

# ***New Trends in Management of Popliteal Artery Aneurysm***

Essay

Submitted for partial fulfillment  
of Master Degree In **General Surgery**

By

**Ahmed Nader El-Outefi**

*M.B.B. Ch*

*Ain Shams University*

Supervised By

Under Supervision Of

**Prof. Dr\ Wagih Fawzy Abdel Malek**

*Professor in General and Vascular surgery  
Faculty of Medicine, Ain Shams University*

**Dr\ Hesham Shehata Ali**

*Lecturer in General and Vascular surgery  
Faculty of Medicine, Ain Shams University*

*Faculty of Medicine  
Ain shams University  
2016*

# الطرق الحديثة لعلاج التمدد الشرياني بشريان ماخلف الركبة

رسالة توطئة

للحصول على درجة الماجستير

في الجراحة العامة

مقدمة من

الطبيب / أحمد نادر العطيبي

بكالوريوس الطب والجراحة

تحت إشراف

**الأستاذ الدكتور / وجية فوزي عبد الملك**

أستاذ الجراحة العامة والأوعية الدموية

كلية الطب - جامعة عين شمس

**الدكتور / هشام شحاتة على**

مدرس الجراحة العامة والأوعية الدموية

كلية الطب - جامعة عين شمس

كلية الطب

جامعة عين شمس

٢٠١٦

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# قالوا

لسبحانك لا علم لنا  
إلا ما علمتنا إنك أنت  
العليم الحكيم

صدق الله العظيم

سورة البقرة الآية: ٣٢



## Acknowledgement

*first and foremost, Thanks to **ALLAH** who continues to bless , support and fill me with hope, faith and patience that enable me to carry out all my daily functions.*

*I feel always indebted to ALLAH , the most kind and merciful.*

*Then i would like to express my deepest thanks , sincere , gratitude and appreciation to **Prof. Dr Wageih Fawzy Abd el Malek**, Professor in General and Vascular surgery for giving me the honor to work under his supervision, for his support and instructive guidance and his care since the beginning of this work,*

*I would like to express my sincerely thanks and deep appreciation to **Dr. Hesham Shehata Ali**, Lecturer in General and Vascular for his helpand advices during supervision of this work,*

*I finally dedicate this work to my family my backbone whom helped me a lot and will always support me through my journey and to my friends whom I share all memories either inside my career or outside , they are always by my side. No words can express their values in my life.*

# *List of Contents*

Title	Page No.
<b>Introduction</b> .....	1
<b>Aim of the Work</b> .....	4
<b>Review of Literature</b>	
• Chapter 1: Anatomy .....	5
• Chapter 2: Pathophysiology .....	11
• Chapter 3: Management .....	23
• Chapter 4: Surgical correction of Popliteal artery aneurysm .....	30
• Chapter 5: Endovascular correction of Popliteal artery aneurysm .....	54
<b>Discussion</b> .....	83
<b>Summary and Conclusions</b> .....	91
<b>References</b> .....	95
<b>Arabic Summary</b> .....	–



## *List of Tables*

<b>Table No</b>	<b>Title</b>	<b>Page No</b>
<b>Table (1)</b>	Series of Open Popliteal Artery Aneurysms Repair	51
<b>Table (2)</b>	Study done on 358 patients with PAA	52
<b>Table (3)</b>	Types of endoleak	73
<b>Table (4)</b>	Literature overview of popliteal artery aneurysms treated with commercially available stent-grafts	75
<b>Table (5)</b>	Comparison of popliteal artery aneurysms treated with commercially available stent-grafts & equal no. of patients treated surgically	88
<b>Table (6)</b>	Procedural early results	88



## *List of Figures*

<b>Figure: No</b>	<b>Title</b>	<b>Page No</b>
<b>Figure (1)</b>	Anatomy of popliteal artery	<b>6</b>
<b>Figure (2)</b>	Anatomy of popliteal artery	<b>6</b>
<b>Figure (3)</b>	Shows popliteal branching patterns	<b>7</b>
<b>Figure (4)</b>	Shows another popliteal artery branching patterns.	<b>8</b>
<b>Figure (5)</b>	Shows Type III Tibial vessel patterns	<b>9</b>
<b>Figure (6)</b>	Shows the Territorial blood supply of the ankle and foot	<b>13</b>
<b>Figure (7)</b>	Unsubtracted (a) and subtracted (b) digital arteriograms	<b>14</b>
<b>Figure (8)</b>	Arteriogram in acute ischemia	<b>15</b>
<b>Figure (9)</b>	Drawings illustrate the classification scheme for PAES(normal anatomy)	<b>16</b>
<b>Figure (10)</b>	Angiography	<b>18</b>
<b>Figure (11)</b>	Angiography	<b>19</b>
<b>Figure (12)</b>	Three-dimensional reconstruction computed tomographic angiogram scan of the both lower limbs	<b>26</b>
<b>Figure (13)</b>	Coronal MIP image from contrast-enhanced lower extremities MRA	<b>27</b>
<b>Figure (14)</b>	Magnetic resonance arteriography demonstrating bilateral popliteal aneurysms	<b>28</b>
<b>Figure (15)</b>	Preoperative arteriograph shows popliteal artery aneurysm	<b>28</b>
<b>Figure (16)</b>	Popliteal artery exposure (medial approach)	<b>34</b>
<b>Figure (17)</b>	Medial exposure of the proximal popliteal artery.	<b>35</b>
<b>Figure (18)</b>	Intra-operative view into the adherent large right popliteal aneurysm	<b>37</b>
<b>Figure (19)</b>	Popliteal artery bypass graft with aneurysm exclusion	<b>38</b>
<b>Figure (20)</b>	Popliteal artery exposure through posterior Approach	<b>40</b>
<b>Figure (21)</b>	large popliteal aneurysm after surgical exposure	<b>41</b>
<b>Figure (22)</b>	Proximal & distal control of popliteal artery.	<b>43</b>
<b>Figure (23)</b>	Proposed management algorithm for acute limb ischemia secondary to popliteal artery aneurysm	<b>47</b>



---

## List of Figures

---

<b>Figure: No</b>	<b>Title</b>	<b>Page No</b>
<b>Figure (24)</b>	Endovascular exclusion of aneurysm	<b>54</b>
<b>Figure (25)</b>	Under roadmap guidance, the Viabahn endoprosthesis is positioned	<b>59</b>
<b>Figure (26)</b>	Delivery system during deployment of stent	<b>60</b>
<b>Figure (27)</b>	The endograft is deployed	<b>60</b>
<b>Figure (28)</b>	Completion angiogram demonstrates exclusion of the popliteal artery aneurysm	<b>61</b>
<b>Figure (29)</b>	Preoperative angiography with collateral artery	<b>63</b>
<b>Figure (30)</b>	Stent graft curled up in large aneurysm sac which could be stretched with a catheter over the guide wire	<b>64</b>
<b>Figure (31)</b>	Fold in proximal part of Hemobahn stent graft	<b>65</b>
<b>Figure (32)</b>	Intraoperative digital subtraction angiography shows the absence of endograft kinking during leg flexion	<b>66</b>
<b>Figure (33)</b>	Angiogram of a popliteal artery showing inadequate landing zone for endovascular repair due to extension of the aneurysm up to the popliteal bifurcation	<b>69</b>
<b>Figure (34)</b>	X-ray of the knee in lateral view showing two overlapping stent grafts in the popliteal artery	<b>70</b>
<b>Figure (35)</b>	(A) X-ray of the knee showing migration in the overlap zone with a disconnection and (B) after correction with a bridging stent graft	<b>72</b>
<b>Figure (36)</b>	Cragg stent (Min Tec)	<b>76</b>
<b>Figure (37)</b>	Corvita stent	<b>77</b>
<b>Figure (38)</b>	Wall graft	<b>77</b>
<b>Figure (39)</b>	Highly flexible Viabahn endovascular stent	<b>78</b>
<b>Figure (40)</b>	Many diameters of viabahn endovascular stents	<b>80</b>
<b>Figure (41)</b>	Viabahn endoprosthesis structures	<b>81</b>



### ***List of Abbreviations***

<b>AAAs</b>	Abdominal Aortic Aneurysms
<b>AT</b>	Anterior Tibial
<b>CAD</b>	Cystic Advential Diseases
<b>CES</b>	Cragg Endopro system
<b>CORV</b>	Corvita
<b>CTA</b>	Computed Tomographic Angiogram
<b>ECG</b>	Electrocardiogram
<b>ePTFE</b>	Expanded Polytetrafluoroethylene
<b>ET</b>	Endovascular Treatment
<b>FEP</b>	Fluorinated Ethylene Propylene
<b>HB</b>	Hemobahn
<b>LSV</b>	Longer Saphenous Vein
<b>MICs</b>	Minimum Inhibitory Concentrations
<b>MRA</b>	Magnetic Resonance Angiogram
<b>NS</b>	Not Significant
<b>OR</b>	Open Repair
<b>P</b>	Passanger
<b>PAAs</b>	Popliteal Artery Aneurysms
<b>PAES</b>	Popliteal Artery Entrapment Syndrome
<b>PGI</b>	Prosthetic Graft Infections
<b>PR</b>	Peroneal
<b>PT</b>	Posterior Tibial
<b>PTA</b>	Percutaneous Transluminal Angioplasty
<b>SSIs</b>	Surgical Site Infections
<b>TPT</b>	Tibio Peroneal Trunk
<b>US</b>	Ultrasound
<b>VB</b>	Viabahn
<b>WG</b>	Wallgraft
<b>WS</b>	Wallstent



## INTRODUCTION

Popliteal artery aneurysms are rare in the general population, although they are the most common peripheral artery aneurysm accounting 70%. Popliteal artery aneurysm preferentially affects men. However, the basis for this sex difference is unknown (*Aparna Diwan, et al 2000*).

About 50% of the patients with popliteal artery aneurysms have bilateral popliteal artery aneurysms and 30 to 50% of these patients may have an associated abdominal aortic aneurysm (*Huang Y et al,2007*).

With exclusion of trauma and rare congenital disorders the majority of popliteal artery aneurysms are considered to be true aneurysms. Many writers in the past regarded popliteal artery aneurysms as atherosclerosis, but most of popliteal artery aneurysms are degenerative (*Jacob et al.2001*).

Aneurysms less than 2 cm are rarely symptomatic & most surgeons use 2 cm as the threshold diameter, symptoms of acute or chronic ischaemia start to present when diameter of aneurysm more than 2.6 cm to 3 cm in diameter (*Pomposelli et al., 2010*).

Duplex ultrasonography has been shown to be superior to physical examination in detecting popliteal aneurysms, beyond detection, duplex ultrasonography provides critical information relevant to treatment, including the diameter, presence of intraluminal thrombus, velocity of blood flow, and patency of outflow artery (*Pomposelli et al., 2010*).

---

## ✍ Introduction

---

Surgical management of complicated popliteal aneurysm as Patients with acute limb ischemia require urgent intervention to avoid amputation. In a patient with a viable limb & no symptoms of sensory or motor dysfunction, intravenous heparin can be administered to stabilize the patient. Arteriography & surgery are performed during The same administration. If the aneurysm is fully occluded & patent distal outflow vessel is identified on arteriography, a vein bypass to the patent outflow vessel is performed as described previously. If no outflow vessel is identified & the patient's limb is not immediately threatened, intra-arterial thrombolysis is started with the objective of restoring flow to potential outflow target vessels (*Pomposelli FB et al., 2010*).

Endovascular treatment has the benefit of not requiring general or regional anesthesia and therefore , the theoretical advantage of decreasing cardiac risk. The procedure can be done by simple percutaneous puncture or small cut down on SFA or CFA. Anatomical selection criteria for endovascular repair includes a good proximal and distal segment at least 2 cm , Lack of extensive vessel tortuosity , and an aneurysm that is not extremely large (*Tielliu IF et al., 2005*).

In a meta analysis comparing open with endovascular repair of popliteal artery aneurysms , reported similar results with no significant difference in long term patency rate , however patients who underwent endovascular repair were more likely to have graft thrombosis and re-intervention at 30 days than those who

---

## **✍ Introduction**

---

had open repair. They also reported significantly shorter length of hospital stay and operative time with endovascular repair (*Antonello M et al., 2005*)



### **AIM OF THE WORK**

The purpose of this study is to assess the management of popliteal artery aneurysm by endo-vascular procedures versus surgical procedures

