7 (30.44 %) cases, on the 14th-16th day – in 2 (8.70 %) cases. In 13 (56.5 %) cases, Rutherford stage I of AAO was established, in 10 (43.5 %) – Rutherford stage IIa of AAO was diagnosed.

Thrombosis of the popliteal segment was diagnosed in 17 (73.9 %) cases in patients with endovascular angioplasty of one of the tibial arteries, in 6 (26.1 %) cases with endovascular angioplasty of two arteries of the tibial segment. In 9 (39.13 %) patients, the thrombotic process developed after intraluminal angioplasty of the tibial arteries, out of 14 (60.87 %) cases, in 11 cases – after subintimal angioplasty and in 3 cases – after subintimal angioplasty with stenting. Surgical treatment of thrombosis of the popliteal segment was performed by the method of minimally invasive rheological thrombus extraction using the Angiojet device (Possies, USA).

RESULTS

A patient with a multilevel stenotic-occlusive process of the femoral-distal arterial bed at clinical stage 3 (according to WIFI classification) had a two-level endovascular angioplasty of the infrapopliteal arterial channel. Thrombosis of the femoral-popliteal segment was diagnosed on the 3rd day after the operation. During the primary operation at the first stage of two-level endovascular angioplasty for multiple lesions with a length > 15 cm of the femoral segment (Type C according to TASK-2 (2014)), endovascular angioplasty of the femoral segment was performed with an OPTA PRO balloon-catheter (Cordis) using a self-expanding Smart Control stent (Cordis). For the elimination of acute thrombosis of the femoral-popliteal segment in Rutherford stage IIa of AAO, an open surgical intervention was performed, during which femoral-popliteal autogenous shunt was formed and thrombectomy with a Fogarty probe from a single primary endovascularized tibial artery (PETA) was performed. The postoperative period was uneventful.

After hybrid revascularization of the multi-level stenotic-occlusive femoral-distal arterial bed, on the 4th and 9th day after the operation, two patients (one with clinical stage 2 and one with clinical stage 3 (according to WIFI classification)) were diagnosed thrombosis of the femoral-popliteal autogenous shunt. Surgical treatment of acute thrombosis of the femoral-popliteal segment in conditions of Rutherford stage IIa of AAO was carried out by the open method. A thrombosed autogenous shunt was removed. Repeated autogenous femoral-popliteal shunting was performed with the formation of a distal anastomosis at the level of the popliteal artery in an end-to-end manner. At the same time, a revision and thrombectomy with a Fogarty probe from the tibial arteries were carried out. The postoperative period was uneventful.

Rheological thrombus extraction from the popliteal-tibial segment using the Angiojet system was used in 14 (60.9 %) patients who underwent two-level endovascular angioplasty of the femoral-distal arterial bed. When performing rheological thrombus extraction, retrograde transfemoral access was used. After puncture of the common femoral artery, a 5F catheter was retrogradely inserted through the introducer. The latter is brought to the level of thrombotic occlusion under X-ray control. After that, indirect thrombus extraction from the popliteal-tibial segment was performed. In the cases in which endovascular angioplasty of two tibial arteries was initially performed, indirect thrombus extraction was performed only from one of them.

Rheological thrombus extraction from the popliteal-tibial segment with the Angiojet system was used in 9
(34.8%) patients who underwent revascularization of the infrainguinal arterial bed by the hybrid revascularization method. When performing rheologocal thrombus extraction, retrograde transfemoral access was used in 2 cases. A 5F catheter was passed through the introducer, which, under radiological control, is advanced through the distal femoral-autovenous anastomosis of the femoral-popliteal autovenous shunt into the lumen of the autovenous and is then advanced through the lumen of the distal anastomosis to thrombotic occlusion. Indirect thrombus extraction is performed from the popliteal-tibial segment, while thrombus extraction was performed only from one of the tibial arteries.

When using transfemoral access in patients with hybrid revascularization and using a catheter for rheological thrombus extraction, difficulties arise in its passage to the segment of thrombotic occlusion. In view of the above, transautovenous access was used in 7 cases. In the projection of the autovenous shunt on the thigh, through the skin incision up to 4 cm, the autovenous is fixed with tourniquets. Then, the introducer is inserted, through which a 5F catheter is passed. The latter is brought under X-ray control to the segment of thrombotic occlusion. In the future, indirect thrombus extraction is performed from the popliteal-tibial segment with thrombus extraction from only one of the tibial arteries.

Upon completion of the surgical manipulation, the patients immediately received 5000 units of unfractionated heparin (UFH) daily with continued administration at a dose of 5000 units every 4-6 hours within 3-5 days. From the 4th to the 6th day, low molecular weight heparin (LMWH) (enoxaparin) was prescribed at a dose of 0.4 mg twice a day for 5 to 7 days. At the same time, double antiplatelet therapy was prescribed: aspirin 100 mg and clopidogrel 75 mg twice a day for a month. The complex of postoperative treatment included prostaglandins (vasoprostan) for 7-10 days.

5 patients developed repeated thrombosis of the popliteal segment 1-3 days after rheological thrombus extraction. The prescribed complex of thrombolytic therapy with the use of UFH in one case contributed to the restoration of blood flow in the popliteal-tibial segment, which made it possible to prescribe LMWH (enoxaparin) at a dose of 0.4 mg twice a day for 5-7 days from the 5th day. At the same time, double antiplatelet therapy was prescribed: aspirin 100 mg and clopidogrel 75 mg twice a day for a month and vasoprostan for 7-10 days.

In 4 other observations, intensive thrombolytic therapy did not allow thrombus lysis to be achieved, and when the manifestations of ischemia increased, amputation of the lower limb was performed.

**DISCUSSION**

A number of researchers [8, 9] indicate that endovascular angioplasty of the femoral-distal arterial bed is accompanied by a high level of postoperative complications, among which thrombosis of the endovascularized segment occurs most often [10]. In the presented study, it was found that after endovascular methods of revascularization of 164 patients with multilevel stenotic-occlusive lesions of the femoral-distal arterial bed in the early postoperative period, in 26 (15.9%) observations, thrombosis of the revascularization segment developed, of which thrombosis of the popliteal-tibial segment — in 23 (88.5%) cases, thrombosis of the femoral-popliteal segment — in 3 (11.5%) cases. Similar results of thrombosis of the popliteal-tibial segment are confirmed by the opinion [11] about the significant risk of postoperative thrombosis of the tibial segment after revascularization of the arterial bed by any method. The study found that in 17 (73.9%) cases, thrombosis of the popliteal segment was diagnosed in patients with endovascular angioplasty of one of the tibial arteries, in 6 (26.1%) cases — with endovascular angioplasty of two arteries of the tibial segment, in 9 (39.13%) — after intraluminal angioplasty of the tibial arteries, in 14 (60.87%) — after subintimal angioplasty.

A number of studies [12, 13, 14] indicate the percentage of formation of postoperative thrombosis of the revascularization segment, but none of them indicates, except for thrombectomy with a Fogarty probe, amputation of the lower limb, methods of its surgical treatment. The paper presents the effectiveness of surgical treatment by the method of rheological thrombus extraction from the popliteal-tibial segment using the Angiojet system. Rheological thrombus extraction from the popliteal segment was performed in 14 (60.9%) patients after two-level endovascular angioplasty of the femoral-distal arterial bed, in 9 (34.8%) patients after hybrid revascularization of the infrainguinal arterial bed. 5 patients developed repeated thrombosis of the popliteal segment 1-3 days after rheological thrombus extraction. In one case, the appointment of thrombolytic therapy contributed to the restoration of blood flow in the popliteal segment. In 4 others, intensive thrombolytic therapy did not allow thrombus lysis to be achieved, and when the manifestations of ischemia increased, amputation of the lower limb was performed.

**CONCLUSIONS**

1. Endovascular methods of revascularization of multilevel stenotic-occlusive femoral-distal arterial bed are complicated in 14.0% of observations by the development of postoperative thrombosis of the popliteal-tibial segment.

2. The effectiveness of the application of rheological thrombus extraction by the Angiojet system of postoperative thrombosis from the popliteal-tibial segment after endovascular methods of revascularization of multilevel stenotic-occlusive femoral-distal arterial bed is at the level of 82.6%.
Prospects for further research. Future research will be aimed at finding ways to prevent the development of thrombosis of the reconstruction segment during open or endovascular interventions in patients with peripheral artery disease.

FUNDING AND CONFLICT OF INTEREST

The authors did not receive any financial support from the manufacturers of medicines and medical devices.

COMPLIANCE WITH ETHICAL REQUIREMENTS

The clinical trial was approved at a meeting of the Ethics Committee of the Ternopil Gorbachevsky National Medical University.

LITERATURE


REFERENCES


РЕЗЮМЕ

РЕОЛОГІЧНА ЕКСТРАКЦІЯ ТРОМБУ ПРИ ПІСЛЯОПЕРАЦІЙНОМУ ТРОМБОЗІ ПІДКОЛІННО-ГОМІЛКОВОГО СЕГМЕНТА ПІСЛІ ЕНДОВАСКУЛЯРНИХ МЕТОДІВ РЕВАСКУЛЯРИЗАЦІЇ

Ігор К. Венгер1, Святослав Я. Костів1, Сергій М. Діденко2, Надія І. Цюприк1, Димитрій В. Хвалибога1

1 – Тернопільський національний медичний університет імені І. Я. Горбачевського, м. Тернопіль, Україна
2 – Клінічна лікарня «Феофанія» Державного управління справами, м. Київ, Україна

Вступ. Застосування ендоваскулярних методів реваскулярізації атеросклеротичного стенотично-оклюзійного процесу стегно-дистального артеріального русла призводить в 1/4 первинних оперативних втручань до необхідності повторного оперативного втручання, в 6-32 % випадків ускладнюється розвитком тромбозу сегмента реконструкції, рестенозом сегмента оперативного втручання [6, 7].

Мета. Основною метою дослідження було покращення результатів ендоваскулярних методів реваскулярізації багаторівневого стенотично-оклюзійного стегно-дистального артеріального русла шляхом проведення реологічної екстракції тромбу системою Angiojet при післяоперативному тромбозі підколінно-гомілкового сегмента.

Матеріали та методи. Під спостереженням перебували 164 хворих з багаторівневими стенотично-оклюзійними ураженнями стегно-дистального артеріального русла. Тромбоз підколінного сегмента діагностовано у 17 (73,9 %) пацієнтів з ендоваскулярною ангіопластикою однієї з великогомілкових артерій, у 6 (26,1 %) випадках з ендоваскулярною ангіопластикою двох артерій великомілкового сегмента. Хірургічне лікування тромбозу підколінного сегмента проводили методом малоінвазивної реологічної екстракції тромбу на апараті Angiojet (Possies, США).

Результати. Хворому з багаторівневим стенотично-оклюзійним процесом стегно-дистального артеріального русла з клінічної стадії (за класифікацією WIFI) виконана двохівнева ендоваскулярна ангіопластика інфраінгвінального артеріального русла. У 14 (60,9 %) пацієнтів після ендоваскулярної ангіопластики стенотично-дистального артеріального русла, застосовували реологічну екстракцію тромбу з підколінно-тибіальному сегменті за допомогою системи Angiojet. У 9 (34,8 %) пацієнтів, яким проводили реваскулярізацію інфраінгвінального артеріального русла гібридною реваскулярізацією, застосовували реологічну екстракцію тромбу з підколінно-гомілкового сегмента системою Angiojet.

Висновки. 1. Ендоваскулярні методи реваскулярізації багаторівневого стенотично-оклюзійного стегно-дистального артеріального русла ускладнені в 14,0 % спостережень розвитком післяоперативного тромбозу підколінно-гомілкового сегмента.

2. Ефективність застосування реологічної екстракції тромбу системою Angiojet післяоперативного тромбозу з підколінно-гомілкового сегмента після ендоваскулярних методів реваскулярізації багаторівневого стенотично-оклюзійного стегно-дистального артеріального русла знаходиться на рівні 82,6 %.

Ключові слова: реологічна екстракція тромбу, тромбоз, реваскулярізація, ангіопластика