

Optimal Technique for Common Femoral Artery Access

Knowing the anatomy, choosing the best puncture site, and techniques for achieving safe CFA access.

BY JOS C. VAN DEN BERG, MD, PhD

After its first introduction by Seldinger, percutaneous vascular access through the common femoral artery (CFA) has become the most widely used route of access to the arterial system for peripheral percutaneous vascular interventions. This article discusses anatomical aspects related to CFA puncture, choosing the optimal puncture site, and methods to increase the efficacy and safety of the CFA puncture.

PUNCTURE SITE AND PUNCTURE TECHNIQUES

Relevant Anatomy

The CFA is the continuation of the external iliac artery after the take-off of the inferior epigastric artery and after crossing the inguinal ligament that forms an anatomical landmark and runs from the anterosuperior iliac crest to the pubic bone (an imaginary line drawn between these bony structures indicates the location of the inguinal ligament; Figure 1A).¹⁻³ Here, the artery lies midway between the anterosuperior crest of the iliac bone and the pubic bone and runs parallel with the medial aspect of the femoral head. It descends almost vertically down toward the adductor tubercle of the femur and ends at the opening of the adductor magnus muscle in the so-called femoral triangle. At its origin, the femoral artery is accompanied by the anterior crural nerve laterally and the femoral vein medially and is covered anteriorly by the inferior extension of the fascia of the transverse abdominal and iliac muscles (the so-called femoral sheath).

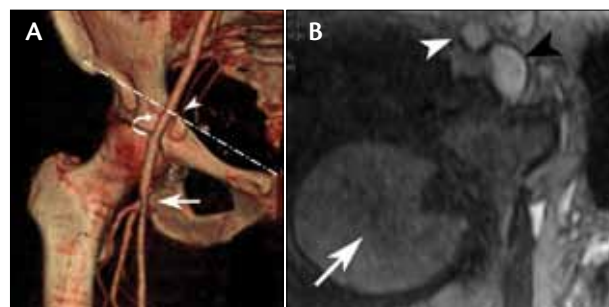


Figure 1. Volume-rendered technique reconstruction of computed tomographic angiography demonstrating the origin of the inferior epigastric artery (arrowhead) and the CFA bifurcation (arrow) and deep circumflex iliac artery (curved arrow) (A). Note the position of the inguinal ligament with respect to the inferior epigastric artery (dotted line). Transverse (axial) image of MRA (steady-state phase using blood pool contrast agent) demonstrating the relation of the CFA (white arrowhead) and common femoral vein (black arrowhead) with respect to the femoral head (arrow) (B).

The femoral sheath is funnel-shaped and fuses with the adventitia of the vessels at the site where the greater saphenous vein joins the femoral vein.⁴ The presence of the femoral sheath that encloses the CFA assists in preventing pseudoaneurysm formation after puncture. The deep femoral artery branches 2.5 to 5 cm distal from the origin of the CFA. The most superficial part of the CFA lies at the level where the artery passes in front of the femoral head.⁴ The center of the CFA lies anterior to the common femoral vein. A portion of the CFA overlaps the corresponding vein

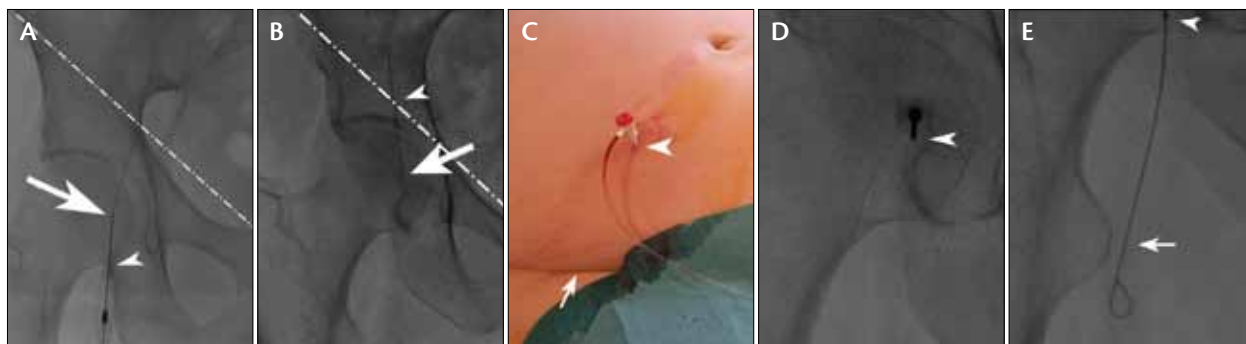


Figure 2. Fluoroscopic image after retrograde puncture of the right CFA (A); the dotted line represents the position of the inguinal ligament, the arrow indicates the arterial entry site, and the arrowhead indicates the skin entry site. Fluoroscopic image after antegrade puncture of the right CFA (B); the dotted line represents the position of the inguinal ligament, the arrow indicates the arterial entry site, and the arrowhead indicates the skin entry site. Image demonstrating positioning of a 4-F introducer sheath relative to the position of the inguinal crease (arrow) and the skin entry site (C, arrowhead). Fluoroscopic image of needle entry (arrowhead) in an antegrade approach in a relatively obese patient; note the almost vertical position of the needle (D). Fluoroscopic image (same patient as panel D), showing needle tip (arrowhead) and proper insertion of guide-wire into the SFA (E, arrow).

in the anteroposterior plane in 65% of cases (Figure 1B). This relationship is important in preventing the development of arteriovenous fistulas.⁵ Many variations of this anatomy have been described, but an extensive discussion on this topic is beyond the scope of this article.

Relative to palpable bony structures, the course of the femoral artery is indicated by the upper two-thirds of the line drawn between the midpoint of the anterosuperior iliac spine and symphysis pubis to the prominent tuberosity on the inner condyle of the femur with the thigh abducted and rotated outward.⁶

The association between low puncture sites and both pseudoaneurysms and arteriovenous fistulas is well known, as is the high risk of retroperitoneal bleeding in cases of high puncture sites. The bleeding may be massive because of the presence of only loose connective tissue in the retroperitoneal space.⁷

Choice of Puncture Site and Technical Aspects

The inguinal crease is frequently used as a landmark, based on the belief that the level of the inguinal crease is closely related to the inguinal ligament.^{8,9} However, the distance between the inguinal crease and the inguinal ligament is highly variable, ranging from 0 to 11 cm (mean, 6.5 cm), and the bifurcation of the CFA is above the inguinal crease in 75.6% of patients.⁹ Another frequently used landmark, the maximal femoral pulse, is over the CFA in 92.7% of limbs, and the CFA is projected over the medial aspect of the femoral head in 77.9% of limbs. This indicates that the level of the strongest femoral pulse is a more reliable means of localizing the CFA than the level of the inguinal crease. Therefore, although popular, the use of the inguinal skin

crease should be considered an unreliable guide for CFA puncture.

The use of palpable landmarks based on the iliac crest and the pubic bone has been recommended as reliable guides to achieve CFA access: either the midpoint of a line drawn between the anterosuperior iliac spine and vertical midpoint of pubic symphysis or a point 2.5 cm distally along a line perpendicular to the line drawn between the anterosuperior iliac spine and the pubic bone can be used.⁶ The presence of clearly identifiable landmarks can be obscured by obesity, the presence of residual hematoma, or scar tissue from previous percutaneous or surgical interventions. Low blood pressure or the absence of pulse distal of a stenosis or occlusion of the iliac arteries can also be a problem when identifying a proper puncture site.

In cases when there is an absence of a femoral pulse, the following technique has been described.¹⁰ Place a finger immediately lateral to the pubic tubercle and inferior to the inguinal ligament, with subsequent palpation of the point that allows the most posterior depression that anatomically lies between the iliopsoas muscle laterally and pectineus medially. The femoral vein can be found in this depression, and the CFA will be found 1.5 cm lateral to this point.

Besides palpation, fluoroscopy has also been used in early interventional experiences as a landmark,^{11,12} with the CFA bifurcation occurring at or below the center of the femoral head in 98.5% of cases.³ The puncture entry site at the level of the skin should be made 1 to 2 cm caudal (in the case of retrograde puncture) or cranial (in case of antegrade puncture) to the planned arterial entry site. The site of skin entry should vary, according to the amount of subcutaneous fat. After skin penetration of the needle, and with the

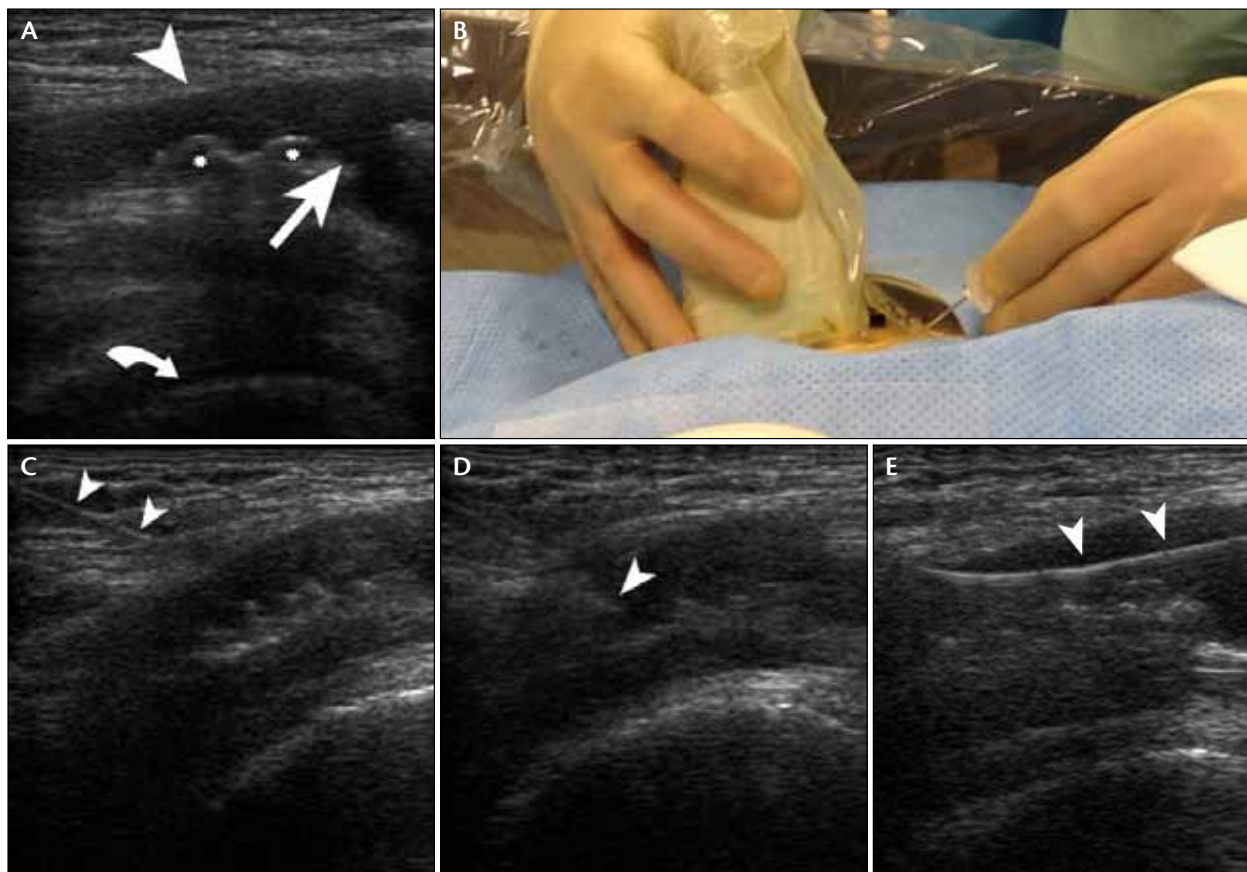


Figure 3. Ultrasound image of the right CFA before antegrade puncture (A); the arrowhead indicates the anterior arterial wall, the arrow indicates the origin of the deep femoral artery just distal of posterior wall plaques (asterisks), and the curved arrow indicates the femoral head. Image demonstrating the position of the needle relative to the ultrasound probe (B); parallel alignment of the needle and probe allow for real-time visualization of the needle along the subcutaneous needle tract (same patient as Figure 3A). Ultrasound image showing a needle (arrowheads) in the subcutaneous tissue before entering the CFA (C). Ultrasound image showing a needle tip (arrowhead) in an intraluminal position (D); ultrasound guidance prevents posterior wall puncture. Ultrasound image showing the presence of a guidewire intraluminally (E, arrowheads).

needle lying directly over the artery, fluoroscopy should be performed again. At this point, the needle should be left lying. By doing so, one can avoid radiation exposure of the hands of the operator. The disadvantage of the fluoroscopic method is the increase in radiation exposure for the patient (and, to a lesser extent, the operator).⁶

Use of fluoroscopy aimed at the level of the middle femoral head will lead to a puncture of the CFA (above the bifurcation) in 99% of cases, thus allowing both retrograde and antegrade access. By using this technique, no intraperitoneal punctures will occur. Needle entry into the artery should be roughly at the bottom of the upper inner quadrant of the femoral head (in an anteroposterior projection; Figure 2).¹³ Morbidly obese patients and patients with a lack of palpable femoral pulse are two categories of patients who might benefit most from fluoroscopically guided puncture.¹⁴ The

incidence of pseudoaneurysms or any other arterial injury can be reduced with the use of fluoroscopy, but no difference in the occurrence of bleeding complications or an influence on the length of hospital stay can be seen.¹⁵

The third technique that can be adopted is ultrasound-guided puncture. With the use of ultrasound, the location of the CFA, femoral artery bifurcation, and inferior epigastric arteries can be readily identified, and thus inadvertent high or low puncture can be avoided (Figure 3). In addition, ultrasound is able to identify arterial wall disease (atherosclerotic plaque with or without calcification and mural thrombus) that cannot easily be identified with angiography, especially when performed in an anteroposterior projection. In this way, puncture of diseased areas or the side-wall can be avoided. This reduces the risk of puncture site complications, especially when arterial closure devices are

being used. Real-time monitoring of needle advancement in the subcutaneous tract and intraluminal positioning of the needle tip can be confirmed, thus avoiding posterior wall puncture.

It has been demonstrated that the incidence of pseudoaneurysm formation can be significantly reduced from 4.5% (in patients undergoing traditional palpation-guided vessel cannulation) to 2.6% when ultrasound guidance is used, mainly by avoiding inadvertent puncture of the external iliac artery and superficial and deep femoral artery.¹⁶ In a prospective evaluation of ultrasound-guided CFA puncture, it was found that the ultrasound-guided technique reduced the time to puncture and the number of attempts in obese patients and patients with weak or absent pulses.¹⁷ In a randomized study, it was found that routine real-time ultrasound guidance can improve cannulation in patients with a high CFA bifurcation and reduces the number of attempts, time to access, risk of inadvertent venous puncture, and vascular complications.¹⁸

By using either anatomical landmarks (palpation and fluoroscopy) or ultrasound, safe CFA access for both retrograde and antegrade procedures can be achieved, thereby reducing the complication rate and allowing for the safe use of closure devices. ■

Jos C. van den Berg, MD, PhD, is Head of Service of Interventional Radiology, Ospedale Regionale di Lugano, sede Civico in Lugano, Switzerland, and Associate Professor

of Vascular Surgery at the University of Pisa in Italy. He has disclosed that he has no financial interests related to this article. Dr. van den Berg may be reached at +41 91811 6072; jos.vandenberg@eoc.ch.

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