

CLINICAL STUDY

Retrograde endarterectomy of iliac arteries

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Abstract: *Objective:* Authors retrospectively analyze a group of patients with symptomatic peripheral arterial occlusive disease (PAOD) who underwent an arterial reconstruction with a remote retrograde endarterectomy combined with intraoperative angiography and endovascular techniques as a hybrid procedure.

Results: During the year 2007, there were 83 patients with PAOD planned for the remote retrograde endarterectomy of the iliofemoral arteries. Due to perioperative findings or complications, in 11 cases (13.25 %) an alternative vascular procedure was necessary. In 52 (62.65 %) patients the remote endarterectomy of iliofemoral arteries was performed separately or in connection with the endarterectomy of femoral bifurcation or bypass. In 20 (24.1 %) patients, the remote endarterectomy was performed as a part of hybrid procedure. A technical success was achieved in 72 (from 83 patients – 86.7 %) and a clinical success in 71 (from 72 patients – 98.6 %) patients in whom a successful remote retrograde endarterectomy was performed. There were 15 operations needed in the postoperative period, but only two of them were necessary because of close relation with an unfavorable outcome after the remote endarterectomy. No perioperative and postoperative mortality was observed in the whole group of patients. During the follow up in the next 6 months, patency was proved in all patients after a successful remote endarterectomy.

Conclusions: Endovascular techniques in vascular surgery, remote endarterectomy is in our opinion a safe and durable method in the therapy of selected patients with PAOD (Tab. 4, Fig. 3, Ref. 8). Full Text (Free, PDF) www.bmj.sk.

Key words: peripheral arterial occlusive disease, remote endarterectomy, hybrid procedures.

Endarterectomy (EA) is one of the basic methods of revascularisation in the therapy of peripheral arterial occlusive disease (PAOD) (1, 8). This method is usually performed as an open endarterectomy or a remote endarterectomy with the use of ringstripper. Remote endarterectomy as a conventional method of revascularisation has been well known for decades. Its indications and technique were presented in several books and articles written by some outstanding vascular surgeons (Van Dongen, Vollmar etc.) (8). Open EA is usually considered as a simple method of revascularisation. On the other hand, remote EA, where a desobliteration of a long arterial segment is performed without a direct control of vision, needs a lot of experience with the use of ringstripper. According to the principle of this method, many vascular surgeons considered this technique to be at a very high risk for vascular injury, so they stopped to perform it in daily practice. In arteries with a severe calcification of the whole vessel wall it is almost impossible to create a correct dissection layer for ringstripper. In some case, the vessel wall could remain so thin after the endarterectomy that it cannot withstand the arterial pressure (8). In such cases, the risk of injury of the arterial wall during the endarterectomy could be relatively high. To minimalise the invasiveness of this technique by omitting the visualisation of proximal iliac arteries from an extraperitoneal

approach (cutting and fixation of proximal intimal flap), a combination of a ringstripper and a cutter has been invented (5, 8). Little invasiveness and an extensive enforcement of endovascular techniques in vascular surgery during the last period caused an increase of popularity of remote endarterectomy in the iliofemoral region (2, 5, 7). Remote endarterectomy has become one of the hybrid procedures that are used in the therapy of PAOD (4).

Remote retrograde endarterectomy as a hybrid procedure in the therapy of PAOD

In cases of long stenotic arterial lesions (femoral bifurcation – external iliac arteries 4–12 cm long, TASC C, D lesions) or with connection with short occlusions of iliac region that are obviously patent for glide wire, a retrograde remote endarterectomy/desobliteration of iliofemoral arteries with the use of ringstripper with subsequent angiography and proximal intimal flap fixation with stent/stentgraft and patchplasty of femoral bifurcation could be performed.

From a single groin incision after the dissection of femoral bifurcation and longitudinal arteriotomy of the most common femoral artery, a glide wire is introduced retrogradely into the aorta. After controlling the correct position of the glide wire with a pigtail catheter using an intraoperative angiography, an appropriate layer for ringstripper is created by dividing the atherosclerotic material from the media of the arterial wall. A remote retrograde endarterectomy/desobliteration with the use of ringstripper or Moll-ring-cutter is performed.

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Fig. 1. Retrograde endarterectomy in therapy of PAOD – Stenosis of the left iliac artery.

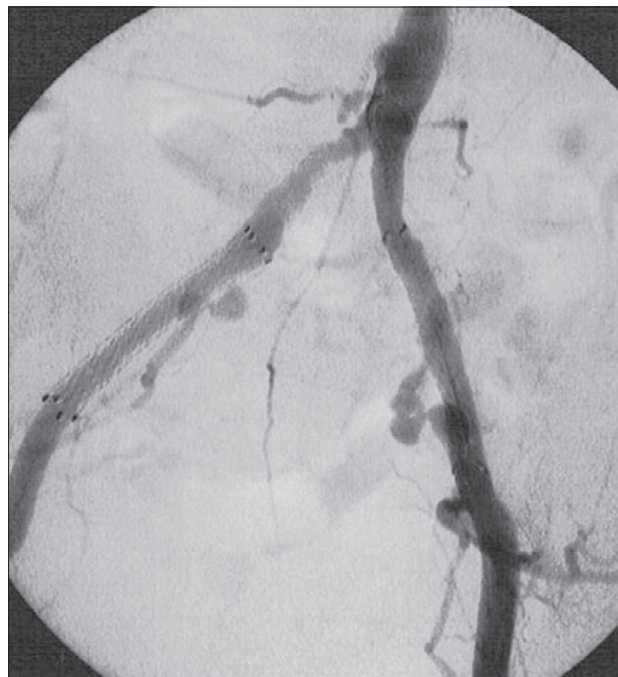


Fig. 3. Stenting of proximal intimal flap with durable iliofemoral region.

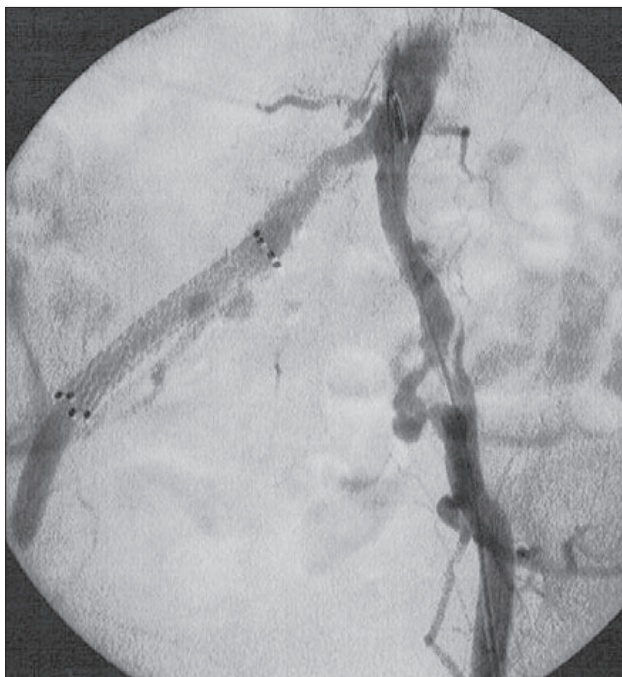


Fig. 2. Status after retrograde endarterectomy of common femoral artery – external iliac artery with proximal intimal flap.

After finishing the remote endarterectomy, a distal intimal flap fixation with a suture following a patchplasty of common femoral artery, and fixation of the glide wire running through or on the one side of the patch is performed. After the patchplasty, blood flow could be restored by declamping the external iliac

artery as well as deep and superficial femoral arteries. The angioplastic sheet and pigtail catheter is introduced retrogradely into the iliac artery (or Aorta) over the wire and intraoperative angiography of iliofemoral region is performed in an antegrade manner (5, 6).

Many times the proximal intimal flap partially occluding the arterial lumen can be observed by angiography or angioscopy after the retrograde endarterectomy. The proximal intimal flap in the form of dissection decreases blood flow leading in some cases to thrombosis or peripheral embolisation from an unstable plaque. In this case, a fixation with stent or stentgraft has to be performed. It is therefore necessary to control the patency of iliac arteries by intraoperative angiography after a successful remote endarterectomy. A correct position of the glide wire, intraoperative angiography and endovascular equipment are playing a major role in the safety of this procedure (1, 2, 5). The retrograde endarterectomy of iliac arteries performed as a hybrid procedure is presented in the Figures 1–3.

Material

In the vascular center Speyer – Mannheim 659 patients were operated on a symptomatic PAOD during the year 2007. In 381 cases a conventional vascular surgery, in 130 endovascular therapy, and in 116 cases hybrid procedures have been performed. This clinical retrospective study analyses a group of patients where a remote endarterectomy in the form of a retrograde endarterectomy using an intraoperative angiography and endovascular techniques has been performed. The type of the operation, classification according to Fontaine, peri and postoperative com-

Tab. 1. Retrograde endarterectomy as a part of complex revascularisation in the therapy of PAOD (Speyer-Mannheim 2007).

Procedure	Classification acc. to Fontain	n	Complications after operation	Revision/Reoperation (0-6 months after Op.)
remote endarterectomy CFA – EIA, angiography, femoropopliteal P I bypass (vein – 13x, PTFE – 4x)	IIb	8	1	0
	III/IV	9	1x wound haematoma	1x wound revision, VAC
remote endarterectomy CFA – EIA, angiography, femoropopliteal P III bypass. (vein – 6x)	III/IV	6	1x bypass occlusion	1x bypass revision, replacement of vein for PTFE, necrectomy, mesh graft, VAC (4 th. day after Op.)
remote endarterectomy CFA – EIA, angiography, cross – over bypass	IIb/III	1	0	0
remote endarterectomy CFA - EIA, angiography, femoropopliteal P I bypass (vein – 1x, PTFE – 1x) – one side, patch – other side	IIb	2	0	0
remote endarterectomy CFA - EIA, angiography femoro-crural bypass	III-IV	2	0	0

CIA – common iliac artery, CFA – common femoral artery, EIA – external iliac artery, Op. – operation, SFA – superficial femoral artery, VAC – Vacuum assisted closure

plications, peri- and postoperative mortality, technical and clinical success and the patency (duplex ultrasound surveillance 0–6 months) were reviewed retrospectively. The aim was to point out and present the complications associated with this procedure.

Results

During the year 2007, a remote endarterectomy in the form of retrograde endarterectomy of iliac arteries using an intraoperative angiography and endovascular equipment was planned in 83 patients. A technical success was achieved in 72 patients (86 %). In 11 cases (13.25 %), the remote endarterectomy was planned, but due to perioperative findings/morphological characteristics (5 cases) or perioperative complications (6 cases) an alternative vascular procedure had to be performed.

In most cases, the failure of the procedure was caused by:

A) Unfavorable morphological findings:

— Due to severe calcification of the whole vessel wall without the possibility of creating a correct dissection layer for ringstripper (4x). Because of perioperative findings, an alternative procedure was primarily performed in all four cases.

B) Perioperative complications:

— Long obliteration of iliac arteries (whole external iliac artery and nearly whole common iliac artery) without the possibility of glide wire passage (5x). An unsuccessful retrograde endarterectomy without the use of glide wire was performed. The whole iliac region could not be desobliterated entirely. The rest of atherosclerotic material could not be removed by ringstripper without a very high risk of vessel wall injury.

— Dissection of iliac vessels without the possibility of reentering the proximal iliac artery with the glide wire and correction with endovascular technique (fixation with stent/stengraft) and without the possibility of removing the occluding intimal flap with ringstripper (1x).

— Severe dissection of distal aorta and both iliac vessels after the fixation of proximal intimal flap with a balloon-expandable stent in the origin of common iliac artery (1x). The retrograde endarterectomy was performed with the intention to fixate the proximal intimal flap with a balloon expandable stent. A severe dissection of distal aorta occurred after the stent deployment without the possibility of correction with endovascular technique. Alternative operative methods (Tab. 4).

Both in the group of patients with a solitary successful retrograde endarterectomy and in the group of retrograde endarter-

Tab. 2. Retrograde endarterectomy as solitary procedure, or in combination with open endarterectomy of femoral bifurcation in therapy of PAOD (Speyer-Mannheim 2007).

Procedure	Classification acc. to Fontain	n	Complications after operation	Revision/Reoperation (0-6 months after Op.)
remote endarterectomy CFA – EIA, angiography, patch CFA	IIb	7	0	0
	IV	3	0	1x below knee amputation
remote endarterectomy CFA – EIA, angiography, open endarterectomy SFA, patch CFA - SFA	IIb	1	0	0
	IV	1	1x occlusion CFA – SFA (old SFA occlusion, left DFA orificial stenosis)	1x revision, thrombectomy CFA - EIA, patchplasty CFA- DFA, toe-amputation (3 th. day after Op.)
remote endarterectomy CFA – EIA, angiography. open endarterectomy PFA, patch CFA - DFA	IIb	4	0	0
	III	2	0	0
	IV	6	0	1x toe amputation

CIA – common iliac artery, CFA – common femoral artery, EIA – external iliac artery, Op. – operation, DFA – deep femoral artery, SFA – superficial femoral artery

ectomy with bypass, 5 subsequent operations in the postoperative period were needed. Only 1 operation (1x occlusion of common femoral artery, superficial femoral artery was occluded and a severe stenosis of deep femoral artery in the bifurcation was present) was necessary due to a direct relation to retrograde endarterectomy. In all patients a clinical and doppler-duplex examination was performed during the follow up. The patency after the arterial reconstruction was 100 % in the following 6 months in both groups. In the group of hybrid procedures (20 patients – 24.1 %), where the remote endarterectomy was used, 9 operations had to be performed. Only in 3 cases (from 9) it was necessary to provide the patency of a complex revascularisation and only 1 (from 9) operation had to be done with relation to an unfavorable outcome after the remote endarterectomy (1x – restenosis of a. iliaca communis after the intraoperative stenting – repeated dilatation and femoral-fibular bypass was performed). As in the first two groups, also in the group of hybrid procedures a 100 % patency was observed. There was no peri- and postoperative mortality observed during the following 6 months. The clinical success (according to clinical examination und doppler-duplex ultrasound) in postoperative period was observed in 71 (98.6 %) from 72 patients that underwent a successful retrograde endarterectomy. Results are presented in Tables 1–4.

Discussion

The remote retrograde endarterectomy/desobliteration in combination with an intraoperative angiography and endovascular

technique as a hybrid procedure is mainly used in revascularisation of iliofemoral arteries (3, 4, 5). Our experiences demonstrate that complications related to this procedure are relatively seldom.

The main risk factors were following: severe atherosclerosis and calcification of the whole arterial wall, obliteration of the entire iliac region, unsuccessful passage of the glide wire through the obliterated and severely stenosed iliac arteries and performing retrograde endarterectomy without a glide wire, severely dilated and coiled iliac arteries, vascular surgeon with no experiences in using ringstripper or endovascular techniques.

In our opinion, main complications related to this procedure involve: inability to desobliterate the entire occluded or stenotic region, inability to divide the atherosclerotic cylinder in the iliac bifurcation or proximal external or common iliac artery, loss of the glide wire by inadequate manipulation without the possibility of fixation of an occluding proximal intimal flap with a stent or stentgraft, injury of the arterial wall during the endarterectomy or by creation of a dissection layer for ringstripper, injury (perforation/dissection) of the arterial wall with the glide wire during the introduction or passage through stenotic or occluded arterial lesions, dissection or occlusion of the aorta or iliac arteries resulting from an incorrect manipulation with endovascular equipment (stents, sheets, catheters, etc.), embolisation from an unstable intimal flap or plaque after the endarterectomy or stenting.

It is necessary to be careful while removing the atherosclerotic cylinder from the iliac artery or stenting the iliac bifurca-

Tab. 3. Retrograde endarterectomy as a part of hybrid procedures in the therapy of PAOD (Speyer-Mannheim 2007).

Procedure	Classification acc. to Fontain	n	Complications after operation	Revision/Reoperation (0-6 months after Op.)
remote endarterectomy CFA – EIA, angiography, patch CFA, ITA SFA	IIb	4	0	0
remote endarterectomy CFA – EIA,angiography, patch CFA, ITA PA (PI)	IIb	2	1x SFA-PA dissection	1x femoro-popliteal PI bypass (24 h. after Op.)
remote endarterectomy CFA – EIA, angioplasty, patch CFA, ITA (PA, crural arteries)	IV	2	0	2x toe amputation, necrectomy 1x transmetatarsal amputation
remote endarterectomy CFA – EIA, angiography, patch CFA, ITSA CIA-EIA, ITA SFA, necrectomy	IV	1	0	0
remote endarterectomy CFA – EIA, patch CFA ITA CIA - EIA	IIb	2	0	0
remote endarterectomy CFA – EIA, patch CFA ITSA CIA - EIA	IIb IV	2 2	0 1x CIA restenosis after stentangioplasty CIA – EIA	0 1x re-stentangioplasty, femorofibular bypass (11 th. day after Op.)
remote endarterectomy CFA – EIA, patch, ITA / ITSA CIA – EIA femoro-popliteal PI bypass (vein), necrectomy	IV	3	1x bypass occlusion	1x femoro-fibular bypass (3 th. day after Op.) 2x toe amputation 1x transmetatarsal amputation
remote endarterectomy CFA – EIA, ITSA CIA – EIA, cross-over bypass	IIb	2	0	0

CIA – common iliac artery, CFA – common femoral artery, EIA – external iliac artery, Op. – operation, SFA – superficial femoral artery, PA – popliteal artery, ITA – intraoperative angiography, ITSA – intraoperative stentangioplasty

tion (a. iliaca communis — a. iliaca externa) in the case of a patent internal iliac artery (3, 4). This artery may remain patent in nearly all cases despite the endarterectomy or stenting due to a high blood flow in this region. The only exception are severely stenosed origins of internal and external iliac arteries, where a stentangioplasty of the common iliac artery and external iliac artery can result in an occlusion of the surrounding artery caused by the pressure and movement of the atherosclerotic plaque into the lumen of the internal iliac artery.

Performing the retrograde endarterectomy with the use of endovascular equipment, endovascular techniques enormously contributed to the safety and decreased invasiveness of this pro-

cedure, considering that the proximal intimal flap fixation through a separate extraperitoneal approach is no longer necessary. An intraoperative angiography plays an inevitable role in the visualisation of iliac arteries after endarterectomy and in the decision of proximal intimal flap fixation with an endovascular stent.

In our group of patients, proximal intimal flap fixation was needed in 8 (11.1 %) from 82 patients. That is why the manipulation with the glide wire must be very careful. In the case of a slipped glide wire, it is occasionally impossible to introduce the glide wire retrogradely and reenter the arterial lumen towards the proximal intimal flap, although a selective catheter is used. In this case a crossover or transbrachial approach is used for

Tab. 4. Operations where retrograde endarterectomy had been planned, but because of perioperative findings or complications an alternative procedure was performed (Speyer-Mannheim 2007).

Planned procedure	Classification acc. to Fontain	Alternative procedure	Complications after operation	Revision/reoperation (0-6months after Op.)
remote endarterectomy CFA – EIA, angiography, patch CFA, ITSA CIA – EIA	IIb (5)	4x rEA CIA-EIA contra-lateral, angiography and cross over bypass	1- wound seroma	conservative therapy
		1x rEA EIA contra-lateral, stentangioplasty and cross over bypass	0	0
	III/IV (6)	3x Iliofemoral bypass and cross over femoro-femoral bypass	2x wound haematoma	1x revision, drainage
		1x Y- bypassu (24h. after the operation) (severe dissection afer stentangioplasty)	1x wound haematoma 2x progression of necrosis on the foot	1x revision, drainage 1x tranmetatarsal amputation 1x below knee amputation
		1x Iliofemoral bypass	0	0
		1x axillo-femoral bypass (infection in the groin)	0	0

CIA – common iliac artery, CFA – common femoral artery, EIA – external iliac artery, rEA – remote retrograde Endarterectomy

stenting the contralateral intimal flap. This may lead to an unexpected delay and, in the worst case, to the change of the operative strategy (conversion of operation) and the revision of the proximal intimal flap by exploring the iliac arteries from an extraperitoneal approach. If an injury (leakage of contrast agent) of the vessel wall occurs during an intraoperative angiography, a tamponade of injured artery with PTA balloon is performed followed by an angiographic control. In the case of a persistent retroperitoneal bleeding, an occlusion of the iliac artery with an PTA balloon and open revision or endovascular bridging with a stentgraft (Viabahn, Fluency, Atrium) and postoperative observation on an ICU seem to be necessary. There were no cases of arterial occlusion or vessel wall injury in our group of patients during the year 2007.

We think that a careful selection of patients plays a major role in a successful performance of this technique. Selection of the patients that are suitable for performing the retrograde endarterectomy often takes place during the operation. In our group of patients in whom the remote endarterectomy of iliac arteries as a hybrid procedure was planned, in four cases an alternative

procedure was primarily performed because of perioperative findings. The remote endarterectomy could not be forced. All patients are informed about an alternative procedure or operative conversion in cases of an unsuitable perioperative findings or technical failure. An alternative procedure must be therefore considered when preparing the operation field.

Advantages of this technique include a very low invasiveness and the possibility of revascularisation of long arterial segments that are not suitable for endovascular therapy (TASC C, D morphologic stratifications of iliac lesions). On the other hand, the retrograde remote endarterectomy with the use of intraoperative angiography and endovascular methods in comparison to conventional vascular surgical techniques enables the shortening of the operating time and the time of ischaemia with a relatively good middle and long term results in a high risk patients. In performing this hybrid procedure, only a single groin incision is needed. In combination with endovascular techniques or bypass, the complex arterial lesions of more arterial regions can be treated (3, 5, 6).

We believe that performing the remote retrograde endarterectomy as a hybrid procedure enables:

– shortening operative range, time of operation and ischaemia, shortening the time of hospitalisation and gives better chances for a high risk patients,

– in many cases an exclusion of prosthetic materials (if great saphenous vein or an arterial vessel wall after local endarterectomy could be used as a patch),

– revascularisation of several arterial regions (retrograde endarterectomy in combination with other endovascular techniques or bypass).

The short and middle term results after the retrograde remote endarterectomy of iliac arteries performed as a hybrid procedure are good according to our experiences from the last years, and correlate with the observations of other authors (although these results are not presented here considering the aim of this study) (6). We think that the morphological characteristics – especially a large diameter of iliac arteries and a high blood flow participate in these good results.

Conclusion

Despite the fact, that the remote retrograde endarterectomy is an old method of revascularisation, performed as a hybrid procedure is safe and still used in surgical practice. The usage of endovascular techniques in surgeon's hand made vascular surgery more safe. Due to this fact, revascularisation of iliofemoral arteries in the last years has become less invasive. Considering the progression of atherosclerosis and possibility of occlusion of vascular reconstruction, future alternative angiosurgical procedures (delay of final operation) have to be considered. This is the aspect why many vascular surgeons consider endovascular therapy or hybrid operations of the iliac region as the first line

treatment. Due to the simplicity and little invasiveness of endovascular techniques with a good short and middle term results, a decreased number of conventional vascular operations has been observed. This is true especially for the iliofemoral region where conventional techniques are often replaced with endovascular and hybrid procedures (2, 5).

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