Lower Extremity Aneurysmal Degeneration of Great Saphenous Venous Allograft Bypass in an Adolescent Male

Nicole Gensicke, MD, MPH, Rachael Nicholson, MD, William Sharp, MD

PII: S2468-4287(21)00181-7
DOI: https://doi.org/10.1016/j.jvscit.2021.10.007
Reference: JVSCIT 838

To appear in: Journal of Vascular Surgery Cases and Innovative Techniques

Received Date: 7 August 2021
Accepted Date: 10 October 2021


This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2021 Published by Elsevier Inc. on behalf of Society for Vascular Surgery.
Manuscript Title: Lower Extremity Aneurysmal Degeneration of Great Saphenous Venous Allograft Bypass in an Adolescent Male

R1WC: 97/1226

Authors: Nicole Gensicke, MD, MPH; Rachael Nicholson, MD; William Sharp, MD

Affiliations:

Corresponding Author and Post-Publication Corresponding Author Information:

Dr. Nicole Gensicke

200 Hawkins Dr, Iowa City, IA 52242

712-249-2461

Nicole-gensicke@uiowa.edu

Presenting Information:

This case report will be presented at the Midwestern Vascular Conference, Chicago, Il, September 9-11, 2021.

Keywords: venous degeneration, allograft bypass, critical limb ischemia, thrombosis, pediatric vascular surgery
Abstract:

Chronic limb-threatening ischemia (CLTI) in the pediatric population is a rare phenomenon. When open repair is necessitated there is a preference for autogenous conduit; however, venous grafts are prone to their own long-term complications. We present the case of a 10-year-old male with CLTI due to popliteal artery thrombosis treated with ipsilateral great saphenous vein (GSV) bypass. Seven years after the initial procedure the venous graft underwent aneurysmal degeneration with acute thrombosis necessitating bypass revision. Through this case we discuss the surgical approach and highlight the importance of long-term post-operative surveillance after open repairs in the pediatric population.
Introduction:

Chronic limb-threatening ischemia (CLTI) refers to a complex condition that manifests as chronic ischemic rest pain or ischemic skin lesions present for greater than 2 weeks. (1,2,3) The pediatric population represents a minute portion of CLTI patients with sparse evidence to guide treatment. The few case reports documenting open repair in the pediatric population have shown a preference for autogenous conduit compared to cadaveric or prosthetic conduit. (4,5) Unfortunately, vein grafts are not without complications as they can develop graft stenosis, thrombosis, and aneurysmal degeneration necessitating reintervention. (6)

This case report concerns an adolescent male with lower extremity ischemia and popliteal artery occlusion due to type III popliteal artery entrapment necessitating above knee popliteal artery to the posterior tibial artery bypass with autogenous GSV. Seven years later, the patient presented with acute limb ischemia with bypass occlusion secondary to aneurysmal degeneration necessitating thrombolysis prior to vein bypass revision. The patient consented to having their case details and images published.

Case Report

A 10-year-old male presented with increasingly prominent claudication symptoms during participation in athletics and a nonhealing ulcer to the plantar aspect of the left foot. Left ankle-brachial index (ABI) was 0.57 and magnetic resonance angiography (MRA) demonstrated occlusion of a medially displaced popliteal artery with reconstitution of the tibial vessels via a large geniculate branch. (Figure 1 & 2) These findings were confirmed during an arteriogram
showing a long segment occlusion of the popliteal artery with reconstitution at the tibioperoneal trunk and the posterior tibial artery serving as the dominant run off vessel.

The patient was electively scheduled for above knee popliteal artery to posterior tibial artery bypass with non-reversed ipsilateral GSV harvest. Intraoperatively a thick myofascial band consistent with popliteal artery entrapment type III was identified and divided. The left GSV measuring 4mm tapering to 3mm was harvested from the saphenofemoral junction to the knee and prepared with valvotomy prior to tunneling the graft laterally to a prominent medial head of the gastrocnemius. Post-operative ABI was 1.3 and duplex ultrasound demonstrated a patent bypass. Four years of annual follow-up visits with noninvasive vascular surveillance demonstrated graft patency without thrombus and gradual dilation of the bypass from 8mm at 1 year to 15 mm at 4 years. During this time the patient reporting inconsistent adherence to daily aspirin (ASA) regimen.

The patient was lost to follow-up until the age of 17 when he presented to the emergency department with acute onset of left lower extremity rest pain and absent pedal Doppler signals. Computed tomography angiography (CTA) showed an occlusive thrombus within the bypass at an area of aneurysmal dilatation measuring 20 mm in diameter. (Figure 3). Catheter-directed thrombolysis was initiated with thrombus resolution after four days and the patient was discharged on ASA and rivaroxaban. Two months later the patient returned for elective revision of the bypass with contralateral non-reversed right GSV prepared with valvotomy. A few centimeters of the proximal and distal portions of the aneurysmal bypass including the anastomoses were resected. The new vein bypass was sewn to the same proximal and distal
arteriotomy sites, tunneling within the same anatomical tract. (Figure 4) Pathology of the excised aneurysmal bypass tissue demonstrated intimal hyperplasia with myxomatous degeneration. At the age of 22, the patient endorses resolution of claudication symptoms and has continued a physically rigorous lifestyle as a collegiate athlete with adherence to daily ASA and annual surveillance with stable noninvasive vascular studies.

Discussion:
CLTI is rare in the pediatric population with existing literature primarily focusing on iatrogenic etiology with minimal data regarding alternative causes such as vasculitis-related stenosis, hypercoagulable state-related thromboses, structural anomalies, infectious or paradoxical emboli. (7) The subject of this case report was diagnosed with popliteal artery entrapment type III due to a myofascial band directly compressing the popliteal artery. Popliteal artery entrapment is caused by direct compression of the popliteal artery and long-term compression can lead to intimal damage and occlusion. (8,9) A review of the literature pertaining to acute and chronic pediatric lower extremity ischemia necessitating open repair shows a preference for utilization of GSV conduit driven primarily by anticipated long-term life expectancies of the pediatric population and associated long-term complications. (7) Dalsing et al performed five lower extremity bypasses with autogenous conduit in patients under the age of 13 with three reversed GSV bypasses remaining widely patent at a mean of 35.6 months. (10) Reed et al treated 4 patients under the age of 18 with reversed GSV for popliteal artery injury with normal duplex waveforms and segmental pressures at 10 to 42 months follow-up without secondary intervention. (11)
The subject of this case report was followed with noninvasive vascular studies for four years without incident or indication of bypass irregularity. Aneurysmal degeneration of the bypass was only noted when the patient returned with rest pain due to acute thrombosis of the aneurysmal bypass seven years after its creation during which time there was a three-year window without surveillance. An extensive review of the literature pertaining to lower extremity bypasses in the pediatric population fails to report outcome data beyond three to four years. The importance of long-term outcome data is emphasized in the events of this case report. Where data is lacking regarding the pediatric population, information can be cautiously extrapolated from the adult population. Huang et al reviewed 358 lower extremity GSV bypasses in adults with five-year primary and secondary patency rates of 85% and 94% respectively. (12) Hoelting et al reported follow-up primary patency rates decreasing to 57%-65% over a period of 8-10 years stressing the importance of continued follow-up in autogenous bypasses due to late complications. (13) As shown in these studies, the importance of ongoing surveillance beyond the initial three to four years cannot be understated as early detection of irregularities can vastly improve overall long-term assisted patency. (14)

Aneurysmal degeneration of autogenous vein bypass is a rare but known late complication. (15) The underlying etiology is speculative. Some have theorized that structural differences between autogenous vein compared to native artery leads to an accelerated rate of atherosclerotic changes and sequelae of ulcerations, obliteration of elastic lamina, and fibromuscular intimal thickening. An alternative proposed mechanism is a systemic dilatory process encompassing inflammation/immune responses, biochemical wall stress, and molecular genetics. (16,17) Various literature supports both theories suggesting the process is likely multifactorial.
Patients with autogenous lower extremity bypasses should undergo life-long surveillance. (18) It is our practice to monitor these patients every three months for the first two years, then every six months for a year, then annually. Noninvasive vascular studies provide inexpensive, valuable information regarding flow dynamics of the native and bypass vasculature with easily obtainable measurements regarding stenotic or aneurysmal variations. (19) A study that tracked 55 popliteal artery aneurysms repaired with aneurysm ligation and bypass or endoaneurysmmorrhaphy and interposition graft found that over an eight-year period 33% of repairs demonstrated a critical abnormality (graft stenosis, vein graft aneurysm, or graft entrapment) necessitating secondary intervention. (17) Utilizing routine duplex surveillance and prompt intervention the study population achieved assisted-primary patency (88%) and limb salvage (100%) at 3 years. (20)

Conclusion:

Aneurysmal degeneration in autogenous bypasses is a rare but known late complication that is particularly concerning in the pediatric population due to extended, life-long dependency of the patient on the bypass. Long term outcomes are optimized with ongoing surveillance and early detection of irregularities allowing for elective rather than emergent intervention.
REFERENCES


Figure 1: Magnetic resonance angiography (MRA) demonstrating occlusion of the medially displaced popliteal artery with collateralization from a large geniculate branch.

Figure 2: MRA demonstrating reconstitution of the tibio-peroneal trunk with three vessel run-off.

Figure 3:
3A: Completion angiogram of the index bypass procedure utilizing ipsilateral non-reversed GSV from above knee popliteal artery to posterior tibial artery tunneled in anatomic fashion.

3B: Computed tomography angiography (CTA) obtained during acute onset of rest pain and absence of pedal doppler signals 7 years after index procedure. Occlusive thrombus 9cm distal to the proximal anastomosis within an aneurysmal segment of the bypass measuring 20mm in diameter.

3C: Completion angiogram after 4 days of catheter-directed thrombolysis demonstrating patency of the aneurysmal bypass without residual thrombus or reoccurrence of external compression.

Figure 4: Completion angiogram of revised autogenous vein bypass with proximal anastomosis at the above knee popliteal artery and distal anastomosis to the posterior tibial artery.
Occluded popliteal artery

Prominent geniculate artery
3A: Proximal anastomosis to the above knee popliteal artery

3B: Thrombus within aneurysmal segment of the bypass

3C: Proximal anastomosis to the above knee popliteal artery

Distal anastomosis to the posterior tibial artery
Proximal anastomosis to the above knee popliteal artery

Distal anastomosis to the posterior tibial artery