



## Outcomes of popliteal vascular injuries at Sri Lankan war-front military hospital: Case series of 44 cases



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### ABSTRACT

**Background and aims:** Traumatic injury to the popliteal vascular zone remains a challenging problem on the modern battlefield and is frequently associated with more complications than other vascular injuries. Limb salvage and morbidity (graft infection, thrombosis and delayed haemorrhage) were studied.

**Materials and methods:** All popliteal vascular injuries over an 8 month period admitted to the Military Base Hospital were analyzed. Local limb evaluation included confirmation of the presence of ischaemia, extent of soft tissue damage, muscle viability after calf fasciotomy, and neurological injury. Ischaemic time was recorded from the time of injury to definitive revascularization. If there was a prior attempt at reconstruction, the amputation was considered delayed.

**Results:** For a series of 44 patients with popliteal vascular injury average time to presentation was 390 min, 46% were completely ischaemic. Of those 39 (89%) had popliteal artery injuries. There were 24 (62%) complete popliteal artery transections and associated venous (69%) and osseous (46%) injuries. The preferred technique of repair was inter-position venous graft (IPVG) (54%). Eleven immediate amputations were performed (28%). There were 13 wound infections (33%), 5 early graft thromboses (5 of 21 IPVG, 238%), 2 anastomotic disruptions (2 of 21 IPVG, 9%), which resulted in 4 delayed amputations. Mortality was 5% (2 patients).

**Conclusions:** In this case series of popliteal artery injury early identification of limbs at risk, early four compartment fasciotomy, temporary intra-luminal shunting, definitive repair of concomitant venous injuries and aggressive treatment of haemodynamic instability were shown to be beneficial in achieving reasonable outcome in an austere environment with limited recourses.

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### Introduction

Popliteal artery injuries (PAI) constitute 3–5% of all extremity artery injuries on the modern battlefield [1]. PAI also have the highest rates of amputations amongst all lower extremity vascular injuries despite advancements in modes of intervention. Today amputation rate is less than 10% thanks to experience gained from war surgery, earlier surgical intervention, the use of broad spectrum antibiotics and vascular grafts [2,3].

The management of such injuries is a challenge for general and vascular surgeons in developing countries with limited resources. The objective of this study was to review the experience in the management of PAI and determine the most influential factors in the decision between attempted limb salvage and amputation. The

primary outcome was limb salvage. The secondary outcome was morbidity (graft infection, delayed graft occlusion (thrombosis) and delayed haemorrhage). Also factors associated with decision for primary amputation were evaluated.

### Methods

The civil war in Sri Lanka ended in 2009 after 26 years of conflict amidst harsh terrain and changing weather. Typical weapons used in the war were similar to those used in other contemporary theatres of conventional war and included assault rifles such as the T-56 and AK-47 and artillery.

Casualty care for Sri Lankan army servicemen was organized at 4 levels. Level 1 and 2 care was for casualties transferred by ground while rapid evacuation and aero-medical transfer to definite care comprised levels 3 and 4. Patients were received at facilities all over the island.

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Limbs with vascular injuries were prioritized and a management protocol established during the study period. At level 2 facilities casualties underwent exploration and haemorrhage control with minimal surgical intervention, early fasciotomy and blood transfusion. The Level 3 facility was the closest facility to the fighting capable of performing definitive vascular repair and situated 120 km south of the main fighting. Evacuation involved 45 min helicopter flying time and the hospital was manned by a general surgeon trained in a vascular reconstruction supported by rotating general surgeons and junior medical officers. This facility had two operating rooms, a three-bed Intensive Care Unit and had 80 surgical ward beds. Casualties in need of further rehabilitation were transferred to a level 4 centre.

Data from all adults with extremity vascular injuries admitted to the Military Base Hospital Anuradhapura (MBHA, the level 3 facility) from November 2008 to June 2009 were prospectively recorded. Out of a total of 129 patients with vascular injured limbs 44 popliteal vascular injuries were identified. The study group of 39 (89%) patients with PAI was analyzed for demography, management and early outcome. Other than these 3 isolated venous injuries and 2 popliteal branch injuries were excluded from analysis. Anti-personal mine injuries were excluded as the severity of injuries often necessitated definitive amputation at an early level of a casualty care.

Mechanism of injury was categorized as caused by gunshot wounds, blast fragments and unidentified objects. Vascular injuries were characterized by type (arterial, venous or combination) and macroscopic description (transection, laceration, through en through, primary thrombosis).

Patients with PAI were assessed clinically for shock and the need for blood transfusion within first 24 h. Systolic blood pressure of  $\leq 90$  mmHg was used as a definition of shock. Limbs were assessed for a palpable pulse and with hand-held Doppler, the extent of soft tissue damage, bone fracture at the level of the knee, muscle viability after 4 compartment calf fasciotomy and the presence of neurologic injury. Mangled extremity severity score (MESS) was calculated retrospectively using available records. An ischaemic time was recorded from the injury itself through the initiation of definitive revascularization.

Vascular repairs were classified into four methods of treatment: ligation, primary repair (including patch angioplasty), interposition autologous vein graft and open vessel exploration with thrombectomy. The great saphenous vein was the conduit of choice. The contralateral vein was taken preferentially for PAI, although the ipsilateral vein was required in few cases. In nearly all cases, vascular repair was attempted within the first hours from the time of admission.

Temporary intraluminal shunting (TIS) was indicated for patients with combined arterial, venous and soft tissue injuries and concomitant long bone fractures, when decision was made towards limb salvage. The standard sterile system tubing was used as a shunt. Concomitant venous injuries were repaired selectively.

Primary amputation was defined as amputation performed at the initial operation. If there was an attempt at reconstruction, the amputation was considered delayed. The decision to perform primary amputation was made by clinical assessment based on ischaemic time, associated haemorrhagic shock, concomitant limb injuries, arterial and venous injury description.

The majorities of patients received all their care at the MBHA and were then discharged. Long bone fractures were managed by immobilization with plaster cast except in a few instances external fixations were applied. Patients who required definitive orthopaedic care or advanced Intensive Care were transferred to other centres after blood flow in the injured extremity was established. Early outcomes were determined, including need for

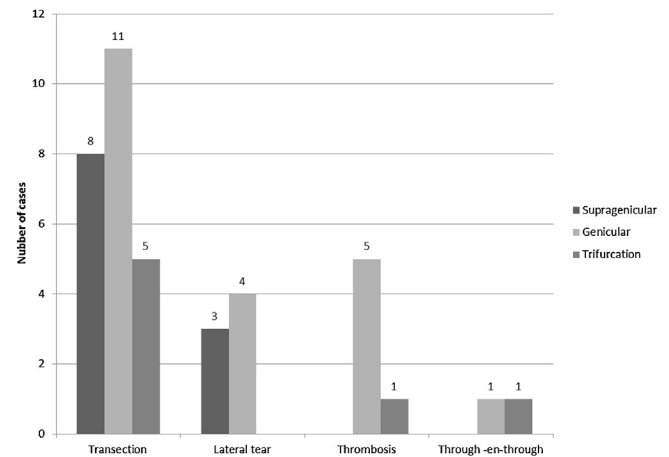


Fig. 1. Anatomical and macroscopic characteristics of 39 popliteal artery injuries.

delayed amputation, graft occlusion and infection with late anastomotic disruption, and death.

## Results

Forty four healthy male servicemen of the Sri Lankan army sustained a popliteal vascular injury during the 8 months study period. Their median age was 24 years (range 18–42 years). In this group of 44 popliteal vascular injuries 39 (89%) involved popliteal artery. The mechanism of injury was a single gunshot in 19 cases (49%), fragment injury from explosive devices in 17 cases (44%), and 3 patients (7%) had unrecognized source of penetration injury. Of these 39, 28 (72%) were combined arterial and venous injuries while 11 (28%) were isolated involved the artery alone. In order to analyze the 39 PAI, authors arbitrarily divided popliteal artery into three segments as supra-genicular, genicular and popliteal trifurcation with 11, 21 and 7 injuries (Fig. 1).

The average time of transfer to definitive care for the 39 patients with PAI was 390 min (range 205–960 min). At presentation 18 (46%) limbs had signs of complete ischaemia with no detectable pulses or recordable Doppler flow (Table 1).

## Associated injuries

Of the 28 patients with combined popliteal artery and venous injuries 21 (75%) had complete venous transections and 7 (25%) lateral tears. Eighteen patients had associated fractures (46%), 12 multi-fragmentary and 6 simple long bone fractures. Two patients had nerve injuries (underscore in author's opinion due to incomplete data on missed injuries).

Altogether 22 units of blood were transfused in 7 cases (32 units per patient). Bilateral four compartment calf fasciotomies were performed in 37 patients (95%) either at presentation to 3rd level care or at second echelon of military care (Fig. 2).

## Treatment

Twenty four popliteal artery repairs were performed (62%) as described in Fig. 3 In all 28 patients with associated popliteal vein

Table 1  
Initial clinical evaluation of 39 popliteal arterial injuries.

Distal limb circulation status	Number (%)
Partial ischaemia (No. pulses + Doppler)	19 (48%)
Total ischaemia (No. pulses, No. Doppler)	18 (46%)
Incomplete data	2 (5%)

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