



Management of traumatic popliteal vein injuries

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ABSTRACT

Purpose: The aim of this study was to evaluate different repair methods of popliteal vein injuries, and to assess the relationship between early patency and surgical outcome.

Methods: Thirty patients with popliteal vein injuries underwent surgical repair procedure at our hospital from March 2000 to April 2010. Patients who were haemodynamically unstable and those with massive bleeding from limb wounds were taken directly to the operating room. Stable patients underwent preoperative colour-flow duplex ultrasonography (CFDU).

Results: Our study group consisted of 26 males and 4 females, ranging in age from 17 to 60 years with a mean age of 25.3 ± 5.9 years. The mechanism of trauma was penetrating in 27 patients and blunt in the remaining 3 patients. Treatment included primary venous repair in 11 cases, end-to-end anastomosis in 8, interposition vein graft in 10, and interposition polytetrafluoroethylene (PTFE) graft in 1. There were 26 patients with associated arterial injury, of which 4 cases had primary repair, 9 had end-to-end anastomosis, 11 had saphenous vein graft interposition, and 2 had PTFE graft interposition. Associated bone fracture was seen in 6 patients. There were no deaths. One patient required a below-knee amputation. Postoperative CFDU revealed thrombosed venous repair in 7 cases without any sequelae.

Conclusion: Popliteal venous injuries can be repaired with minimal downside and a good early patency rate. Additionally, transient venous patency allows for establishment of venous and lymphatic collateralisation. Alternatively, venous ligation should be considered only in unstable patients who refuse blood transfusion (Jehovah's witnesses). In these victims, adjuvant management may be required such as the use of fasciotomy and anticoagulation treatment.

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Introduction

Although there have been numerous civilian reports regarding the management of arterial injuries, there have been the paucity of papers addressing the management of venous injuries.¹⁹ The optimal management of popliteal vein injuries performing ligation or various repair techniques continues to be a topic of controversy, partly because of uncertainty of continued luminal patency. However, the effects of major venous ligation such as venous hypertension and decreased accompanying arterial flow have been recognised in both experimental and clinical studies.¹⁶ Despite this, some suggest that venous ligation should be considered a safe and effective management alternative for serious lower limb venous injuries if combined with postoperative deep venous thrombosis (DVT) treatment.¹¹

The aim of this study was to evaluate different repair methods of popliteal vein injuries, and to assess the relationship between early patency and surgical outcome.

Materials and methods

Thirty patients with popliteal vein injuries underwent surgical repair procedure at our hospital from the beginning of March 2000 to the end of April 2010. The vascular injuries were diagnosed by physical examination and colour-flow duplex ultrasonography (CFDU). Patients who had a popliteal vein injury but required extremity amputation due to a non-salvageable extremity or who had associated severe abdomen, chest or head injuries were also excluded from the study.

Patients who were haemodynamically unstable and those with massive bleeding from limb wounds were taken directly to the operating room. Stable patients underwent preoperative CFDU. Popliteal vein and accompanying popliteal artery injuries were repaired by primary repairs (lateral repair, patching), end-to-end anastomoses, saphenous vein interposition grafts obtained from the contralateral lower extremity, or ringed polytetrafluoroethylene (PTFE) interposition grafts when indicated. Interposition vein

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or synthetic grafts were anastomosed with a continuous suture of 6-0 or 7-0 polypropylene. Panel or spiral grafts were not used. Fasciotomy was performed liberally, whenever the calf was tense after revascularisation, and in patients who had a tourniquet applied in the field. We have not used any adjuvant therapy such as pneumatic compression devices, or arteriovenous fistula creation.

On the tenth postoperative day, CFDU was used to evaluate patency of the repaired vessels in all patients. The deep and superficial venous systems were assessed for venous thrombosis, valvular incompetence, and reflux. A venous repair was defined as occluded if no flow could be seen at the reconstruction site or if there was obvious intraluminal thrombus impeding venous outflow.

Postoperatively, the injured lower limb was kept elevated and wrapped with a compression bandage. Early ambulation was encouraged. All victims received prophylactic antibiotics, which were continued postoperatively for 3–5 days, unless prolonged use was dictated by the presence of obvious contamination or infection. Low molecular weight heparin (enoxaparine) was administered throughout the period of hospital confinement. In patients who developed DVT, oral warfarin therapy was initiated 3–4 days before discharge, and the international normalised ratio (INR) value was maintained between therapeutic ranges.^{2,3} Oral warfarin therapy was maintained at least 3 months.

Results

Our study group consisted of 26 males and 4 females, ranging in age from 17 to 60 years with a mean age of 25.3 5.9 years. The mechanism of trauma was penetrating in 27 patients and blunt in the remaining 3 patients (from road traffic accidents). Gunshot injury was the most common frequent form of penetrating trauma (16 of 27). Other forms of penetrating trauma in a descending order of frequency were stab injuries in 8 patients, a sharp object in 2 patients, and a mine injury in 1 patient. The time interval between injury and admission ranged from 20 min to 36 h with an average of 3.6 h. All victims were in good health prior to the trauma.

The most common reason for surgical management was an associated arterial injury in 26 patients. In these patients with active bleeding, immediate surgical intervention without ultrasonographic examination was undertaken to avoid morbidity or mortality due to exsanguinations. The diagnosis of popliteal vein injury was made during the operation. The remaining 4 patients had a relatively stable condition without active arterial bleeding. We thought that any delay in exploration owing to ultrasonographic examination did not cause serious complications. Therefore, CFDU was performed in these patients. Ultrasonographic examination revealed popliteal vein injury with intact popliteal artery in these 4 patients. So, the diagnosis was preoperatively confirmed by CFDU.

Treatment included primary venous repair in 11 cases, end-to-end anastomosis in 8, interposition vein graft in 10, and interposition polytetrafluoroethylene (PTFE) graft in 1. There were 26 patients with associated arterial injury, of which 4 cases had primary repair, 9 had end-to-end anastomosis, 11 had saphenous vein graft interposition, and 2 had PTFE graft interposition (Table 1). We have used externally ringed PTFE graft and graft size ranged from 6 to 8 mm.

Associated bone fracture requiring external fixation was seen in 6 patients. Bone stabilisation was performed after vascular repair in all. Two patients had extensive soft tissue damage. Associated nerve damage of varying degree was seen in 3 patients. Deep venous thrombosis (DVT), unrelated to the site of surgical repair, was developed in 2 patients. All DVT occurred after surgical intervention, and the diagnosis was confirmed with imaging by CFDU. Fasciotomies were performed in 6 patients of whom 4 required split-thickness skin grafting of their fasciotomy sites.

All accompanying arterial repairs were patent by clinical evaluation and CFDU at the time of discharge. However, in three patients, the anastomotic arterial stenosis was revealed by CFDU. These stenoses were less than 50 percent. Therefore, reoperation was found unnecessary. Six patients were discharged with mild lower oedema. CFDU examinations of these six patients revealed venous repair thrombosis in 5 patients and venous repair patency in 1 patient.

There were no deaths. One patient required a below-knee amputation on the sixth day after surgery because of extensive tissue damage. At the time of amputation, interposition saphenous vein grafts for popliteal artery and popliteal vein were found occluded. In the remaining 29 patients, postoperative CFDU revealed thrombosed venous repair in 7 patients (Table 2).

Discussion

The early history of venous repair is not as well documented as for arterial injury. German surgeon Schede reported the first successful repair of an injured femoral vein with lateral venorrhaphy in 1882. Then Kummel performed the first successful end-to-end anastomosis.¹⁸ However, despite these early successful reports, until the Korean War, ligation had been the accepted historical method of managing venous injuries. Rich showed that repair of military venous injuries could be performed safely.²¹ Later studies reinforced venous repairs, as both early and late complications of venous repair were lower than ligation.¹³

In the acute setting, diagnosis of venous injury is usually made during surgical exploration. Most commonly an arterial injury is exposed and the venous damage discovered incidentally.¹⁸ The clinical detection of isolated venous injury may be more difficult than that of arterial injury, because arterial injury can be diagnosed according to the presence or absence of distal pulses. Massive venous haemorrhage, however, may be quite dramatic with the steady flow of dark blood, in contrast with the spurting, bright red blood associated with arterial bleeding. Massive haematomas may be associated with venous bleeding, and shock is common with major venous injuries. Concomitant arterial injury may be part of the multiple injury complexes and can contribute to exsanguinating haemorrhage.¹⁹ Concomitant venous and arterial injuries occur mostly in the superficial femoral and popliteal vessels.¹¹

Doppler ultrasonography has been useful, and this can be a practical diagnostic tool in evaluating patients with interrupted veins regardless of the cause and the presence of thrombus. However, the practical application of Doppler ultrasonography in the acutely injured patient is limited.²⁰ Similar comment can be made regarding impedance plethysmography, phlebography, and radionuclide studies, which have been successful in diagnosing venous occlusions. These modalities have been particularly

Table 1
Management of popliteal artery and vein injuries by type of vascular repair.

	Lateral venorrhaphy	Vein patch	End-to-end anastomosis	Vein interposition	PTFE graft interposition
Popliteal vein	9	2	8	10	1
Popliteal artery	3	1	9	11	2

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