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Anatomical Landmarks That Can Be Used For Localization In Common Femoral Artery Puncture

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ABSTRACT

This study was designed to achieve the more standardized identification of anatomical landmarks during femoral artery puncture and minimize the rate of complications.

Of patients who were diagnosed with spontaneous subarachnoid hemorrhage and received treatment following the incidental detection of intracranial aneurysms at our department between November 14, 2017 and November 14, 2020, we retrospectively examined the digital subtraction angiography images of 85 patients with suitable images (covering the puncture site). In the angiograms of the 85 patients, the superior and medial borders were determined as the borders of the acetabulum, whereas the lateral and inferior borders were determined as the borders of the femoral head. The images were divided into six equal parts, including three in the cranial-caudal plane and two in the medial-lateral plane. The region of localization for the puncture was evaluated. D was considered outside the femoral head.

Of the 85 patients, 42 were males and 43 were females. The number of punctures in the regions numbered 3, 4, 5, and 6 was 3, 42, 32, and 8, respectively. No significant difference was observed in the intervention side based on catheters or the inside or outside of the femoral head based on age ($p > 0.05$). Moreover, no significant difference was observed between patients with both hypertension and diabetes mellitus and those without ($p > 0.05$). Regarding sex-related differences, more interventions in the region numbered 4 were observed among male patients ($p < 0.05$).

Although in the literature, 85%–92% of punctures were in the femoral head, particularly under its medial aspect, in this study, the punctures were outside the borders of the femoral head in 35 patients (41.2%) and in the region numbered 3 in three patients (3.5%). Moreover, no significant difference was observed between patients with hypertension, diabetes mellitus, and other diseases and those without these diseases in terms of their localization of catheter placement or whether their catheter placement was inside or outside the femoral head. It was thought that the reason for the intervention being made in regions other than those reported in the literature could be the unsuitable position of the patient (patient lying asymmetrically) or anatomical variations.

Keywords: DSA, femoral artery puncture, intracranial aneurysm

Introduction

The rate of endovascular interventions for diagnosis and treatment is increasing in many medical fields, such as neurosurgery and cardiology. This situation increases the probability of vascular complications. The percutaneous vascular access method that was first defined by Sven-Ivar Seldinger in 1953 is being used, and the puncture is frequently made from the common femoral artery (CFA) (3). The inguinal ligament is the anatomical landmark where the CFA branches from the external iliac artery (11). The inguinal ligament extends from the anterior-superior iliac spine to the pubic tubercle. The recommended puncture site is 1–2 cm distal to the region of the bifurcation of the inguinal artery and the femoral artery (9). Fluoroscopy is a reliable method for identifying the bifurcation of the femoral artery, which is usually located in the inferior medial part of the femoral head (9,10). In punctures made below the level of the CFA, local complications, such as pseudoaneurysm (8%), hematoma (0.3%–0.6%), and arteriovenous fistula (0.1%), can be encountered (4). In punctures made above the point where compression can be applied, postprocedural bleeding can occur. Because of these complications, the hospitalization of patients is prolonged, and the morbidity and mortality rates increase. To not only apply compression to the artery but also prevent complications, making the puncture from the CFA is important. Doppler ultrasonography (USG) can be used when possible; however, its use in punctures made from the CFA is not a routine procedure. In case of vascular complications, it would be more appropriate to carry out these procedures in centers

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Table 1: Distribution of Patients Based On Sex

		n	%
Sex	Male	42	49.4%
	Female	43	50.6%

Table 2: Distribution of Patients Based On Comorbidities (HT, Hypertension; DM, Diabetes Mellitus; CVE, Cerebrovascular Event; CAD, Coronary Artery Disease)

		n	%
Comorbidities	HT	17	30.4
	DM	2	3.6
	CVE	7	12.5
	CAD	1	1.8
	HT-DM	7	12.5
	HT-CVE	10	17.9
	HT-DM-CAD	4	7.1
	HT-CAD	2	3.6
	HT-DM-CVE	5	8.9
	DM-CVE	1	1.8

where cardiovascular surgery can be performed in order to be able to treat them(12).

This study was designed to identify bony anatomical structures in a more standardized manner and minimize the rate of complications related to CFA puncture procedures.

Materials and Methods

In this study, of patients who were diagnosed with spontaneous subarachnoid hemorrhage and received treatment following the incidental detection of intracranial aneurysms at our department between November 14, 2017 and November 14, 2020, we retrospectively examined the digital subtraction angiography (DSA) images of 85 patients with suitable images (covering the puncture site). Before commencing the study, an ethical approval was obtained from the local ethics committee. In the angiograms, the superior and medial borders were determined as the borders of the acetabulum, whereas the lateral and inferior borders were determined as the borders of the femoral head. The images were divided into six equal parts, including three in the cranial-caudal plane and two in the medial-lateral plane. The localization region for the puncture was evaluated (Fig. 1). D was considered outside the femoral head.

Statistical Method: To provide information on the general characteristics of the groups included in this study, descriptive statistics were calculated. The data of the qualitative variables are presented as numbers and percentages. Intergroup differences were examined using the chi-square test. For the analyses, the results were considered statistically significant when the p-values were less than 0.05. Statistical Package for the Social Sciences (version 22; IBM Corp, Armonk, NY, USA) was used for all statistical analyses.

Results

Of the 85 patients, 42 were males and 43 were females (Table 1). Among the comorbid diseases of the patients (Table 2), hypertension (HT) was the most frequently observed disease, which was seen in 45 patients. HT was followed by diabetes mellitus (DM), seen in 19 patients. Table 3 shows the catheterization sides for the DSA interventions and the number of patients based on whether the interventions were made inside or outside the femoral head. Examples of pictures for the cases of

Table 3: Distribution of Patients Based On The Catheterization Site and Intervention Status (Inside Or Outside The Femoral Head).

		n	%
Catheterization Site	3	3	3.5
	4	42	49.4
	5	32	37.6
	6	8	9.4
Femoral Head	Inside	50	58.8
	Outside	35	41.2

Table 4: Distribution of Patients Based On Age Regarding The Catheterization Site and Intervention Status (Inside Or Outside The Femoral Head) With P-Values

		Age (years)		p
		Under 65	65 or older	
Catheterization site	3	1 (2.2)	2 (5.0)	0.313
	4	19 (42.2)	23 (57.5)	
	5	21 (46.7)	11 (27.5)	
	6	4 (8.9)	4 (10.0)	
Femoral head	Inside	26 (57.8)	24 (60.0)	0.835
	Outside	19 (42.2)	16 (40.0)	

puncturing inside and outside the femoral head are provided below (Figs. 1–2). No catheterization interventions were made from the regions numbered 1 and 2. Moreover, no statistically significant difference was observed in the intervention site (being inside or outside the femoral head) based on age ($p > 0.05$) (Table 4). There was also no significant difference between patients with HT and DM and those without in terms of the intervention site ($p > 0.05$). Regarding sex-related differences, a significant difference in the number of interventions in the region numbered 4 (more frequent among the males) was observed between male and female patients ($p < 0.05$) (Table 5). There was no significant difference between male and female in puncture according to the femoral head ($p=0.072$) (Table 6). Angiography was performed on the same day for patients who did not undergo catheter treatment afterward and on the next day for those who underwent catheter treatment afterward.

Discussion

Although in the literature, 85%–92% of punctures are on the femoral head, primarily under its medial aspect, in this study, the punctures were outside the borders of the femoral head in 35 patients (41.2%) and in the region numbered 3 in three patients (3.5%). Therefore, our results were not in agreement with those in the literature; however, the absence of any complications suggests that the unsuitable position of the patient (patient lying asymmetrically), weak arterial pulse, and anatomical variations cause these differences in rates. Thus, it was thought that localization using the recommended anatomical landmarks introduced in this study could be more reliable.

Different methods and landmarks have been proposed to perform CFA punctures from the most suitable point and reduce complication rates. Grier

Table 5: Comparison of Patients Based On Sex Regarding The Catheterization Site and Intervention Status (Inside Or Outside The Femoral Head) (Same Superscripts Indicate The Absence of A Statistically Significant Difference).

		Sex		p
		Male	Female	
Catheterization site	3	1 (2.4) a	2 (4.7) a	0.048*
	4	27 (64.3) a	15 (34.9) b	
	5	12 (28.6) a	20 (46.5) a	
	6	2 (4.8) a	6 (14.0) a	
Femoral head	Inside	26 (61.9)	24 (55.8)	0.726
	Outside	16 (38.1)	19 (44.2)	

Table 6: Catheter intervention site relative to the femoral head

		Sex		p
		Male	Female	
3-In	n	1	2	0,072
	%	2.4%	4.7%	
4-In	n	20	9	
	%	47.6%	20.9%	
4-D	n	7	6	
	%	16.7%	14.0%	
5-In	n	5	13	
	%	11.9%	30.2%	
5-D	n	7	7	
	%	16.7%	16.3%	
6-D	n	2	6	
	%	4.8%	14.0%	

and Hartnell reported that the most frequently used landmarks were the sites with the maximum pulse and bone landmarks (1). Performing punctures on sites with the maximum pulse can be misleading in cases with hypotension, arrhythmia, and obesity. This may have prevented a safe intervention. In 1974, Grossman recommended using fluoroscopy for identifying CFA localization (2). Garrett et al. revealed a consistent relationship between the femoral head and CFA in their fluoroscopy examination in the anterior-posterior (AP) view. Additionally, they showed that CFA coursed "over" the femoral head in 92% of the cases. Moreover, in most patients, the femoral artery was under the medial aspect of the femoral head, almost as a standard; it bifurcated at the lower border of the femoral head; and no bifurcation was observed over the inguinal ligament in any patient. These results demonstrated that a significant part of the CFA is localized at the medial level of the femoral head in AP projection, and a puncture can be made reliably in this site (5). In the study by Schnyder et al., the rate of the punctures made from the lower and medial aspects of the femoral head, accepted as the appropriate site, was 46% (11). Huggins (8) and Chinikar et al. (7) divided the femoral head into five equal parts on the cranial and caudal planes. They

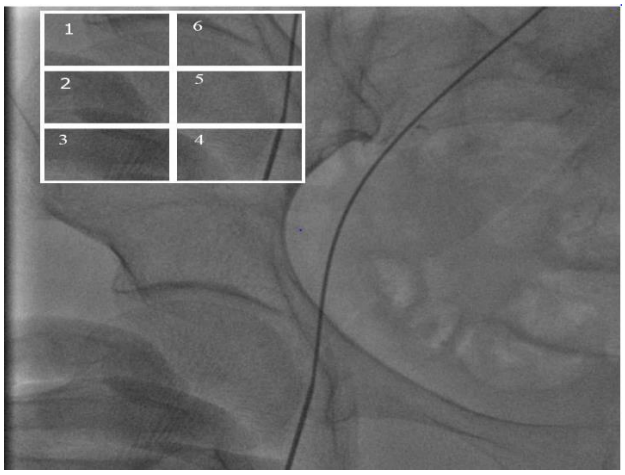

Fig. 1. Femoral Catheter Entry Sites and Puncture Needle Entry Site (Outside Femoral Head), 4D

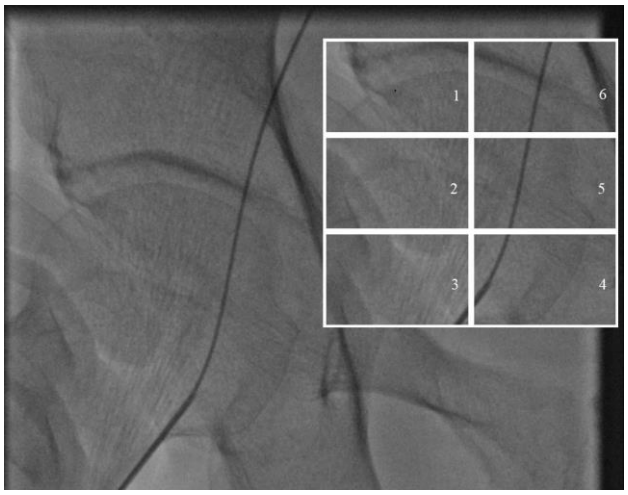

Fig. 2. Femoral Catheter Entry Sites and Puncture Needle Entry Site (On Femoral Head), Region 4

reported that the rate of punctures made in the regions over the femoral head, which they accepted as suitable sites, was 89.5%. This study showed that punctures made under fluoroscopic guidance significantly increase the rates of interventions made over the femoral head and from the CFA.

It was reported that among patients with body mass index ≥ 30 and female patients, punctures under fluoroscopic guidance were more reliable than those made solely based on anatomical data (7). Although there are recommendations in the literature for the use of landmarks, such as the inguinal ligament and the site of the maximum pulse, anatomical variations are an underlying cause of puncture-related complications (6). In line with these data, considering all recommendations together as much as possible can minimize the rate of complications.

Among patients for whom interventions based on the maximum pulse assessed by palpation are unsuitable, using bone landmarks identified on fluoroscopy will be appropriate. We believe that performing femoral artery puncture interventions from the regions numbered 4 and 5 is more reliable by dividing the area into six equal parts with the borders of the acetabulum as the superior and medial borders and the borders of the femoral head as the lateral and inferior borders. Doppler USC can be used in patients for whom the use of the maximum pulse or fluoroscopy is unsuitable.

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