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Fluoroscopic Localization of the Femoral Head as a Landmark for Common Femoral Artery Cannulation

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We sought to determine the reliability of frequently used landmarks for femoral arterial access in patients undergoing cardiac catheterization. The common femoral artery (CFA) is the most frequently used arterial access in cardiac catheterization. Arterial sheath placement into the CFA has been shown to decrease vascular complications. Some authors recommend locating the inferior border of the femoral head using fluoroscopy due to the relationship of the femoral head and the bifurcation of the CFA. We performed a descriptive study in a prospective design of 158 patients undergoing catheterization from the femoral approach. A femoral angiogram was performed, and the CFA bifurcation location was recorded in relation to the inguinal ligament, middle and inferior border of the femoral head, and the inguinal skin crease. The CFA bifurcation was distal to the inguinal ligament, middle femoral head, and inferior femoral head in most patients with mean distances (cm ± SD) of 7.5 ± 1.7, 2.9 ± 1.5, and 0.8 ± 1.2, respectively. The inguinal skin crease was below the bifurcation in 78% of patients (−1.8 ± 1.6 cm). The CFA overlies the femoral head in 92% of cases. The femoral head has a consistent relationship to the CFA, and localization using fluoroscopy is a useful landmark. Published 2005 Wiley-Liss, Inc.†

Key words: femoral artery; anatomy; cannulation; catheterization

INTRODUCTION

Cardiac catheterization is most commonly performed from a percutaneous approach utilizing the femoral artery for arterial access (SCAI registry). The common femoral artery (CFA) is defined as the continuation from the external iliac artery from the level of the inguinal ligament to its bifurcation into the profunda femoris (deep femoral artery) and the superficial femoral artery.

Arterial introducer sheath placement into the CFA, and not the deep or superficial femoral artery, has been shown to decrease complications. The CFA overlies the femoral head, which allows for manual compression to control bleeding and obtain hemostasis. Puncture superior to the inguinal ligament increases the risk of retroperitoneal bleeding complications, and puncture distally into branch vessels increases the risk of thrombosis and arteriovenous fistula formation. The need to avoid smaller branch vessel puncture has increasing importance with the increased use of arteriotomy closure devices.

Validation of reliable radiographic landmarks to assist in identification of the appropriate puncture site could improve the accuracy of arterial access into the CFA in cardiac catheterization. The purpose of this study was to define the relationship of the CFA and its bifurcation to the inguinal ligament, femoral head, and inguinal skin crease.

MATERIALS AND METHODS

Patients referred for elective cardiac catheterization from the femoral approach were considered for participation in the study. Patients were excluded if serum creatinine was above 2.5 mg/dL or the performing angiographer did not want to participate. All eligible patients offered enrollment agreed to participate. The protocol was approved by the institutional review board of the study hospitals. Signed informed consent was obtained on all patients prior to participation.

Femoral artery cannulation and placement of the introducer sheath were performed by the usual technique of the performing angiographer without restric-

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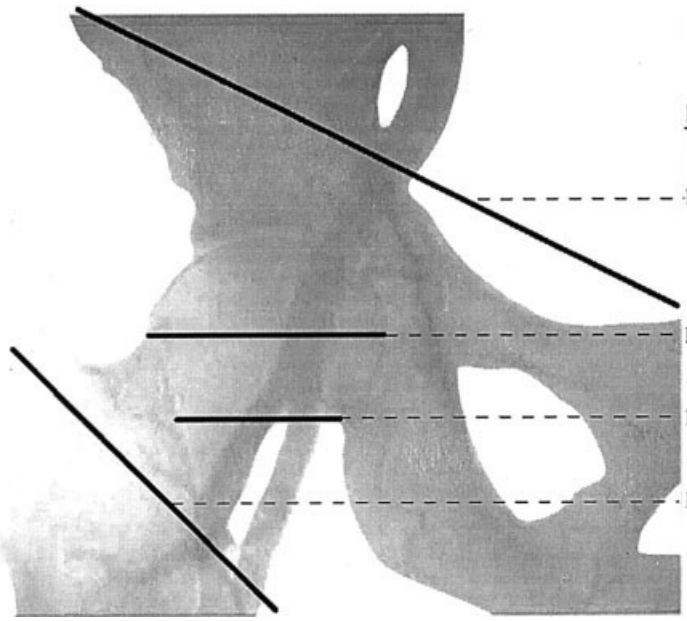

Fig. 1. Radiographic landmarks during femoral arteriography and their position relative to the bifurcation of the femoral artery. Inguinal crease identified by the use of radio-opaque marker at the time of arteriography.

tions. The introducer needle was then placed along the inguinal skin crease as a radiographic marker. A femoral arteriogram was recorded using digital cine fluoroscopy in a 9″ anterior-posterior projection centered onto the femoral head. The bony landmarks of the pubis symphysis and anterior superior iliac crest were included in the view to allow for radiographic identification of the course of the inguinal ligament.

Analysis of all angiograms was performed by a single author (P.D.G.) on the digitally stored images. The locations of the inguinal ligament, middle of the femoral head, inferior margin of the femoral head, and the inguinal skin crease were recorded in relation to the bifurcation of the common femoral artery.

RESULTS

Informed consent was obtained on 181 patients. No femoral angiogram was performed on 18 patients and an incorrect view was taken on 2 others due to error of the angiographer. Three patients had an artificial femoral head due to hip replacement and were excluded from analysis. Femoral angiograms were reviewed on 158 enrolled patients for location of CFA bifurcation in reference to the landmarks. Of these, 126 angiograms were able to be appropriately calibrated on the digital software to allow for accurate distance measurements.

The CFA bifurcation was below both the inguinal ligament and middle of the femoral head in nearly all study patients (Fig. 1). The inferior border of the femoral head was similarly above the CFA bifurcation in the majority (80%) of the patients. The inguinal skin crease was below the CFA bifurcation in 78% of patients. The CFA bifurcated above (0.7 cm) the middle femoral head in only one patient. This places a segment of the CFA between the middle and inferior border of the femoral head in 99.4% of study patients.

The CFA bifurcation was a mean of 7.5 cm below the inguinal ligament, 2.9 cm below the middle femoral head, and 0.8 cm below the inferior femoral head. The inguinal skin crease was a mean of 1.8 cm above the CFA bifurcation (Table I). The CFA coursed over the medial femoral head in the AP view in 92% of cases. The femoral artery was medial to the entire femoral head in 8% of patients.

DISCUSSION

Despite agreement on the optimal location for artery puncture, there is variation in the landmarks utilized by angiographers to best identify the puncture site in patients prior to cannulation of the artery. Grier and Hartnell [1] reported that the most commonly used landmarks among angiographers are the inguinal skin crease, maximal pulsation, and/or bony landmarks. Among those using the inguinal crease as a landmark, 47% punctured below, 21% above, and 26% at the crease. Lechner et al. [2] reported that the inguinal skin crease does not correlate to the inguinal ligament,

TABLE I. Relationship of Common Femoral Artery to Landmarks Identified in the Study*

	Mean ± SD	Median	Range
Inguinal ligament	7.5 ± 1.7	7.4	2.9–11.8
Middle femoral head	2.9 ± 1.5	2.9	−0.7–9.9
Inferior femoral head	0.8 ± 1.2	0.6	−3.2–7.5
Inguinal crease	−1.8 ± 1.6	−1.8	−6.5–3.9

*All measurements recorded as distance in centimeters from landmark to the bifurcation of the common femoral artery. Negative numbers indicate distance of landmark below the common femoral artery bifurcation.

being $\geq$ 3 cm below the ligament in 95% of cases. They also reported that the bifurcation of the CFA was above the inguinal crease in 77% of cases, with the majority being 1–4 cm above the inguinal skin crease. They estimated that a branch vessel puncture would occur in 25% of cases if this technique is used [2].

The common palpable landmarks can often be obscured or distorted by obesity, prior hematoma, scarring, or low blood pressure in shock, making them less reliable. The relatively constant anatomic relationship of the CFA to the underlying femoral head has been recommended by some as a radiographic landmark to assist in obtaining proper arterial access to the CFA. Grossman [3] suggested using fluoroscopy over the femoral head to locate the CFA in 1974. Dotter et al. [4] later reported the relationship between the femoral head and the common femoral artery in 100 patients, and the CFA bifurcation was an average of 3.4 cm from the center of the femoral head in an AP projection. They concluded that the femoral head and CFA relationship was consistent enough to use as a guide for an obscured pulse. Specter and Lawson [5] noted the CFA bifurcated below the inferior femoral head in 76% of cases by review of RAO projection angiograms, but did not use this as a landmark prior to puncture. Other studies have described femoral anatomy associations from CT scans with similar results [6].

Some physicians currently use fluoroscopy of the femoral head to help localize the site of puncture in difficult cases; however, this technique has never been prospectively validated. In this study, it has been demonstrated that the femoral artery almost universally bifurcates below the middle of the femoral head and bifurcates below the inferior border of the femoral head in most patients. No patient had a bifurcation above the inguinal ligament. These results indicate that a significant segment of the CFA is reliably located at the level of the middle femoral head in the AP projection. The reliable relationship of the femoral head to the CFA may allow for fluoroscopy of the femoral head to be used to help localize the CFA prior to attempted puncture. These findings confirm those reported by Dotter et al. [4], in which they suggested using the femoral head as a radiographic landmark. This can be especially helpful for less experienced angiographers, such as in training programs, or when superficial landmarks are obscured.

This descriptive study was not designed to demonstrate that fluoroscopy improves the accuracy of appropriate CFA puncture. However, if needle insertion was at the level of the middle femoral head in this cohort of patients, then CFA puncture would have occurred in 99% of patients with no intraperitoneal punctures. Future randomized prospective study would be needed to determine if prepuncture fluoroscopy would decrease vascular complications.

Our findings show that the femoral head as assessed by fluoroscopy in the AP view does have a consistent relationship to the CFA. Confirming the intended access site with fluoroscopy of the femoral head prior to puncture may help reduce vascular complications and may serve as a reproducible landmark in patients with obscured palpable landmarks.

REFERENCES

1. Grier D, Hartnell G. Percutaneous femoral artery puncture: practice and anatomy. Br J Radiol 1990;63:602–604.
2. Lechner G, Jantsch H, Waneck R, Kretschmer G. The relationship between the common femoral artery, the inguinal crease, and the inguinal ligament: a guide to accurate angiographic puncture. Cardiovasc Interv Radiol 1988;11:165–169.
3. Grossman M. How to miss the profunda femoris. Radiology 1974; 111:482.
4. Dotter CT, Rosch J, Robinson M. Fluoroscopic guidance in femoral artery puncture. Radiology 1978;127:266–267.
5. Spector KS, Lawson WE. Optimizing safe femoral access during cardiac catheterization. Catheter Cardiovasc Interv 2001;53:209–212.
6. Baum PA, Matsumoto AH, Teitelbaum GP, Zuurbier RA, Barth KH. Anatomic relationship between the common femoral artery and vein: CT evaluation and clinical significance. Radiology 1989;173:775–777.