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Short and Medium-Terms Outcomes of Endovascular Treatment of Atheromatous Lesions of the Femoral Artery Bifurcation: A Systematic Review

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Abstract

The objective of this literature review is to evaluate the short- and medium-term results of endovascular treatment of atheromatous lesions of the femoral arterial bifurcation. To do this, we used the PRISMA method. This last allowed us to collect 13 articles.

The average age was 70-11 years with 67.7% claudicants. Stenting was performed in 40% of patients. In the short term, the technical failure rate is 5% and the 30-day mortality rate is 1.2%. In the medium term, the overall primary patency rate at 1 and 2 years was 78% and 75%, respectively.

These results of endovascular surgery of the femoral tripod should be interpreted with caution because of the variety of procedures adopted by the different teams.

Keywords: Femoral artery bifurcation; Endovascular; Atheromatous; Outcomes; Stenting

Abbreviations: TLR: Target Lesion Revascularization; TER: Target Extremity Revascularization; CFA: Common Femoral Artery; SFA: Superficial Femoral Artery; PFA: Profound Femoral Arte**ry**

Introduction

Endovascular treatment has become, in the last two decades, as an alternative to conventional surgery for the treatment of both aortic and peripheral arterial diseases. The limits of these endovascular therapies are constantly being repulsed and the femoral arterial bifurcation (femoral tripod) is one of the examples that illustrates the extension of indications to territories previously considered to be contraindicated. Although femoral tripod open surgery is the gold standard for atheromatous lesions [1], it remains associated with a postoperative mortality of 3.4% [2] and a significant local complication rate, ranging between 6.6%. and 28.3% according to the literature, with type of surgical site infection, hematoma, lymphorrhaea and paresthesia [2-4] requiring reintervention in more than one third of cases [5].

The postoperative morbidity and mortality associated with this surgery on the one hand and the minimally invasive character of the endovascular treatment on the other hand, have led some authors to seek an alternative to surgery and to report the results of their endovascular approach experiments, at the level of the femoral tripod. Actually, the respective place of endovascular treatment and surgery, in the management of occlusive lesions of the femoral tripod, remains controversial between the proponents of surgery who argue for a better long-term permeability: primary and primary patency assisted at 5 years of age respectively by 91% and 100% [6]; and advocates of endovascular treatment who emphasize the reduction of mortality, morbidity and length of stay [1]. Different endovascular approaches (simple angioplasty, cutting balloon, atherectomy, stenting) have been proposed but no consensus exists on the optimal technique. Thus, this work aims to take stock of the outcomes of endovascular treatment at the level of the femoral tripod, through a systematic review of the literature.

Materials and Method

This review of the literature was performed in accordance with the P.R.I.S.M.A recommendations (Preferred Reporting Items for Systematic Review and Meta-Analyzes). The studies are identified through an electronic search on the "Embase" and "MEDLINE" databases between 2000 and 2017.

The following terms: "atherosclerosis", "peripheral artery disease", "intermittent claudication", "limb ischemia" , "Stenosis", "occlusion", "endovascular", "angioplasty", "balloon", "stent", "common femoral artery", were used in combination with the Boolean operators AND or OR. Two independent observers reviewed the abstracts of the publications to determine the eligibility of the studies for inclusion.

Inclusion criteria include:

1) studies reporting 10 or more patients treated.

2) for atheromatous lesions of the common femoral artery.

3) endovascular.

4) These lesions may be isolated or associated with ilio-femoro-popliteal lesions.

5) Short-, medium- or long-term results should be clearly described.

Exclusion criteria include:

1) Clinical cases and series of fewer than 10 patients,

2) Treatment of restenosis or traumatic injury,

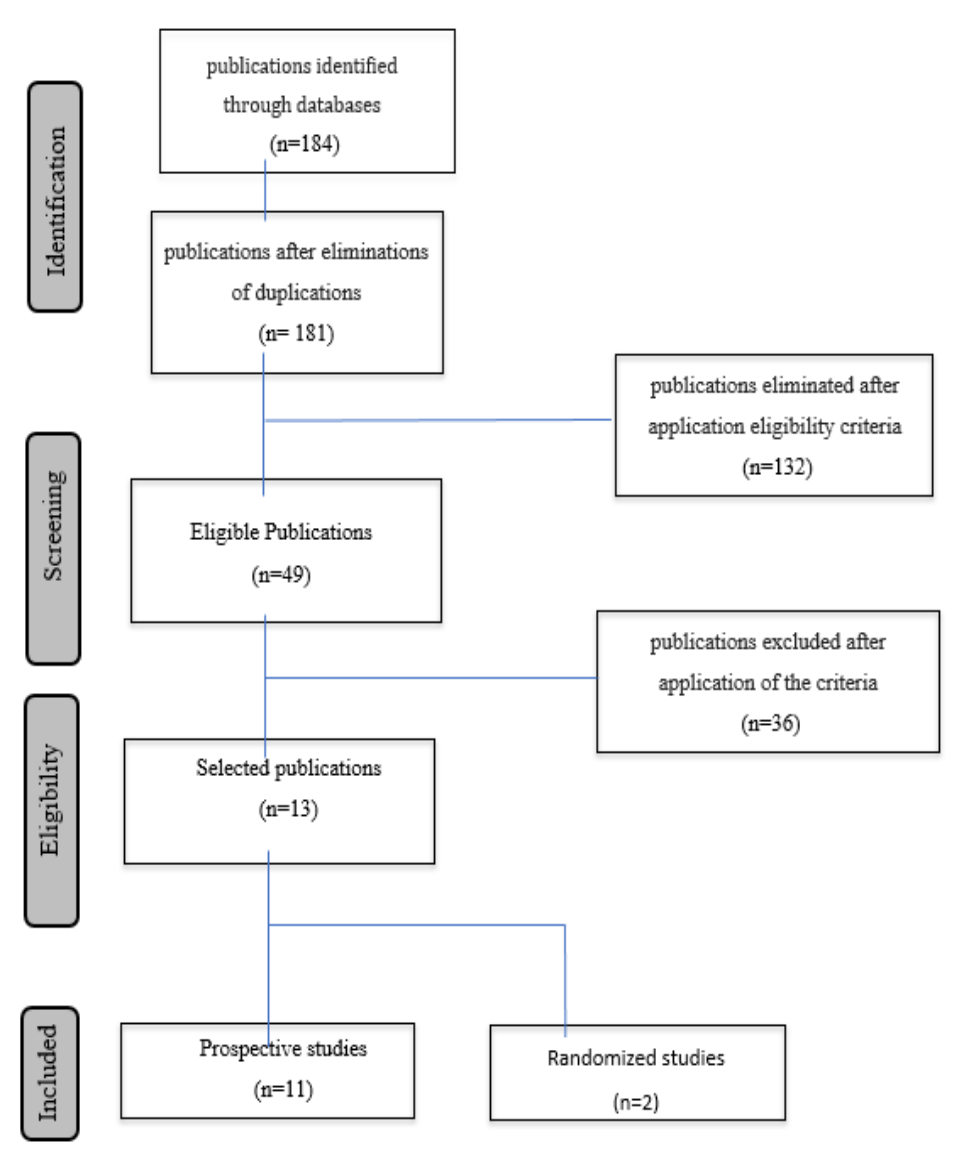

Figure 1: Summary of the bibliographic search.

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3) Series reporting a mix of femoral, iliac and femoro-popliteal lesions (Figure 1).

The following data is collected from each selected article:

a. Age,

b. Preoperative data including indication, topography, length of lesions, proportion of complete occlusion and proportion of severe calcification;

c. Intraoperative data including: the percentage of stenting and the type of stent used;

d. Short-term results: technical failure rate, mortality and morbidity at 30 days;

e. The results in the medium or long term: duration of follow-up, primary permeability rate, assisted primary and secondary, re-intervention rate at the target lesion (TLR), restenosis rate and stent fracture.

Results

From the 184 abstracts initially identified by the electronic bibliographic search, 49 were eligible. After careful analysis of the corresponding articles, 12 publications fulfilling all of our inclusion criteria were selected for this systematic review. We had as a result of our research 184 publications on the surgery of the common femoral artery. Forty-nine publications dealt with endovascular surgery of the common femoral artery. According to our exclusion criteria, we selected 13 publications. The latter consisted of 11 retrospective studies and two prospective randomized studies; with a total of 2011 procedures.

Pre and intraoperative results:

The average age was 70 ± 11 years old. The claudicant population accounted for 67.7%. The average lesion length of the femoral tripod was 25 ± 9mm. According to our modified classification of Azema et al. [7] 50% of the lesions are classified as type III and IV (interesting femoral artery bifurcation) (Table 1).

Table 1: pre et per-opérative data.

Authors	n	Type of Study	Age	Claudicants : n (%)	Topography of Lesions: n(%)	L lesions (mm)	Occlusion : n(%)	Severity of Calcifications n (%)
Silva 2004	21	Retrospective	64,9 ±9,79	12 (57)	NR	NR	NR	NR
Cotroneo 2009	27	Retrospective	82,1 ± 6,4	8 (44,4)	NR	17.2 +/- 5.8	NR	19 (70)
Baumann [16]	98	Retrospective	72 ± 11	78 (79,5)	NR	30.6+/- 11.7	NR	NR
Bonvini [3]	360	Retrospective	67,6 ± 9,1	250 (77,9)	NR	NR	81 +/- 12	NR
Azema [7]	36	Retrospective	67,3 ± 11,7	28 (70)	Type I 8 (20) Type II 17 (42,5) Type III 10 (25) Type IV 5 (12,5)	NR	NR	NR
Soga 2013	111	Retrospective	72 ± 8	75 (82)	Bifurcation 51 (45,4)	31.3 +/- 11.1	19 (17,1)	92 (83)
Davies 2013	121	Rétrospective	71	NR	NR	NR	13 (11)	NR
Linni [14]	40	Randomized prospective	71,6 ± 9,7	24 (60)	Type II : 16 (40) Type III : 24 (60)	21+/- 8	NR	NR
De Blic 2015	34	Retrospective	68,8 ± 25	16 (47,1)	Type I 11 (31,4) Type II 11 (31,4) Type III 13 (37,2)	NR	19 (54,3)	NR
Thiney [11]	53	Retrospective	68	36 (68)	Type I 8 (15) Type II 19 (36) Type III 22 (41,5) Type IV 4 (7,5)	NR	4 (7,5)	8 (15)
Nasr [10]	40	Rétrospective	67,3 ± 11,7	28 (70)	Type I 8 (20) Type II 17 (42,5) Type III 10 (25) Type IV 5 (12,5)	NR	NR	NR
Siracuse [17]	1014	Rétrospective	67,4 ± 10,8	679 (67)	NR	NR	NR	NR
Gouëffic [1]	56	Prospective randomisée	68 ± 8	45 (82)	Type I 6 (10) Type II 21 (34) Type III 34 (56)	NR	NR	NR
Cumulative dara	2011		70 ± 11 ans	1279 (67.7%)	Type I 41 (16) Type II 101 (39) Type III 113 (43.6) Type IV 14 (5.4)	25±9 mm	136 (20%)	119 (62.3%)

NR: not reported; BE: balloon-expansible; AE: auto-expansible; BioA: bioabsorbable.

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With the exception of two studies reporting cutting-balloon angioplasty results and angioplasty-associated atherectomy, the technique used in most studies was angioplasty with or without stenting. In total the proportion of stenting is 40% of procedures. Four studies consistently performed angioplasty plus stent for all treated patients.

Table 2: Short and medium terms outcomes.

Authors	Failure Rate n (%)	Stent Fracture n (%)	30 Days Mortality	30 Days Mortality	Follow up (Month)	PP (%)	APP (%)	SPS (%)	TLR (%)	TER f (%)	Resténosis Rate n(%)	Reintervention Rate (%)
Silva 2004	2 (10)	NR	1 (5)	0	11.4 ± 6	NR	NR	NR	100 (1an)	NR	NR	0
Cotroneo 2009	0	NR	0	0	18	57,9 (1 y)	NR	79,6 (1 y)	NR	NR	7 (25,9)	10 (37)
Baumann [6]	2 (2)	NR	0	NR	16	NR	NR	NR	Claud : 85 (1y) 70 (2y) CLI : 73,2 (1y) 30 (2 y)	Claud 80 (1y) 75 (2y) CLI 65 (1y) 30 (2y)	NR	NR
Bonvini [3]	26(7)	NR	NR	NR	10 ± 5	NR	NR	NR	80 (1y)	NR	99 (27,6)	NR
Azema [7]	0	1(2.7)	0	1 (2,8)	22	NR	NR	NR	85 (1y)	80	7 (20)	1 (2,8)
Soga 2013	5 (4,2)	0	0	7 (7,2)	NR	73.5 (1y) 67 (2y)	100 (1y) 97,6 (2y)	NR	NR	NR	NR	1 (0,9)
Davies 2013	12 (10)	NR	2 (2,5)	12 (10)	28	NR	NR	NR	NR	85 (1y) 77 (2y)	22 (18,2)	15 (12,4)
Linni [14]	0	0	NR	NR	12	80 (1y)	NR	100 (1y)	NR	97,5(1y)	6 (15)	4 (10)
De Blic 2015	0	NR	0	2 (5,7)	11	88 (1y)	NR	NR	84 (1y)	55 (1y)	4 (11,4)	19 (57)
Thiney [11]	2 (4)	4 (9.4)	0	3 (5,7)	24	NR	NR	NR	96	89	2 (3.7)	2 (3,8)
Nasr [10]	0	1 (2.5)	0	2 (5)	64	78,5 (1y) 78,5 (2y) 72 (5y)	100 (1y) 100 (2y) 96 (5y)	NR	88,4 (1y) 79 (5y)	87,8 (1y) 73 (5y)	11 (28)	21 (52,5)
Siracuse [17]	42 (4,1)	NR	16 (1,6)	100 (9,9)	12	NR	NR	83 (1y)	NR	NR	NR	45 (4,5)
Gouëffic [1]	3 (5)	1 (1.7)	0	3 (6,4)	24	88 (1y) 88 (2y)	NR	NR	85 (1and 2y)	78 (1 and 2 y)	0	0
Cumulative data	100 (5%)	7 (2%)	19 (1.2%)	130 (8.5%)	21 months	78% à 1 y	98.2% à 1 y	83.5% à 1 y	83,7% à 1y	82,9% à 1 y	158 (20,6%)	118 (7,6%)

Short and medium terms results

In total, the technical failure rate is 5% ranging from 0 to 10%, with a 30-day mortality rate of 1.2% (0 to 5%).

During the follow-up period, which averaged 21 months (10 to 64 months), stent fractures were observed in 2% of cases and restenoses noted in 20.6%. The reoperation rate reported at the end of this follow-up period is 7.6%. Thus, the overall primary patency rate at 1 and 2 years was 78% and 75%, respectively. The overall primary assisted patency rate at 1 and 2 years was 98.2 and 98%, respectively, while the secondary patency was 83.5% at 1 year (Table 2).

Discussion

Endovascular treatment of femoral tripod lesions is a recent approach advocated by some authors but not yet commonly accepted as the technique of choice for these lesions. The advantages of this technique demonstrated by the two randomized studies [1,8] and confirmed by our review of the literature, are lower mortality and morbidity compared to conventional surgery. Our work reports an overall mortality rate of 1.2% and morbidity of 8.5% after endovascular treatment, whereas they are respectively 3.4% and 37% for endarterectomy [2,9]. However, in the medium term, the results of primary, assisted primary and

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secondary permeabilities seem to favor surgery. Indeed, our systematic review shows a primary and primary assisted patency rate at 2 years respectively of 75% and 98% and a secondary patency rate at 1 year of 83.7%. These data contrast with those of endarterectomy whose primary patency at 1 year is 100% and that at 5 years of 82.5% [5]. It should be noted that the duration of follow-up of the "endovascular" series is relatively short (mean <2 years) with the exception of the Nasr et al. [10] study which reports results at 64 months [11]. In addition, TLR (Target Lesion Revascularization) and TER (Target Extremity Revascularization), which are used by most "endovascular" series, are not used in open surgery. According to this systematic review, the percentage of intervention following endovascular treatment is 7.6%. The latter are mainly related to thrombosis of the common femoral artery after angioplasty or intra-stent restenosis [8]. The rate of restenosis is not often evaluated after endarterectomy. Those found are relatively weak: Kuma et al. [12] reported 0.8% of restenosis and Nishibe et al. [13] evaluated it at 5.2%. The rate of reintervention in relation to postoperative complications, technical failures and restenosis are important after endovascular surgery. Nasr et al. [10] has recovered more than half of its series with 52.5% of reinterventions and Linni et al. [14] with 57%. Moreover, the reintervention, after endarterectomy, is weak with 1.8% for Kechagias et al. [15], 10.8% for Nguyen et al. [2] and 5% for Kang et al. [6].

These results of endovascular surgery of the femoral tripod should be interpreted carefully because of the variety of procedures adopted by the different teams. Azema et al. [7] advocate the eviction of stent deployment on the segment of the common femoral artery with respect to the hip-femoral joint, to avoid stent fracture hence its classification. Thus, type III should benefit from first-line angioplasty. The use of a single stent is recommended in the treatment of lesions of the femoral artery bifurcation. On the other hand, for Bonvini et al. [3], the use of the stent is identified as the only independent protective factor against the failure of the procedure, the TER and restenosis, at 1 year. Baumann et al. [16] found more satisfactory results in the group that benefited from stent implantation in terms of clinical improvement. Linni K [14] concludes that bioabsorbable stents are not a good option for calcified occlusive lesions of the femoral tripod due to the lack of satisfactory radial force. In addition, the frequent presence of osteoid metaplasia in the femoral tripod, which is a mature bone structure, often compromises the procedure [1]. Indeed, the dexterity of the endovascular surgeon, his equipment and the technical choice are independently related to the reduction of the risk of technical failure with an odds ratio of 0.2 [3]. In addition, the use of new generations of Nitinol stents should make it possible to treat periarticular vascular segments because of their resistance to compression and fracture, under the constraint of physiological torsion [8]. In total, the indication of stenting has no consensus in the literature. It should be noted that the stenting technique concerning the bifurcation has not been clearly defined by the quasi-majority of authors. Only Thiney et al. [10] describe their technique with the use of a single stent between Common Femoral Artery (CFA) and Superficial Femoral Artery (SFA) covering Profound Femoral Artery (PFA) or between CFA and PFA covering SFA; and their two-stent technique: one in the CFA extending into the SFA and one in the PFA without overlap [17].

Conclusion

The less satisfactory outcomes of endovascular treatment in the medium term are related to the lack of technical consensus on the choice between angioplasty and/or stenting and the anatomical particularity of the femoral tripod. The latter should be taken into account when considering therapeutic choices, like coronary bifurcations for interventional cardiology.

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