Optimal Technique For Antegrade Femoral Artery Puncture

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With the advent of transluminal popliteo-femoral angioplasty, lower limb arterial embolization for malignancy, catheter placement of intra-arterial thrombolysis and intra-arterial chemotherapy, optimal technique for antegrade femoral artery puncture has gained a crucial importance. The main object of our study was to devise an easier, convenient and accurate method to get a clean vessel wall antegrade puncture in the first attempt, at a safe level along femoral artery. The femoral artery puncture at the level of common femoral artery puncture was highly desirable as common femoral artery has larger caliber, best osseous support of femoral head and is in direct line of the superficial femoral artery. A constant landmark to identify the optimal level of entry into the common femoral artery would be helpful. On the basis of our data obtained from 50 patients, we conclude that beginning of common femoral artery is located proximal to the center of femoral head and the femoral artery bifurcation is located distal to the center of femoral head. If the arterial entry is chosen at the level of center of femoral head which is localized by fluoroscopy a safe puncture of common artery is ensured. With skin puncture site 1-2 cm proximal to this level needle is directed obliquely through the skin, the common femoral artery is entered at the level of center of femoral head.

Key Words : Antegrade femoral artery puncture, femoral head.

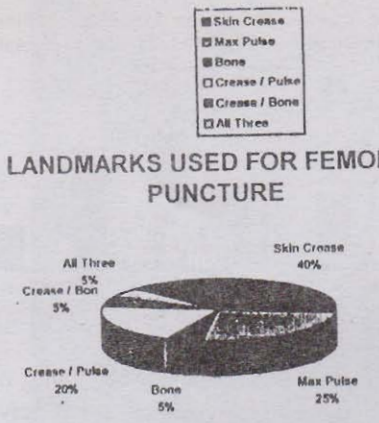
Ever since its introduction [1] percutaneous puncture of the femoral artery, has become the commonest means of access for arterial tree. The common femoral artery is considered to be the safest site for the arterial puncture as this artery lies for much of its course over the bone against which it can readily be compressed to ensure adequate haemostasis. It's larger diameter than superficial femoral artery or profunda femoris artery, enables it more optimal for the passage of large catheters and sheaths (up to 16 French), especially during complex interventional procedures. In a large series the puncture site complication rate quoted between 0.11-0.47%. Complications include haemorrhage (0.26%), arterial thrombosis (0.14%), pseudo-aneurysm (0.05%) and AV fistula (0.01%) [5]. Local complications depend on many factors such as age of patient, state of peripheral vasculature, type of procedure, anticoagulation, also the technique of arterial puncture and subsequent haemostasis. A high groin puncture of the femoral artery is associated with increased risk of extra peritoneal bleeding, which could be massive due to presence of loose connective tissue. More-over, the manual compression after the procedure is hampered due to tense inguinal ligament and deep location of external iliac artery. In a large series the puncture site complication rate quoted between 0.11-0.47%. Complications include haemorrhage (0.26%), arterial thrombosis (0.14%), pseudo-aneurysm (0.05%) and AV fistula (0.01%) [5]. Local complications depend on many factors such as age of patient, state of peripheral vasculature, type of procedure, anticoagulation, also the technique of arterial puncture and subsequent haemostasis. For these reason a low puncture site has been advocated. In low punctures there is tendency for the needle to enter into deep femoral artery. Further a greater incidence of pseudo-aneurysm, arteriovenous fistula and thrombosis, has been reported when the puncture were made too low, puncturing the superficial femoral artery and profunda femoris artery [3].

To over come the a forestated hurdles, the femoral artery should be entered caudal to the inguinal ligament (as under normal condition the abdominal cavity does not extend beyond the inguinal ligament into the femoral triangle), at a site where the artery can easily be compressed against the osseous support such as femoral head, further at this site, the presence of femoral sheath enclosing the common femoral artery will probably also prevent pseudo-aneurysm formation [4].

A landmark to identify the optimal level of entry into the common femoral artery at this point would be helpful. However, there is little data relating the common femoral artery and its bifurcation to the landmarks used to guide puncture level.

Materials and Methods

The study was conducted in Catheterization laboratory of main X-ray department Mayo Hospital, Lahore utilizing Siemens Tridorus 5 S, 1000 mA X-ray machine with automatic stepping table and biplane rapid film changer. An initial survey was conducted to sought the details of landmarks commonly used to select the puncture level at groin from 20 angiographers working in cardiac catheterization laboratories of Lahore and Rawalpindi.



(Fig 1)

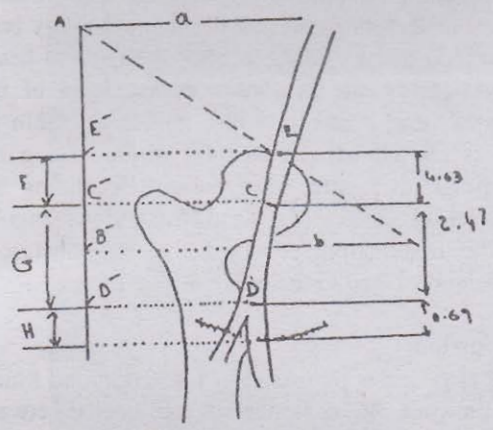


Fig 2 shows schematic representation of angiographic studies. A = anteriopostcrior iliac spine. B = pubic tubercle dashed line = inguinal ligament. C = center of femoral head. D = femoral artery bifurcation. E = beginning of common femoral artery. a = distance from anteriosuperior iliac spine to iliac artery. b = distance from femoral artery to pubic tubercle. B to B' distance from anterosuperior iliac spine to pubic tubercle. C' level of center of femoral head. D' = level of femoral artery bifurcation. E' = level (calculated) of beginning of common femoral artery. F = distance from the level of beginning of the common femoral artery to level of the center of femoral head. G = distance from the level of the center of the femoral head to the level of the femoral artery bifurcation. H = Distance from the level of common femoral artery bifurcation to inguinal skin crease.

The position of these superficial landmarks were correlated with underlying anatomic structures in fifty patients undergoing diagnostic transfemoral lumbar-aortography with at least good pulsation in one groin. Metallic marker were placed for skin crease and the site of maximum pulse in one groin and after fluoroscopic localization of femoral head on contra-lateral side. A radiographic ruler was positioned over the lower abdominal wall permitting the corrected measurements for radiographic magnification. The control radiograph displaying these metallic markers was then related to subsequent angiogram demonstrating the underlying arterial anatomy. From the data obtained a comparative analysis between commonly used superficial landmarks and our suggested landmarks of femoral head with respect to underlying femoral artery, were made for precise puncturing site.

Results:-

Details of landmarks for the preferred site of puncture by angiographers are given in the table 1.

Table ! : Preferred site of puncture by angiographers

Landmark	n	%age
Skin crease	08	40
Max. pulse	05	25
Bone	01	05
Crease / pulse	04	20
Crease / bone	01	05
All three	01	05
Femoral head	00	00
Total	20	100

Results of measured relationships for superficial landmarks are given as follows:-

(i). The bifurcation of common femoral artery was proximal to inguinal skin crease in 74% of limb and distal in remainder 26%

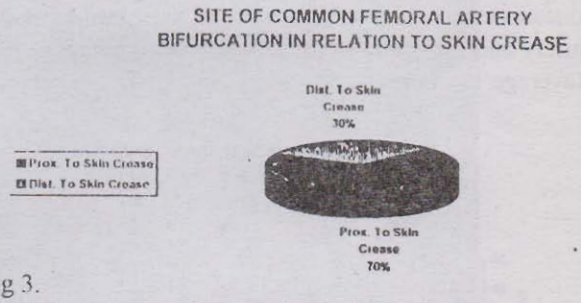


Fig 3.

(ii). The marker for maximal femoral pulsation was projected over the common femoral artery in 80% of the limbs, over the superficial femoral artery in 14% and over bifurcation in 6%

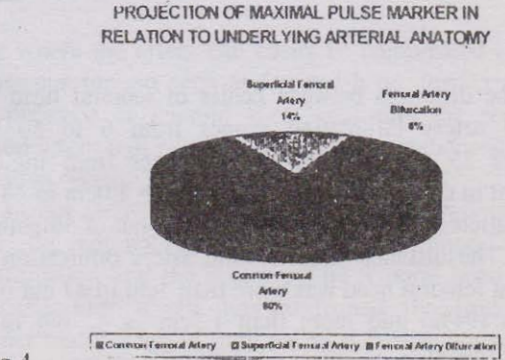


Fig 4.

(iii). The maximal pulsation was projected over the medial aspect of the femoral head in 70% of cases, medial aspect of femoral neck in 16% of cases, superior pubic ramus in 8% and bifurcation in 5% .

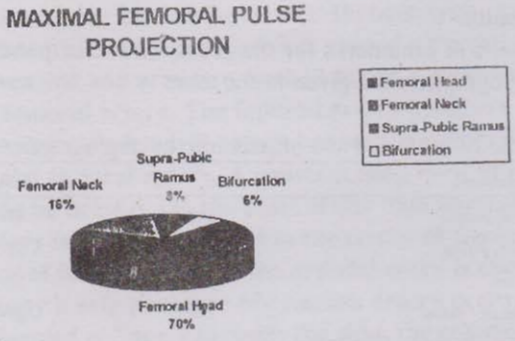


Fig 5.

To obtain quantitative data about relationship of common femoral artery to underlying femoral head the following anatomical landmarks were identified i.e. Anterior superior iliac spine, Pubic tubercle, center of femoral head, and femoral artery bifurcation.

The common femoral artery begins at inguinal ligament which is not visualized on radiograph the position of inguinal ligament is taken to be the line between anterior superior iliac spine and pubic tubercle. The calculated data from angiograms shows that the distances between the beginning of the common femoral artery and the center of the femoral head, ranges 6-40mm (average 19.5mm) .

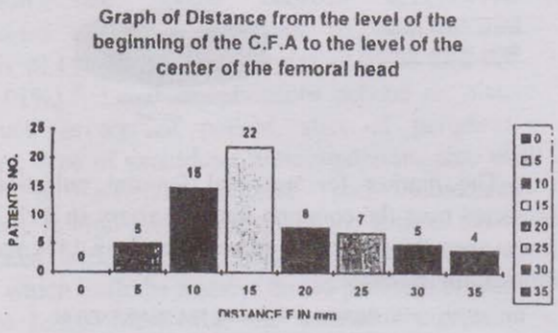


Fig 6.

The distances between center of femoral head and femoral artery bifurcation ranges from 6 to 50 mm (average 25 mm) Fig 8, the distances from inguinal ligament to center of femoral head was > 1.0cm in 44 out of 50 patients (88%) and >1.5 cm in 35 out of 50 patients (70%). The distance from femoral artery bifurcation the centre of femoral head was more than 1cm in 47 out of 50 patients (94%) and more than 1.5cm in 42 out of 50 patients (84%).

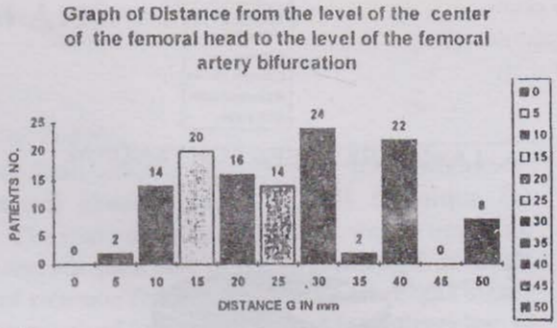


Fig 7

To calculate the level of the beginning of common femoral artery we assumed that the artery and the ligament had a straight course.

On the basis of our data we conclude that beginning of common femoral artery is located proximal to the center of femoral head and the femoral artery bifurcation is located distal to the center of the femoral head. If the arterial entry site is chosen at the level of centre of femoral head a safe puncture is ensured. Skin puncture site is chosen irrespective of position of inguinal skin proximal to inguinal skin crease. Depending upon the distance of the femoral head, for oblique angulation of needle. In antegrade punctures the skin puncture site can be 5 cm proximal to the inguinal skin crease.

Discussion:-

In a large series presented by Chiverton and Murie, 1986 the puncture site complication rate quoted between 0.11-0.47%. Complications include haemorrhage (0.26%), arterial thrombosis (0.14%), pseudo-aneurysm (0.05%) and A.V fistula (0.01%) .

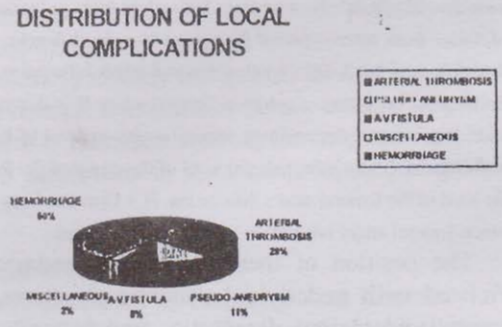


Fig 8.

Local complications depend on many factors such as age of patient, state of peripheral vasculature, type of procedure, anticoagulation also the technique of arterial puncture and subsequent haemostasis. In low punctures there is tendency for needle to enter the superficial or deep femoral artery. In antegrade puncture if the common femoral femoral artery is entered in its proximal part,

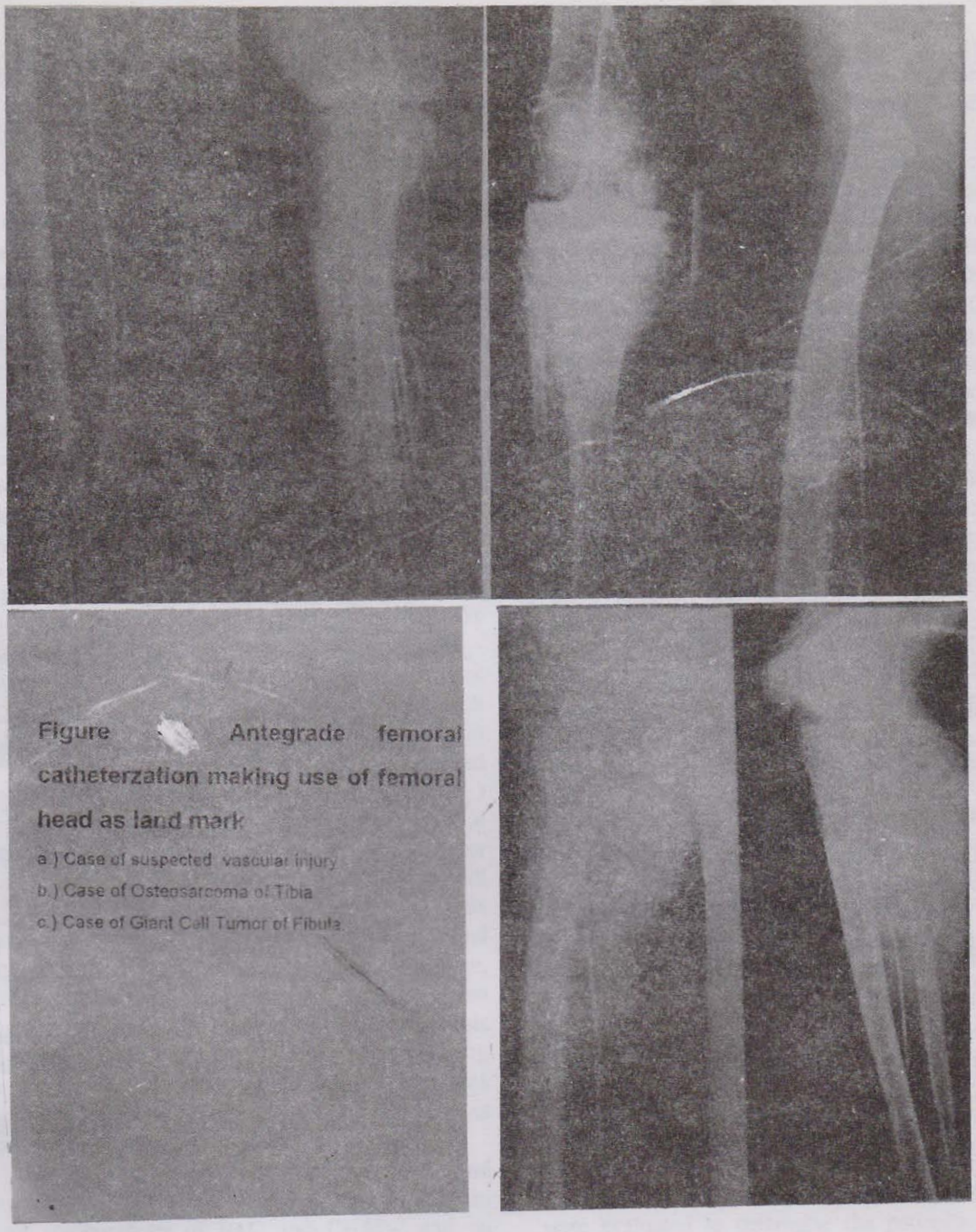


Fig. 9

superficial femoral artery can easily be catheterized without special effort. Entering the superficial femoral artery should generally be avoided because it precludes treatment of stenosis located in proximal end of SFA. Our results also suggest that a low approach at the inguinal skin crease is more likely to puncture the superficial femoral artery of profunda femoris artery. To over come the fore state hurdles it is desirable that femoral artery should be entered caudal to the inguinal ligament (as under normal condition abdominal cavity does not extend beyond the inguinal ligament into the femoral triagnle), at a site where the artery can easily be compressed against the osseous support such as femoral head, further at this site, presence of femoral sheet enclosing the common femoral artery will probably also prevent pseudoaneurysm formation.

In our study, relationship among the inguinal skin crease, the inguinal ligament, the common femoral artery, its bifurcation and the center of the femoral head, were evaluated. Our results has confirmed the finding of Lechner that the use of inguinal skin crease is a popular though unreliable guide, for the puncture of common

femoral artery because it bears no constant relationship with inguinal ligament, the common femoral artery or underlying bones [6]. Further a low puncture at inguinal skin crease is more likely to puncture the superficial femoral artery or profunda femoral artery. The use of mid inguinal point has been advocated as a precise guiding landmark for common femoral artery [7]. Certainly this is true in Cadavers and thin patients but in obese patients, because of thick subcutaneous fat, bony landmarks of anterior superior iliac spine and pubic tubercle, for mid inguinal point can not be palpated and as such sole reliance upon this method is not advisable. The use of maximum femoral pulse is even more constant guide to the level of common femoral artery [8] but the diffuseness of maximum femoral pulse over 6.5 cm (average length of CFA) reduces the accuracy of exact puncturing site. Our study has confirmed the finding of Grossman and Dottar [9] that the center of femoral head is always located caudal to the level of inguinal ligament and femoral head is consistent enough to be used as a landmark for entering the common femoral artery at safe level. The whole point of puncture should be overlying the femoral head to limit the possibility of pelvic or thigh haematoma and to improve the compression of artery against the femoral head, thereby ensuring a safe puncture. Femoral head localisation require fluoroscopic assistance. Added benefit of fluoroscopy prior to the puncture is the confirmation that the unit is functioning and to facilitate the identification of tubular or linear vessel wall calcification which can be useful in locating the vessel exactly and avoiding adjacent femoral vein puncture. With the "last image hold" facility available as in our department, the added radiation dose is insignificant.

By experience we have found that fluoroscopic correlation of the position of the femoral head with the site of maximum pulsation is the best method to identify an optimal common femoral artery puncture site. Following technique is suggested for the antegrade femoral artery puncture: With the leg in neutral position, the femoralartery is punctured from the ipsilateral side. The level of the centre of the femoral head is determined fluoroscopically. A skin incision , depending upon the amount of sub cutaneous fat, is made ,about 1 to 2 cm proximal to this level . The needle is held at 45 to 55 angle from the skin surface, with the tip pointing downwards. The needle is directed through an oblique downwards course, the common femoral artery is entered at the level of the femoral head

References

1. Seldinger,S.I Catheter placement of the needle in percutaneous arteriography. A new techniqueActa Radiologica, 39. 368 376, 1953.
2. Reuter, S.R. & Redman, H.C., In Gastro intestinal angiography, 2nd edn (W.B. Saunders a& Co., Philadelphia, U.S.A), P.8. 1977.
3. Altin R.S, Flikrs, Naidech H.J. Pseudo aneurysm and arteriovenous fistula after femoral artery catheterization. Association with low femoral puncture. AJR:152:629 63, 1989.
4. William PL. Warwick R., eds, Gray's anatomy, 36th ed. Edinburg, Chirchill Living Stone: 725 727, 1980.
5. Chiverton, S.G. and Murie, J.A. incidence and managment of arterial injuries from left heart catheterization. Journal of Royal College of Physicians of London, 20, 126-128, 1986.
6. Lechner G, Jantsch H, Waneck R, Kretschmer G. The relationship between the common femoral artery, the inguinal crease and inguinal ligament: a guide to accurate angiographic puncture. Cardiovasc interven Radio; 11:165 169, 1988.
7. Mc Millan, I. & Murie, J.A. Vascular unjury following cardiac catheterization, British Journal of Surgery, 71, 832, 835, 1984.
8. Grier, D. & Hartnell G., Percutaneous femoral artery puncture: practice and anatomy. British Journal of
9. Wilson NV et al. A critical appraisal of coagulation studies prior to trans femoral angiography. BJR, 63, 147 148, 1990. Radiology. 63, 602 604, 1990.
10. Grossman, M. How to miss profunda femoris. Radiology, 111:482, 1974.