

EDUCATION

Femoral artery ligation for treatment of infected groin pseudoaneurysm in injected drug abusers

Philippe Tresson^{1,2}  | Ugo Huvelle^{1,3} | Marine Bordet^{1,3}

¹Hospices Civils de Lyon, Hôpital Louis Pradel, Department of Vascular and Endovascular Surgery, Bron Cedex, France

²Intestinal Stroke Center, Centre rHodANien d'isChémie intEstinale (CHANCES Network, Lyon), Lyon, France

³Université Claude Bernard Lyon 1 (Univ Lyon), Villeurbanne, France

Correspondence

Philippe Tresson, Service de Chirurgie Vasculaire et Endovasculaire, Hôpital Louis Pradel, 28 avenue Doyen Lepine, F-69677 Bron Cedex, France.

Email: philippe.tresson@chu-lyon.fr

Abstract

Drug addiction is a major social and medical concern. Infected groin pseudoaneurysm (IGP) is the result of direct arterial needlestick injury associated with contamination of the arterial wall or peri-arterial area by the injection equipment. Femoral artery (FA) ligation with extensive debridement is an alternative to direct revascularization in an area of sepsis. In case of femoral bifurcation free of infection or in case of isolated FA below the femoral artery of thigh involvement, a simple ligation of the FA is performed. Ligation of each femoral vessel is indicated in case of extension of the infection to the femoral bifurcation. Proximal ligation is performed on the proximal part of the FA. Distal ligation is performed on the proximal part of the deep artery of thigh and the FA below the origin of the deep artery of thigh. Ligation is effective and represents an appropriate method to control hemorrhage and sepsis syndrome in IGP.

KEYWORDS

drug abusers, femoral artery, pseudoaneurysm

1 | INTRODUCTION

Drug addiction is a major social and medical concern. Intravenous drug addicts use inguinal folds after exhausting upper and lower superficial veins, and these puncture sites are a source of contamination due to a lack of hygiene and sterile injection equipment. Infected groin pseudoaneurysm (IGP) is the result of direct arterial needlestick injury associated with contamination of the arterial wall or peri-arterial area by the injection equipment. These lesions are difficult to diagnose and to treat. There is currently no consensus whether revascularization or ligation should be used for the management of IGP; however, the frequency of complications such as infection, graft thrombosis, and amputation remain high in case of synchronous revascularization even with autologous material, ligation of the proximal and distal arteries is proposed as an alternative (Georgiadis et al., 2005; Kakisis, 2019). The aim of this technical note is to

describe the anatomic considerations of the two techniques of femoral artery ligation in case of IGP.

2 | SURGICAL TECHNIQUE

Ligation of the femoral arteries is indicated in IGP associated with infected soft tissue in injected drug abusers. Preoperatively, all patients undergo a 1-mm-slice computed tomography (CT) angiography of the abdominal aorta and lower limb to confirm diagnosis, locate the arterial rupture, and assess the need for a simple or triple femoral artery ligation according to the extent of the infection. In addition, CT angiography is used to identify any sign of arterial thrombosis or stenosis secondary to repeated traumatic punctures, and fluoroscopy can identify the presence of foreign bodies such as needle fragments. The first objective of surgical management is to

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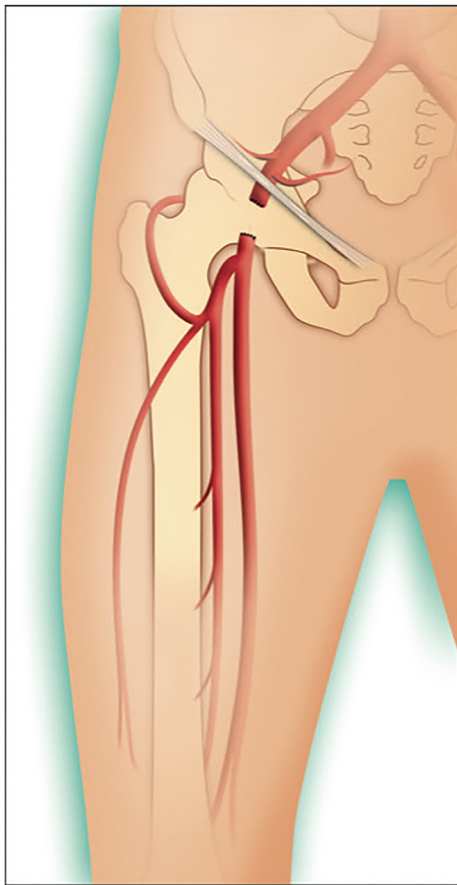


FIGURE 1 Illustration of simple femoral artery ligation

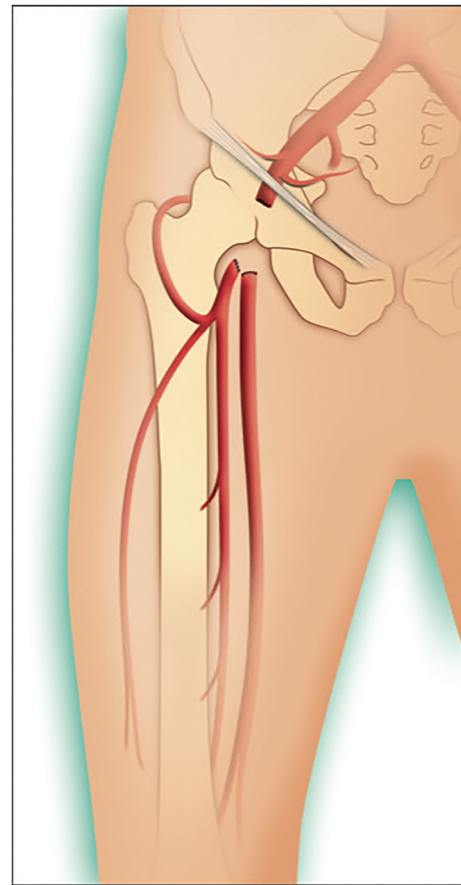


FIGURE 2 Illustration of triple femoral artery ligation

control the hemorrhage, and when the pseudoaneurysm and hematoma extend up to the inguinal ligament there is a risk of significant bleeding during proximal control of the femoral artery (FA). An external iliac artery approach through an oblique incision above the inguinal ligament is therefore used with retroperitoneal progression. Collateral vessels of the FA, above and below the inguinal ligament, must be preserved during the approach of the external iliac artery. Distal control is performed with isolated distal FA clamping or clamping of the deep artery of the thigh and FA below the origin of the latter. The arterial hemostasis can be controlled using a Fogarty catheter in case of difficulties encountered in arterial dissection. Before arterial ligation, an arterial thrombectomy can be performed, allowing withdrawal of thrombi and preserving collaterality.

According to femoral bifurcation involvement, either a simple ligation of the FA above or below origin of the femoral artery of thigh or triple ligation may be used. Ligation is performed in a healthy area, at least 1 cm from the end of the infected arterial segment; proximally 1 cm above healthy tissue and distally 1 cm below healthy tissue.

2.1 | Single branch ligation

In case of femoral bifurcation free of infection or in case of isolated FA below the femoral artery of thigh involvement, a simple ligation of

the FA is performed. For FA ligation above the origin of the deep artery of thigh, proximal ligation is performed leaving free the superficial circumflex iliac artery and the superficial epigastric artery (Figure 1). It can also be performed at the distal part of the external iliac artery, above the inguinal ligament and below the deep circumflex iliac artery and inferior epigastric artery. Distal ligation is performed above the femoral bifurcation respecting the safety limits for sepsis. Pseudoaneurysm located on the FA below the origin of the deep artery of thigh is treated with a simple ligature of this artery. Proximal ligation is performed below the femoral bifurcation to preserve the patency of the deep femoral artery of thigh; distal ligation is performed in healthy tissue in the thigh.

2.2 | Triple branch ligation

Ligation of each femoral vessel is indicated in case of extension of the infection to the femoral bifurcation. Proximal ligation is performed on the proximal part of the FA, as described above for single ligation. Distal ligation is performed on the proximal part of the deep artery of thigh and the FA below the origin of the deep artery of thigh (Figure 2). The femoral bifurcation is also resected in case of involvement. If the 1-cm safety margin is below the femoral bifurcation, the ligation is located below the origin of the deep artery of the thigh, leaving the bifurcation

in place. Arterial dissection is as limited as possible in order to avoid a wound of a collateral artery wound such as the deep and superficial external pudendal arteries and circumflex femoral arteries. Each ligature is performed with two 5/0 thread monofilament sutures: the outward is performed with a continuous horizontal mattress suture; the return with a simple continuous suture. The use of pledgets is not recommended; although they reinforce a vascular suture, they represent a prosthetic material in a septic area.

2.3 | Additional treatment

All infected tissues are removed (including infected artery) and multiple samples were taken for microbiological analysis are taken during pseudoaneurysm treatment. Local sepsis is controlled by wide excision of infected tissue. Extensive debridement can result in a large loss of tissue, and therefore local flaps may be necessary to cover exposed vessels even if ligated. The sartorius muscle is the best local flap in the lower limb to cover femoral vessels; if this is not possible, the gracilis and rectus femoris could also be used. In addition, negative wound pressure therapy (Vacuum-Assisted Closure) can be used to accelerate healing, provided that the femoral vessels are not exposed. Oxygen saturation of blood is examined at the end of the affected limb with a continuous pulse oximeter; this postoperative monitoring is particularly necessary to identify signs of severe ischemia.

3 | DISCUSSION

Arterial complications due to repeated non-sterile puncture are common in drug abusers, and the FA is one of the most common sites of drug injection of intravenous drugs (Patel et al., 1988; Reddy et al., 1986). IGP represent only a small population (0.14%) of the complications associated with the injection of intravenous drugs (Tsao et al., 2002). However, rupture of femoral IGP or sepsis syndrome accounted for nearly 75% of patients in injected drug abusers and can result in life-threatening hemorrhage (Singh et al., 2021). After an arterial approach and hemorrhage control, simultaneous lower limb revascularization is the next logical step, but remains controversial due to the high rate of infectious and thrombosis complications of in situ bypass (Coughlin & Mavor, 2006; Kakisis, 2019). In this context, vascular reconstruction in a septic area can be avoided by performing isolated arterial ligation (Becker & Makaloski, 2020). Tolerance of this ligation is assessed intraoperatively with distal measurement of the saturation oximetry or a Doppler scan of the pedal arteries once proximal control of the FA or external iliac artery is achieved (Arora et al., 2001). If a Doppler signal is present, the FA can be ligated under the inguinal ligament to preserve the lateral circumflex femoral and inferior epigastric arteries. For distal arterial ligation, preservation of the femoral bifurcation improves clinical tolerance by leaving free collaterals between the deep artery of thigh and the distal part of the FA (Chan & Burnand, 2006; Qiu et al., 2016). Arteriography of this collateral circulation demonstrated a hemodynamic compensation via the

internal iliac artery collaterals; several types of supplementations were described such as the obturator artery or the inferior epigastric artery, as well as circulatory anastomosis such as trochanteric anastomosis between the superior gluteal artery and the medial circumflex artery, or cruciate anastomosis between the inferior gluteal artery and the medial circumflex artery (Hu et al., 2010). Moreover, intraoperative angiography found branches of the internal iliac artery and compensatory enlarged deep femoral artery of thigh after FA ligation (Hu et al., 2010; Mousavi et al., 2010). In addition, measurements of the mean arterial pressure before and after femoral ligation found that a distal peak systolic pressure ≥ 40 mm Hg was compatible with limb rescue (Padberg et al., 1992). Chronic vessel injury related to repeated femoral puncture may result in stenosis or occlusion of the femoral vessels and may promote the development of collateral arteries (Arora et al., 2001). Previous history of chronic peripheral arterial disease cannot be assessed before the acute event in this population without medical follow-up; however, ligation of the FA is considered at low risk of limb loss when the distal arteries are patent (Gan et al., 2000) and it is reported to result in a relatively low rate of lower limb amputation, ranging from 0% to 12.5% (Singh et al., 2021). Triple vessel ligation carries an increased risk of amputation compared to single vessel ligation (Tan et al., 2009), and it is of note that above-knee amputation mostly concerns patients with a previous episode of distal ischemia from intra-arterial injections (Gan et al., 2000). In addition, the frequency of intermittent claudication is high, reaching up to 80.9% post-operatively (Coughlin & Mavor, 2006). In case of persistent signs of ischemia, revascularization may be considered after control of local sepsis. The frequency of reinfection and rebleeding requiring further surgical intervention is very low after femoral ligation, from 0% to 17.6% (Coughlin & Mavor, 2006), and furthermore the results of arterial reconstruction are generally disappointing. Long-term bypass benefit is reduced by drug reinjection with high risk of reinfection (Becker et al., 2019; Chan & Burnand, 2006). Autogenous materials, such as saphenous veins, arm veins, or deep lower limb veins, are almost always in poor condition and not suitable for a bypass due to iterative puncture and a high rate of deep thrombophlebitis from previous injections; in case of patency, they are preserved to maintain lower limb venous drainage (Jayaraman et al., 2012; Schulz et al., 2002). There may also be difficulties in the availability of arterial or venous allograft. The presence of an inguinal bypass represents a new vascular access in patients with high probability of continued drug use and still injecting drugs (Chan & Burnand, 2006).

This ligation has some limitations. There is no recommendation regarding postoperative anticoagulation that would maintain patency of femoral collaterals and improve tolerance of femoral ligation. However, anticoagulation should be considered while taking in to account the risk of hemorrhage with the loosening of arterial sutures in a septic context.

4 | CONCLUSION

The extensive excision of infected tissue associated with proximal and distal arterial ligation with neighboring muscle flap coverage appears

to be optimal first-line surgical treatment. Conserving femoral bifurcation improves clinical tolerance.

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ORCID

Philippe Tresson  <https://orcid.org/0000-0002-6352-4528>

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