

# The Treatment of Popliteal Artery Aneurysm

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July 25, 2020

## Abstract

Surgical treatment of Popliteal Artery Aneurysm (PAA), either medial or posterior approach, remains controversial. Debate continues regarding which approach has the less morbidity and the better long patency. A single center retrospective study in our department was done comparing the primary patency between the two different approaches. Both approaches have relatively the same primary patency. Concerning the bypass material, vein bypass stays patent for a longer period of time. By adding the preoperative run-off situations as a variable to compare the two approaches, the posterior approach using the vein as a bypass material has more competitive results. With a poor run-off situation, the prognosis is not promising.

## Introduction

Popliteal Artery Aneurysm (PAA) is rare but it can lead to significant morbidity and mortality. The incidence of PAA is not well known, however many studies suggest that the prevalence increases with age (during the sixth or seventh decade of life).<sup>1</sup>

50% of PAA comes bilateral and 35% of patients with PAA have an Abdominal Aortic Aneurysm (AAA).<sup>2</sup>

By definition, PAA is a focal dilation in its diameter of more than 50% of the normal vessel diameter.<sup>3</sup>

Atherosclerosis tends to increase flow turbulence distal to a stenosis leading to a pathological dilation of the artery.

The rate of amputation following an acute ischemia due to PAA falls between 25% and 59% and the mortality rate is 11%.<sup>4</sup>

Different surgical techniques for open surgical repair include posterior approach and medial approach. This study is of a single center experience managing PAA from 2002 to 2016 and focuses on comparing the primary patency between the medial approach and the posterior approach and its relation to the run-off of the lower limbs.

## Method and Results

In the study, conducted from 2002 till 2014, an electronic database was used to collect data on 43 patients. The primary patency of these PAAs was followed. Five PAAs were treated through an endovascular technique and were excluded from this study.

The preoperative variables include the approach of the operation (either medial or posterior), the type of bypasses used in these approaches, and the vascular situation preoperatively with regard to the run off vessels at the lower limbs.

The preoperative diagnostics include Doppler Ultrasound, digital arterial subtraction angiography (DSA), and CT- Angiographies. The indication for treating an asymptomatic PAA was a diameter  $> 2$  cm. With the symptomatic PAA, the diameter of the PAA was unrelated. The ankle-brachial index (ABI) was preoperatively not fully documented, so these values were excluded from this study.

Vascular surgeons did all operations. The choice for which approach was performed was dependent on the anatomy. In urgent cases, the medial approach was chosen.

The first chosen graft material to be used in these operations was the vein graft. When the vein graft was not anatomically available, then the prosthetic graft, PTFE and Dacron, was used instead. During the 3 to 4 postoperative days, the patients received parental heparin therapy, which was then converted to oral anticoagulants lifelong. The patients also received anti-platelet therapy.

The superficial saphenous vein bypass was used in most of the vein bypasses. Almost all of the cases had the disease located in the P2 segment, but some had it located in the PI segment.

This study analyzes the PAA in 43 patients. Of the 43 patients, 10 were found to have bilateral PAA and, therefore, fell in more than one category. Consequently, the data shows the results of 53 patients in total.

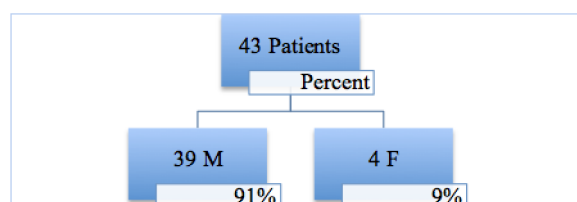
### Demographic Data

39 patients were male (91%) and 4 were female (9%). Fifteen patients were in the age group 60-69 (35%) and thirteen patients were in the age group from 70-79 (30%).

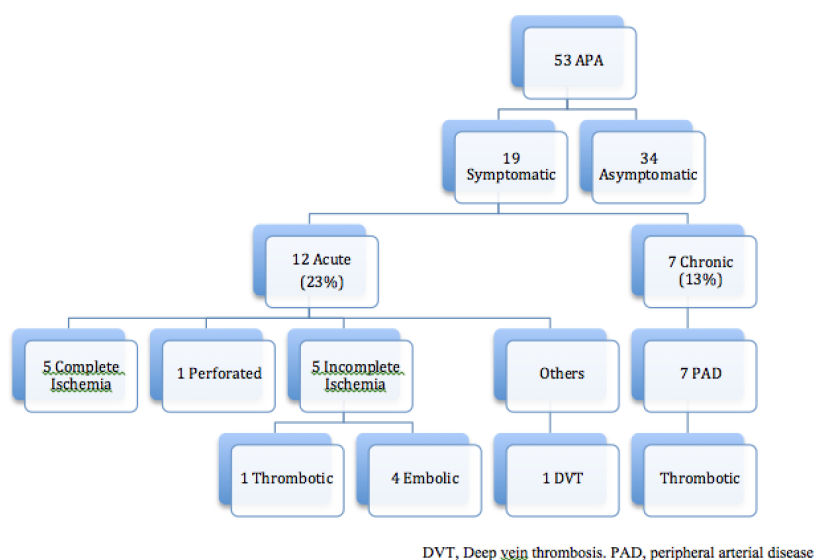
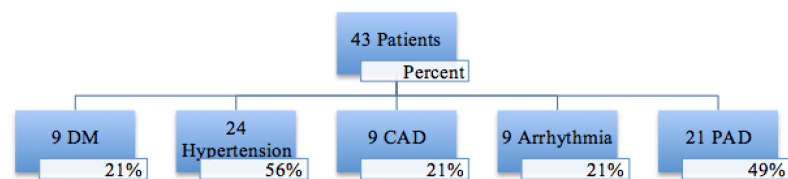
The number of patients with symptomatic PAA was 34 (64%). 11 Patients came with acute ischemia (23%). 7 patients showed a picture of peripheral arterial disease as claudication by totally obstructed thrombotic PAA (13%).

As for the associated diseases, 56% of the patients had hypertension and 21% had atrial fibrillation.

18 patients had other aneurysms elsewhere, 13 of these patients showed symptoms of an Aortic Artery Aneurysm AAA. (30%)



Age Group	40-49	50-59	60-69	70-79	Over 80
How many patients?	2	5	15	13	6
Percent	5%	12%	35%	30%	14%



The PAAs had a mean diameter of 3.96 cm. The largest diameter PAA was measured at 12 cm.

Most of the PAA were located in PII segment of the popliteal artery and some were located in the PI segment.

## Operative Results

27 operative procedures were performed using the posterior approach (51%) and 20 were performed using the medial approach (38%). Five cases were treated through endovascular maneuvers (9%) and they were excluded from this study.

One case showed a septic popliteal artery aneurysm with perforation, which needed a primary above knee amputation. This case was also excluded from this study.

The study analyzes the posterior approach cases (27) and medial approach cases (20).

For the cases treated with posterior approach, 21 cases were treated with vein bypass and 6 were treated using a prosthetic bypass. Of the 21 cases treated with vein bypass, 20 used the long saphenous vein. The short saphenous vein was used as a bypass material in the remaining case.

As for the cases performed by the medial approach, 14 were treated with a long saphenous vein as the bypass material and six were treated using a prosthetic bypass. (PTEFE and Dacron).

#### Treatment

20 Medial Approach (38%)		27 Posterior Approach (51%)		5 Endovascular (9%)	1 OSA (2%)
14 Vein BP (27%)	6 Prosthetic BP (11%)	21 Vein BP (40%)	6 Prosthetic BP (11%)		

### 30 Days Postoperative Results

The mortality rate was zero. Six patients had postoperative complications. Two patients suffered from early bypass obstruction and with no succeeded revascularization, which led to an above knee amputation. Two other patients with early bypass obstruction received a revascularization. One patient had postoperative bleeding and one had a surgical wound healing complication with lymph secretion.

#### Re-Intervention

Re-Intervention	AKA	New BP	Lymph Secretion	Bleeding
Number of Patients	2	2	1	1

### Follow-Up

The follow-up program included assessments at six-month, 1-year and 2-year intervals. It included the clinical evaluation, Doppler ultrasound examination, and the ABI measurement.

The limb salvage rate was 100% in the asymptomatic group and above 90% in the symptomatic group. The primary patency was documented.

The primary patency rate in the posterior approach group was 93%, 70%, and 63% in comparison to 75%, 65%, and 50% in the medial approach.

The Run-off classification of the patients were divided into <2 and [?] 2 below knee vessels.

The patients with a pre-operative Run-off <2 showed a primary patency rate 61%, 44% and 33% while the results at the run-off [?] 2 group were 91%, 74% and 63%.

# The Preoperative Angiographic Lower Limb Scans and the Postoperative Primary Patency Rate

	53 Runoff					
	18 Runoff < 2 (34%)			35 Runoff ≥ 2 (66%)		
Time Interval	6 M	1 Y	2 Y	6 M	1 Y	2 Y
How many? Percent	11 (61%)	8 (44%)	6 (33%)	32 (91%)	26 (74%)	22 (63%)

## Results

	27 Post Approach			20 Med. Approach			5 Endovasc.	1 AKA
	6 M	1 Y	2 Y	6 M	1 Y	2 Y		
Time Interval								
How many? Percent	25 (93%)	19 (70%)	17 (63%)	15 (75%)	13 (65%)	10 (50%)		

## Comparison between the Primary Patency Rate According to the Chosen Approach and the Bypass Material

	27 Post Approach					
	21 Vein (78%)			6 BP (22%)		
Time Interval	6 M	1 Y	2 Y	6 M	1 Y	2 Y
How many? Percent	21 (100%)	16 (76%)	14 (67%)	4 (67%)	3 (50%)	3 (50%)

	20 Medial Approach					
	14 Vein (70%)			6 BP (30%)		
Time Interval	6 M	1 Y	2 Y	6 M	1 Y	2 Y
How many? Percent	10 (71%)	8 (57%)	8 (57%)	5 (83%)	5 (83%)	2 (33%)

27 Posterior Approach						
21 Vein						
Runoff	2 Runoff < 2			19 Runoff ≥ 2		
Time Interval	6 M	1 Y	2 Y	6 M	1 Y	2 Y
How many? Percent	2 (100%)	2 (100%)	1 (50%)	19 (100%)	14 (74%)	13 (68%)

27 Posterior Approach						
6 Bypasses						
Runoff	3 Runoff < 2			3 Runoff ≥ 2		
Time Interval	6 M	1 Y	2 Y	6 M	1 Y	2 Y
How many? Percent	2 (67%)	1 (33%)	1 (33%)	2 (67%)	2 (67%)	2 (67%)

20 Medial Approach						
14 Vein						
Runoff	8 Runoff < 2			6 Runoff ≥ 2		
Time Interval	6 M	1 Y	2 Y	6 M	1 Y	2 Y
How many? Percent	5 (63%)	4 (50%)	4 (50%)	5 (83%)	4 (67%)	4 (67%)

20 Medial Approach						
6 Bypasses						
Runoff	0 Runoff < 2			6 Runoff ≥ 2		
Time Interval				6 M	1 Y	2 Y
How many? Percent				5 (83%)	5 (83%)	2 (33%)

## Discussion

The Efficiency of PAA treatment has been intensively studied. The main aim for treatment of PAA is to avoid threatening complications. The bad prognosis is due to embolic occlusion of the popliteal artery with occlusion of the lower limb vessels.

The amputation rate due to ischemia following of a popliteal artery aneurysm is over 25%.

Well-known and accepted therapies are PAA resection or exclusion and revascularization through bypass. By introduction of the endovascular therapy in the vascular surgery, the endovascular treatment of the PAA runs in competition to the traditional bypass solution. Till now, the gold standard method of repair remains controversial.

Ruptured PAA has the worse prognosis. In this study, a patient presented with ruptured PAA, who was

in the early postoperative stage (– 30 days) suffered from a critical ischemia, which led to an above knee amputation. Similarly, the infected PAA share the same postoperative results. In this study, another patient also suffered from an infected PAA, which also has led to above knee amputation.

In this particular study, we focused on the results of a PAA surgical repair. The posterior approach applies relatively the same principle as in the treatment of the AAA open technique using resection of the PAA with interposition (end-to-end anastomosis) vein or prosthetic grafting.<sup>5</sup> The medial approach provides a revascularization therapy with good access to healthy proximal and distal artery without the resection of the PAA sac. In a posterior repair, there is a reduced possibility of future sac expansion.<sup>4</sup> However; there is a higher risk of nerve damage.<sup>3&6</sup>

This study showed a similar primary patency rates (posterior approach had a 93%, 70% and 63% while the medial approach had a 75%, 65% and 50%) in 6-month, 1-year and 2- year intervals.

Dorweiller et al showed a primary patency rate of 88% and Davis et al showed 63%.

Poor runoff (zero to less than 2) was linked to worse primary patency. In this study, patients with PAA and preoperative runoff <2 showed a primary patency of 61%, 44% and 33% in comparison to patients who had a runoff >2 (91%, 74%, and 63%) in 6 months, 1 year and 2 year interval.

This study also shows that vein material as a graft with better patency rates (100%, 76% and 67%) than a prosthetic graft (83%, 83% and 33%).

The paper, “The Posterior Approach in the Treatment of Popliteal Artery Aneurysm: Feasibility and Analysis of Outcome” details the use of anticoagulation after PAA repair.<sup>7</sup> in this study, 24 patients received anticoagulant therapy using warfarin and 3 used Rivaroxaban.

There has not been much focus in other studies on the below knee runoff as a variable for comparing the primary patency related to PAA repair. By doing a review on the results and using the runoff as a comparing factor, we found that in the posterior approach group with using a vein bypass, the 1-year-primary patency was 100% even in the group with a poor runoff, while the results were with lower in the medial approach group. Though, in both approaches, the results were only with 50% patency rates after 2 years.

For the group with better runoff (>2), the patency rates were 100%, 74% and 68% in the posterior approach using the vein as a graft material. In the medial approach group, with similarly using the vein graft, the results were 83%, 67% and 67%.

Astonishingly, in the first year, the medial approach with a prosthetic graft showed better results compared to the posterior approach in the runoff > 2 group (83% primary patency versus 67%) but in 2 years, the posterior approach group has a better patency rate (67% versus 33%).

## Conclusion

The results of the PAA confirm that surgical repair is a safe procedure. The choice of which approach to perform is still a debate. Vein graft shows a better result in PAA. A big concern should be taken of the runoff situation.

## Limitation

Concerning the postoperative anticoagulants, not all patients received the same therapy. By using the prosthetic bypasses, the bypass materials were not identical.

## Acknowledgements

I want to acknowledge Prof. Dr. Wozniak for advising me and reviewing my work every step of the way.

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