

POST CATHETER DIAGNOSTIC CORONARY ANGIOGRAPHY THROMBOTIC COMPLICATIONS AT FEMORAL VASCULAR ACCESS SITE- AN ULTRASOUND BASED STUDY

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ABSTRACT

Objective:

- To determine the frequency of atherosclerotic plaques in common femoral artery in patients undergoing coronary angiography.
- Identify any significant post procedure change in plaque morphology.
- Determine the number of patients who develop thrombosis at the access site.

Study Design: Descriptive study

Place and Duration of Study: The study was carried out in Radiology Department, Military Hospital, Rawalpindi from 10 Aug 2005 - 09 Feb 2006.

Patients and Method: The patients undergoing coronary angiography were included in the study. Doppler ultrasound of the right common femoral artery (vascular access site) was done prior to and following coronary angiography. The ultrasound examinations were performed on ALOKA Prosound SSD 5500 using 7.5 MHz linear array probe.

Results: Out of the 100 patients included in the study, atherosclerotic plaque was detected in 10 patients at the femoral access site. Out of these 10 patients, having a plaque at access site 01 patient developed a thrombus at the access site. The post procedure diameter of the femoral artery was significantly reduced.

Conclusion: Despite the advancements in technique and equipment a thrombus can form at the vascular access site. Doppler ultrasonography proves an ideal diagnostic tool in evaluation of cases with suspected access site complications.

Keywords: femoral artery, thrombosis, angiography complications, peripheral vascular disease.

INTRODUCTION

In recent years there have been rapid advancements in least-invasive imaging of coronary arteries (Computerized tomographic angiography, Magnetic resonance angiography). However catheter coronary angiography still remains the gold standard of diagnosis in coronary heart disease¹⁻⁴. Cardiac catheterization is the prerequisite for this procedure. It is done by percutaneous puncture of femoral, radial and brachial arteries or under direct vision by brachial cut down approach^{1,2}. The choice of approach depends on preference of the operator, anatomic and pathophysiologic abnormalities of the patient. Considerable intimal damage at access site occurs due to introduction of the cannula, guide wire and coronary catheters. Formation of clot at the end

of a catheter is a well documented mechanism². This is stripped off as the catheter is withdrawn through the puncture hole. Hence a focus for thrombosis and embolism is formed.

Predisposing factors for arterial thrombosis include small vessel lumen, peripheral vascular disease, diabetes mellitus, and female sex. The list of vascular access site complications also includes bleeding, infection, arteriovenous fistula, pseudo-aneurysms, arterial dissection, perivascular or subintimal contrast injection and damage to femoral nerve^{1,2,5,6}. Bleeding attributable to the vascular site could be retroperitoneal (retroperitoneal bleeding), a local haematoma (haematoma bleeding), or external (entry site bleeding). International studies state vascular access site complications as the commonest major complications of coronary angiography¹.

Acute thrombosis in common femoral artery results in lower limb ischemia. If it is not

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diagnosed timely the patient presents with various signs and symptoms; claudication, dependent rubor and elevation pallor, ischaemic rest pain, paresthesias, coldness of the limb and gangrene⁷. The patient who is being investigated for ischemic heart disease may end up crippled for the rest of his life.

The choices available for closure of percutaneous approach are manual compression and arteriotomy closure devices⁸⁻¹².

An atheroma is an abnormal fatty deposit which develops within the walls of arteries over time¹³. Veins do not develop atheromata, unless surgically moved to function as an artery, as in bypass surgery. The process of atheroma development within an individual is called "atherogenesis" and the overall result of the disease process is termed "atherosclerosis"¹³.

In the context of arteries, atheroma is commonly referred to as "plaque".

Atherosclerotic plaque morphology on ultrasonography^{2,9} is as follows:

Type 1: Predominantly anechoic with a thin rim over the surface

Type 2: <25% echogenic components

Type 3: < 25% hypoechoic components

Type 4: Predominantly echogenic

If a plaque has a thin cover separating it from the blood stream, it becomes vulnerable to rupture (tearing of surface). Such plaques render a patient more prone to sudden major problems, such as heart attack, stroke and limb ischaemia. Atherosclerosis is the commonest cause of arterial occlusive diseases^{13,14}. According to a local study there is significant prevalence of peripheral vascular disease in patients with coronary artery disease¹⁵.

The percutaneous transfemoral approach is the most preferred one. This approach is rendered difficult in presence of extensive peripheral vascular disease, marked obesity, bleeding diathesis and severe systemic arterial hypertension¹.

Access is gained by insertion of a sheath using Selding - Sutton technique for advancements of cardiac catheters^{1,2}. Managing the arterial puncture site after femoral sheath

removal is an important aspect of cardiac nursing practice in patients undergoing coronary angiography. Haemostasis is achieved by applying manual pressure about 1cm cephalad to the skin incision for 10 to 15 minutes. Personnel change during compression is associated with increased risk of groin haematoma^{16,17}.

Arterial plaques lead to flow disturbances is shown beautifully by colour Doppler technique⁵. Our study highlights the need of pre angiography ultrasonography of the vascular access site. A radiologist must remember mimics of groin injury while evaluating such cases. These include inguinal lymphadenopathy, varicosities, true aneurysms and atypical but normal branch vessels^{18,19}. The referring cardiologist may choose to alter the approach if local atheroma is diagnosed pre-procedure.

Objectives: The objectives of this study were to:

Determine the frequency of atherosclerotic plaques in common femoral artery in patients undergoing coronary angiography whether symptomatic or not.

Identify any significant post procedure change in atherosclerotic plaque morphology (in patients in whom these are detected before procedure).

Determine the number of patients who develop thrombosis at the puncture site.

PATIENTS AND METHODS

Study Design: Descriptive study

Setting: Radiology department, Military Hospital, Rawalpindi.

Duration of Study: 06 months (from 10 Aug 2005 to 09 Feb 2006)

Sample Size: 100 patients, of either gender.

Sampling Technique: Non-probability purposive sampling

Sample Selection:

Inclusion criteria: Patients of all ages undergoing coronary angiography.

Patients who had a successful cannulation in the first attempt.

Exclusion criteria: Patients on anticoagulants.

Patients in whom an upper limb artery was chosen as access site.

Data Collection Procedure:

Identification of the study variables:

Categorical (Qualitative) data:

- Nominal data : Presence of thrombus and atheromatous plaque
- Ordinal data : Types of plaque

Numerical (Quantitative) data:

- Luminal diameter of vascular access (before and after procedure)

Methods for collection of the data:

1. 100 patients who underwent coronary angiography at the Armed Forces Institute of Cardiology /National Institute of Heart Diseases were included in the study. It is a center of excellence for management of cardiac diseases and is located adjacent to the Military Hospital Rawalpindi. On a routine working day the average work load is about 40 coronary angiograms.
2. In this setup common femoral artery is the preferred vascular access site.
3. Coronary angiographies of patients included in the study were performed by consultant cardiologists.
4. The access site was evaluated by B-mode, pulse Doppler and colour Doppler ultrasonography prior to coronary angiography (to establish base line values of all variables).
5. The vascular site was accessed by single wall puncture method.
6. Access site cannula and sheath (Abocath 5F), Judkins catheters (for right and left coronary arteries). The sheath was flushed with heparin in all cases.
7. The sheath was removed upon conclusion of the procedure. Manual compression was then applied to access site for 10- 15 minutes.
8. The vascular access site must not be manipulated for 16-20 hours after removal of the pressure dressing. Hence the repeat

ultrasonography was carried out between the first and third post procedure day.

Data Collection Tools:

1. USG Machine: ALOKA, Prosound SSD 5500
2. Probe: Linear, 7.5 MHz

Data Analysis Procedure:

Data had been analyzed using SPSS version 10. Descriptive statistics were use to describe the data.

RESULTS

Thrombotic vascular access site complications following diagnostic cardiac catheterization were studied prospectively in 100 patients, 74 were men and 26 were women. The mean age of patients in the study was 53.4 years (SD=8.40), minimum age was 33 years while maximum was 72 years.

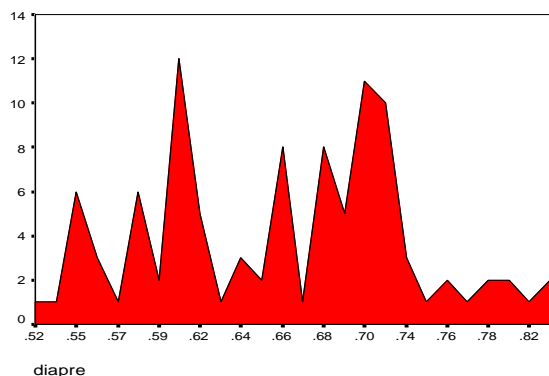
The post procedure mean luminal diameter of common femoral artery (access site) was reduced as compared to pre-procedure mean value; graphically represented in figure.

Out of the 100 patients included in the study, atherosclerotic plaque was detected in 10 (10%) patients at the femoral access site. Two (20%) of these patients were aged 50 years and below while 08 (80%) patients were above 50 years of age.

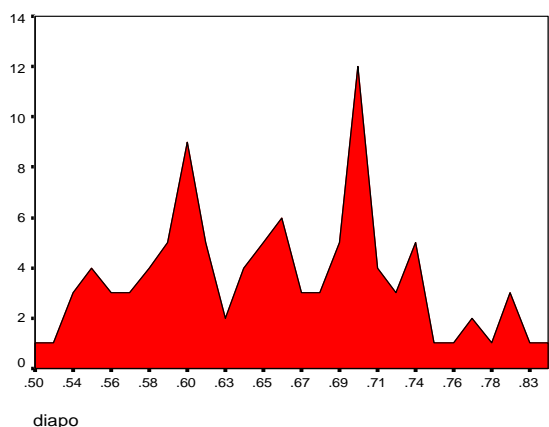
The types of plaques noted were: type I in 1(10%) patients, typeII in 5(50%) patients, type III in 3(30%) patients and type IV in 1(10%) patients

Out of these 10 patients, having a plaque at access site, one (1%) patient developed a thrombus at the access site on the second post intervention day. The patient was a 60 years old male. In the pre-procedure ultrasonography a type II atherosclerotic plaque was noted at the femoral access site. On post-procedure ultrasonography of the access site the lumen of the artery was occupied by a hypoechoic lesion (thrombus) and the plaque was not separately visualized. Hence the plaque had ruptured and caused this thrombotic complication. None of the 90 patients with no local plaque developed thrombosis at access site.

Access site haematoma was not a variable of this study. A groin haematoma (measuring approximately 8.0 cm x 6.0 cm x 6.0 cm) was noted incidentally in the patient who developed thrombus at the access site.



A. Pre-procedure Diameter



B. Post-procedure Diameter

Figure: Simple area charts showing comparison of pre-procedure (A) and post-procedure (B) diameters of the access site (n=100).

DISCUSSION

Vascular access is gained by insertion of a sheath using Selding-Sutton technique for advancements of cardiac catheters^{1, 2}. Managing the arterial puncture site after femoral sheath removal is an important aspect of cardiac nursing practice in patients undergoing coronary angiography^{8,17}. Haemostasis is achieved by applying manual pressure about 1 cm cephalad to the skin incision for 10 to 15 minutes. Personnel change during compression is associated with increased risk of groin haematoma¹⁸. Acute thrombosis in common femoral artery results in lower limb ischemia. If

it is not diagnosed timely the patient presents with various signs and symptoms; claudication, dependent rubor and elevation pallor, ischaemic rest pain, paresthesias, coldness of the limb and gangrene¹⁹. The patient who is being investigated for ischemic heart disease may end up crippled for the rest of his life.

A radiologist can assess the presence and type of plaque at the site chosen to serve as the vascular access. Atherosclerotic plaque morphology on ultrasonography^{2,8} can be divided into 4 types;

Type 1: Predominantly anechoic with a thin rim over the surface.

Type 2: <25% echogenic components.

Type 3: < 25% hypoechoic components.

Type 4: Predominantly echogenic

Mimics of groin injury must be kept in mind while evaluating access site of post angiography patients. These include inguinal lymphadenopathy, varicosities, true aneurysms and atypical but normal branch vessels^{15,16}.

To compare and contrast the results of our study an extensive review of literature was done. There is no published study to quantify the risk of percutaneous transfemoral access site complications, in cardiac catheterization laboratories in Pakistan.

Among approximately 23,000 patients (72 percent males) at Emory University Hospital¹ had percutaneous coronary artery angiography. 14 patients (12 females and 02 males) required femoral artery thrombectomy. The smaller femoral artery in the female was considered more prone to thrombotic occlusion than is that of the male.

In another study by Bach et al access site complications were twice more common in women than men²⁰. In this study the only patient who developed a thrombus was a male. The limitation of our study is a relatively smaller study sample. If such a study is performed on a larger scale, the results can be even more informative.

Arteriotomy closure devices are not used at AFIC/ NIHD. These devices are virtually unavailable in the country due to tremendous

cost. Most local cardiologists prefer the manual compression method. Studies suggest that a second attempt at vascular access is more difficult if these devices are used, due to excessive local fibrosis. A study by Dangas shows that the initial time to haemostasis that is gained with the use of such devices is counterbalanced with the slightly increased incidence of access site complications¹².

In a study by Skillman et al.⁶ 1% of patients underwent operative repairs of access site complications. The results of this study are comparable with the present study.

Transfemoral approach is favoured in AFIC/ NIHD. A local study performed at National Institute of Cardiovascular Diseases, Karachi analyzed transradial approach in 167 cases (of both diagnostic coronary angiography and percutaneous cardiac interventions). There were no major complications like major bleed, limb ischemia etc²¹.

Kiemeneij²² concluded that access failure is more common following transradial approach.

In a study about percutaneous coronary interventions, by Nasser et al.²³ access site complications occurred in 1. 5-9% cases. In comparison, lesser complications occurred in the present study which encompassed only diagnostic coronary angiography. This shows that more damage to access site occurs during coronary angioplasty.

Peripheral vascular disease was a variable predicting the likelihood of access site complications ($p = 0.03$) in a study carried out by Muller et al²⁴. In the present study the patient who developed thrombus at the access site had a local atherosclerotic plaque. This had been detected before the procedure. If an atherosclerotic plaque is noted at pre-procedure ultrasound examination, the clinician may choose an alternate access site.

The fact that only one patient developed an access site complication reflects upon the excellent technique of percutaneous puncture as well as diligent manual compression for closure of access.

CONCLUSION

Colour Doppler ultrasonography is a noninvasive, readily available, inexpensive

diagnostic modality. Peripheral vascular disease is a known risk factor for increased access site complications. If preoperative diagnosis of severe atherosclerosis at prospective vascular access site is made by ultrasonography, the choice of access site may be changed. This will reduce the risk of complications. Early recognition of post procedure access site complications results in prompt management.

In light of this pertinent information provided by the radiologist, the necessity and urgency of surgical intervention can then be decided by the clinician.

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