Options of common femoral artery access for chronic lower limb ischemia endovascular treatment: Comparison between ultrasound versus anatomical guidance

Original Article

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ABSTRACT

Background: One of the most frequent causes of illness and mortality is chronic lower limb ischemia. Most patients often report rest discomfort or intermittent claudication. In most cases, peripheral arterial disease (PAD) involves endovascular therapy along with adjunctive stenting, which is a well-acknowledged and utilized method for treating lower limb arterial endovascular disease. To achieve common femoral access, the traditional access process combines fluoroscopic guidance, anatomic landmarks, and palpation. To treat chronic lower limb ischemia using an endovascular approach, this study compares the use of ultrasound (US) against anatomical guides in common femoral artery access. According to the study's findings, US guidance reduces access times, puncture tries, the incidence of venipunctures, the incidence of retroperitoneal hematomas, and local bruising during puncture to the femoral artery in the treatment of chronic lower limb ischemia by angioplasty.

Patients and Methods: The 400 patients in this retrospective study had persistent lower limb ischemia. The research is carried out at Beni-Suef University Hospital's Vascular Surgery unit from January 7, 2023, until January 9, 2023. For the last two years, from January 7, 2021, to January 7, 2023, statistics were gathered via patient registration data.

Results: Compared with patients who underwent access to the femoral artery anatomically, the intraprocedure time required for femoral artery access was significantly shorter in those patients who underwent access to femoral artery access guided by US, also less morbidity like bruises, hematoma, and pseudoaneurysm was recorded in US-guided group.

Conclusion: Routine US-guided femoral artery access was superior to anatomical-guided femoral access and improved CFA cannulation.

Key Words: Anatomical guidance, common femoral artery access, endovascular treatment, ultrasound.

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INTRODUCTION

One of most frequent causes of illness and mortality is chronic lower limb ischemia. Most patients generally appear with claudication's, which is presented with discomfort in the muscles of the legs during movement or pain at rest that affects the foot and eventually results in tissue loss and ulceration. Actually, as the proportion of the population that is elderly rises, so too will the prevalence of chronic lower limb ischemia. In affluent nations, the prevalence of peripheral arterial disease ranges from 14 to 20% in adults; the ratio of symptomatic to asymptomatic individuals is typically 1 : 3–1 : 4[1]. The first choice of treatment for peripheral artery disease in the lower limb is often endovascular therapy combined with adjunctive stenting, which is a well approved and utilized technique for lower limb arterial endovascular therapy[2]. To achieve common femoral access, the traditional access process combines fluoroscopic guidance, anatomic landmarks, and palpation[3]. When people undergo endovascular interventions (PVI), access complications like hematoma, arteriovenous fistula, pseudoaneurysm, and venipuncture are the reasons for postprocedural morbidity and mortality. These complications also result in longer hospital stays, higher costs, higher 1-month and 1-year mortality rates[4]. For central venous access, ultrasound (US) guidelines have been utilized recently. It has been demonstrated in many randomized studies that US guidance reduces central venous cannulation-related problems, trial counts, and access times[5]. Although randomized trials have not found that using fluoroscopic guidance is preferable to anatomical guiding when it comes to reducing access site problems, it appears to be a promising approach[3]. Conversely, using ultrasonic guidance (UG) instead of the routine method of palpation of the femoral pulse has been shown to increase success rates and decrease access issues following CFA access[6].

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PATIENTS AND METHODS:

The 400 patients in this retrospective study had persistent lower limb ischemia. The research is carried out at Beni-Suef University Hospital's Vascular Surgery unit from January 7, 2023 to January 9, 2023. For the last two years, from January 7, 2021 to January 7, 2023, statistics were gathered via patient registration data.

Ethical approval was obtained from Research Ethical Committee, faculty of medicine. Beni-Suef University, approval NO: FMBSUREC/09072023/Muhammad.

Percutaneous transluminal angioplasty was performed on patients using a common femoral artery approach. Two groups were formed out of the patients:

200 patients in group (A) had access to the femoral artery by palpating pulse anatomically.

200 patients in group (B) had femoral artery access under US guidelines.

Data were collected retrospectively from patient registry data at the vascular surgery unit in Beni-Suef University Hospital.

Inclusion criteria

(a) Individuals being evaluated for interventional angioplasty and diagnosed with chronic lower limb artery disease.

(b) Men and women alike.

Exclusion criteria

(a) Individuals whose femoral pulses are not felt.

(b) Individuals who have a recent myocardial infarction with ST elevation.

(c) Expectant women.

(d) Individuals with renal functions.

All patients were subjected to:

Pre-procedural preparation

History taking, clinical examination, duplex scanning, and computed tomography Angiography.

Steps of the procedure

Group A: following drapery, all patients were manually palpated for pubic symphysis, anterior superior iliac spine and femoral pulse, among other anatomic landmarks. A 0.035 guide wire and a 6-fr sheath were passed through the puncture created above the femoral pulse and against the femoral head using fluoroscopy until a jet of arterial blood was observed. An angiography was then performed to validate the placement of the sheath and guide wire.

Group B's US machine was assembled, covered, and transmission gel was used. The axial plane was used for the US imaging. It was intended to apply the modified seldinger approach in every situation.

Postinterventional surveillance

Patient follow-up within thirty days following the surgery to assess any problems in the femoral artery access site either immediate, early, or late.

•Primary endpoint: the CFA cannulation went well.

•Secondary endpoint: the total time required to set up suitable access, the success rate for artery access, number of punctures required for artery access, inadvertent femoral vein puncture rate, and accidental PFA access rate. Issues at the puncture site following the procedure, such as retroperitoneal bleeding, local hematomas, bruising, or pseudoaneurysms.

Statistical methodology

To ensure appropriate CFA implantation, femoral angiograms were examined. The inferior epigastric artery's sheath, CFA bifurcation, origin, and most inferior reflection about the femoral head were all examined in angiograms. Intention-to-treat analysis was used to examine the collected data. For continuous variables, the unpaired Student's t test or the Wilcoxon rank sum test was employed, and for proportions, the χ^2 test. For the clinical results, Fisher's exact test was employed. For significance, a two-tailed *P value* of 0.05 was employed.

RESULTS:

Utilizing the χ^2 test, the collected data were statistically examined to compare the distribution of a categorical variable in one sample to that of the same variable in another sampling. The T-test is used to calculate the standard error of the difference between two means and to evaluate the degree of probability by calculating the magnitude of the difference by this standard error. χ^2 is a tool used to compare a categorical variable's distribution and to determine the degree of probability using a standardized table.

This is a retrospective study addressing individuals with chronic limb ischemia. 400 patients who were being evaluated for interventional angioplasty and had been diagnosed with chronic occlusive or stenotic lower limb artery disorders participated in the research.

Based on the technique of common femoral artery access for angioplasty for chronic lower limb ischemia treatment, the patients under study were divided into two groups:

200 patients in group (A) had femoral artery access with the use of anatomical guidance. Group (B): 200 patients who had femoral artery access under the supervision of ultrasonography. The age range of the patients was 48–70 years old, with an age average of 59.35±5.7 years (Tables 1 and 2).

Table 1: Lesion site among studied population

	Patients according to access method		TOTAL	*P* value
	Anatomical guidance *N*=200	US guidance *N*=200		
Rt. SFA	40 (20)	80 (40)	120 (30)	0.721
Lt. SFA	80 (40)	40 (20)	120 (30)	
Infrapopliteal Rt	40 (20)	40 (20)	80 (20)	
Infrapopliteal Lt	40 (20)	40 (20)	80 (20)	

**P value* less than or equal to 0.05 is considered significant by χ^2 Test; Rt, right; Lt, left.

Table 2: Intraprocedure access method to the femoral artery

	Patients according to access method		Total	*P* value
	Anatomical guidance *N*=200	US guidance *N*=200		
Antegrade ipsilateral	120 (60)	180 (90)	300 (75)	**0.152**
Contralateral retrograde	80 (40)	20 (10)	100 (25)	

Compared with patients who underwent access to the femoral artery anatomically, the intraprocedure time required for femoral artery access was significantly shorter in those patients who underwent access to femoral artery access guided by US; the time average by minutes was 2.19 versus 4.22 in both cases, with a *P value* of 0.007 for both types of guidance (Table 3).

Table 3: Comparison of time average by minutes for the femoral artery access

	According to the access method of guidance		Total	*P* value
	Anatomically guided N=200	US guided N=200		
Mean±SD	4.22±1.7	2.19±1.1	59.35±5.7	0.007*
Minimum	1.08	0.83	49	
Maximum	7.67	4.50	65	

**P value* less than or equal to 0.05 is considered significant by Independent Samples Mann–Whitney U Test.

When comparing patients who underwent femoral artery access through US guidance versus those who underwent anatomical guidance, a number of needed attempts to femoral artery access was significantly lower; the average number of attempts for US guidance and anatomical guidance, respectively, was 1.60 versus 2.80; *P value=0.011*.

There were no unintentional venipunctures among all the patients in the study who received femoral artery access under US guidance, which differed statistically significantly from anatomical guidance (*P value=0.013*) (Table 4) (Fig. 1).

Table 4: Comparison of rate of accidental venipunctures among the studied patients

	Patients according to access method		Total	*P* value
	Anatomical guidance *N*=200	US guidance *N*=200		
No accidental vein-punctures	60 (30)	200 (100)	260 (65)	0.013*
1 time	80 (40)	0	80 (20)	
2 times	40 (20)	0	40 (10)	
3 times	20 (10)	0	20 (5)	

**P value* less than or equal to 0.05 is considered significant by χ^2, Chi-Square Test.

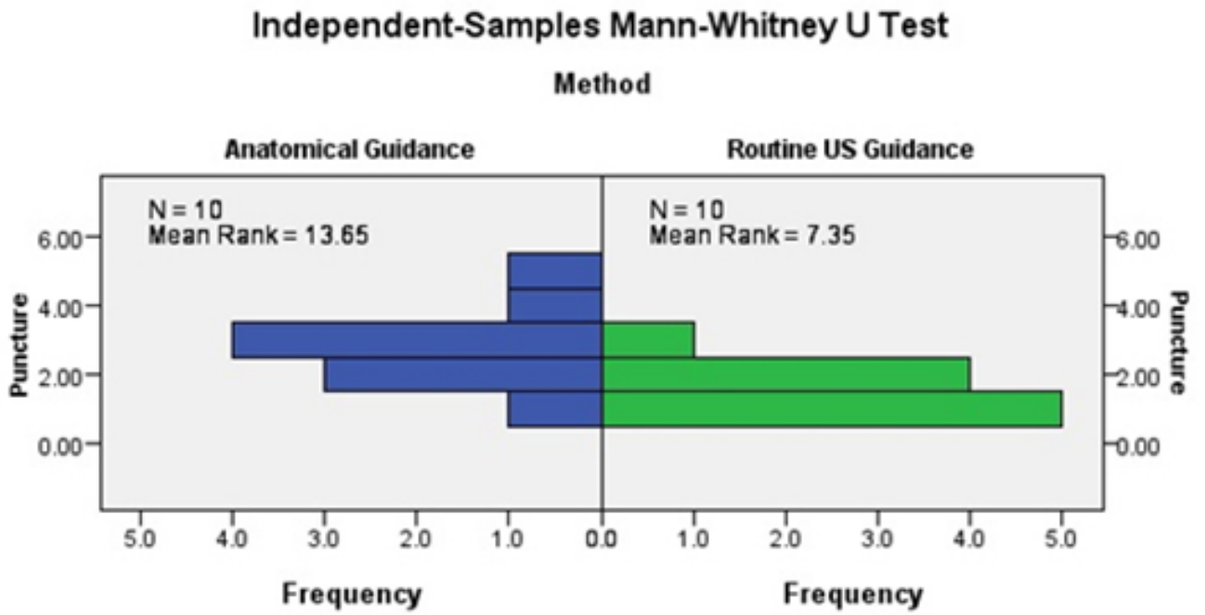

Fig. 1: The number of required attempts needed for femoral artery access was significantly lower among patients who have undergone femoral artery access guided by ultrasound as compared with patients who have undergone access to femoral artery guided by anatomical method; the average number of attempts was (1.60 vs. 2.80) in ultrasound guidance and anatomical guidance respectively; (*P value=0.011*).

Conversely, among patients who had femoral artery access via anatomical guidance, there were only 60 (30%) cases in which there were no unintentional venipunctures, 80 (40%) cases experienced one unintentional venipuncture, 40 (20%) cases experienced two unintentional venipunctures, and 20 cases experienced three unintentional venipunctures (Table 5).

Table 5: PFA puncture among studied cases

	Patients according to access method		Total	*P* value
	Anatomical guidance *N*=200	US guidance *N*=200		
No	140 (70)	200 (100)	340 (80)	0.105
Yes	60 (30)	20 (10)	80 (20)	

After surgery, there was a greater incidence of bruising, hematomas, and pseudoeurysms in the anatomical guided access group than in the US guidance group (*P value*= 0.291). Compared with 20 (10%) instances (10%) using the US-guided access approach, 60 (30%) patients using the anatomical method experienced post-operative bruising. Duplex guided compression was used to treat the pseudoaneurysm development in just two cases using the anatomical guiding access approach (Table 6).

Table 6: Postoperative bruises and hematoma or pseudoaneurysm among studied cases

	Patients according to access method		Total	*P* value
	Anatomical guidance *N*=100	US guidance *N*=100		
No	140 (70)	180 (90)	340 (80)	0.291
Yes	60 (30)	20 (10)	80 (20)	

DISCUSSION

One of the most common causes of morbidity and death in lower limb ischemia is chronic lower limb ischemia. The most common procedure used for infrainguinal endovascular treatment is percutaneous transluminal angioplasty (PTA) with or without stenting, which is a widely accepted and commonly used procedure[2]. When patients undergo peripheral vascular intervention (PVI), access site complications such as hematoma, pseudoaneurysm, incorrect venipuncture, and AV fistula are thought to be a major cause of postprocedure morbidity and death[4]. In this study, to successfully cannulate CFA, which is defined as the midpoint between the origin of inferior epigastric vessels and bifurcation into superficial femoral artery (SFA) and profunda femoris artery (PFA), we compared the anatomical guidance with the US guidance for femoral artery access. We also compared the number of trials required overall, the time required for the access, the number of venipunctures, the number of PFA punctures, and the rate of bruises and hematoma formation in 400 patients divided into two groups. Previous randomized multicenter trials have found that routine US guidance of femoral arterial access does not improve the rate of common femoral artery (CFA) successful cannulation, with the exception of patients with high CFA bifurcations; in other cases, it is a time-wasting procedure without statistically significant benefit, and it also requires specific training and the availability of US devices in each center.

The results of our study showed that US guidance reduced the time needed for access and showed an increased CFA successful cannulation rate in patients whose CFA bifurcation occurred higher than the inferior border of the femoral head. It also improved the first pass success rate and nearly eliminated the risk of complications related to vascular access. In most cases, this patient subgroup cannot be identified prior to catheterization in the absence of prior angiography data.

When comparing studied patients who underwent femoral artery access through US guidance versus studied patients who underwent femoral artery access through anatomical guidance, the intraoperative time needed for femoral artery access was significantly shorter, the average time in minutes was (2.19 vs. 4.22) for US guidance, and anatomical guidance, respectively (*P value=0.007*). According to Arnold Seto *et al*. (2016)[7], the US direction improves the first-pass success rate (83% vs. 46%, *P<0.0001*). US guidance reduced the number of trials needed to successfully cannulate CFA (1.3 vs. 3.0, *P<0.0001*), according to research done in 2009 by Abu Fadel *et al*.[8]. In our study, patients who underwent femoral artery access through US guidance required a significantly lower total number of attempts to access the femoral artery than patients who underwent femoral artery access through anatomical guidance; the average number of attempts was 1.60 vs. 2.80 in US guidance and anatomical guidance, respectively, *P value=0.011*. When UG was used instead of typical palpation techniques, there was a 42% increase in the chance of first-attempt success and a 49% decrease in overall access site problems, according to a systematic evaluation of four studies including 1422 patients who had femoral artery catheterization.

There were no unintentional venipunctures among all the patients in the study who received femoral artery access utilizing US guidance, which differed statistically significantly from anatomical guidance (*P value=0.013*). Conversely, among patients who had femoral artery access via anatomical guidance, there were only 60 (30%) cases in which there were no unintentional venipunctures, 80 (40%) cases experienced one unintentional venipuncture, 40 (20%) cases experienced two unintentional venipunctures, and only 20 cases experienced three unintentional venipunctures.

Compared with the US guidance group, the anatomical guided access group experienced a greater incidence of postoperative bruising (*P value=0.291*). Compared with 10 (10%) patients using the US guided access approach, 30 (30%) cases using the anatomical method experienced post-operative bruising. In a 2018 research that was published in the Annals of Vascular Surgery, Inagaki *et al*.[9] found that US guidelines provided protection against hematoma development and bruising among high-volume surgeries. *P* is equal to 0.030.

The reduction in tissue and artery stress from repeated venipunctures and attempts is most likely the mechanism via which the therapeutic advantage of US guidance is conveyed. Additionally, using US guidance increases the likelihood of achieving a genuine anterior wall puncture, which might lead to improved artery wall apposition and more suitable initial sheath seating. The diameter of a femoral artery access may be reduced by anatomical guidance, increasing the possibility of a posterior or double wall puncture. A posterior wall puncture may be prevented by using US guidance, which minimizes and makes obvious any compression of the artery throughout the surgery.

CONCLUSION & RECOMMENDATIONS

By reducing the number of trials, time to access, risk of venipunctures, PFA punctures, and local vascular

complications like bruises and hematoma formation in femoral arterial access in endovascular treatment of chronic lower limb ischemia, routine US guided femoral artery access was found to be superior to anatomical guided femoral access and improved CFA cannulation.

CONFLICT OF INTEREST

There are no conflicts of interest.

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