ORIGINAL ARTICLE

DOUBLE STAB EXCISION ARTERIOTOMY–A NOVEL TECHNIQUE FOR A BETTER OUTCOME

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Background: This study was carried out to introduce a new technique of excision arteriotomy and to compare it with standard excision arteriotomy in terms of achieving desired size, shape and margins with minimal technical problems. **Methods:** This was a comparative study carried out at the Vascular Surgery Unit of Combined Military Hospital Peshawar between January and September 2022. A total of 150 patients of chronic renal failure undergoing Arteriovenous access fulfilling the inclusion criteria were enrolled in our study. The patients were randomized into two groups, 75 in each group: Group A consisted of patients who underwent Conventional excision arteriotomy and Group B underwent Double Stab excision Arteriotomy. The endpoint of the study was to achieve an appropriate arteriotomy of the desired size and shape by having regular margins without intimal dissection during its formation or otherwise inappropriate arteriotomy if any of the criteria is not met. **Results:** Among the total 150 patients included in our study, Ages ranged between 30–60 years and a mean age of 52.5 years. There were 82 (54.66%) males and 68 (45.33%) females with a male-to-female ratio of 1.2:1. In group A (Conventional Excision arteriotomy) there were 30 (40%) inappropriate arteriotomies and 45 (60%) appropriate arteriotomies. Among the total 30(40%) inappropriate arteriotomies in group A, larger than desired size arteriotomies were 10 cases (33.33%) followed by smaller than desired size arteriotomies; 6 (20%), irregular margins 9 (30%), intimal dissection 3(10%) & lateral tear 2 (6.66%) respectively. In group B of double stab excision arteriotomies, appropriate arteriotomies were achieved in 69 (92%) while the rest had inappropriate arteriotomies in 6 (8%). Among the total 6 (8%) inappropriate arteriotomies in group B, larger than desired size arteriotomies were 2 (33.33%), smaller than desired size arteriotomy; 1 (16.66%), irregular margins 1 (16.66%), intimal dissection; 2 (33.33%) & no lateral tear respectively. **Conclusion:** This study concluded that the Double stab excision arteriotomy technique is superior to the conventional excision arteriotomy technique. The advantages of our technique are; its reliability with a short learning curve and can be performed precisely and safely.

Keywords: Chronic kidney disease; Arteriotomy; Arterio-Venous fistula; Intimal dissection

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INTRODUCTION

Vascular bypass is the main operative procedure performed for various pathologies. Arteriovenous fistula (AVF) is a trusted and effective means of arteriovenous access (AVA). Both of these operations require end-to-side (ETS) anastomosis. For an ETS anastomosis, an appropriate arteriotomy is a key operative step.[1,2] In 1979 Godina was the first one to explain ETS microvascular anastomosis in free tissue transfer, particularly in the lower extremities.[3,4]

Arteriotomy technique and anastomosis angle are two important points of concern in performing successful ETS vascular anastomosis.[3] Due to the concentric nature of the vessel wall and the risk of dissection, performing a uniform arteriotomy of desired size and angle is a difficult job, especially in diseased vessels.[5,6]

A perfect excision arteriotomy should be preferably obtained in the first attempt leading to the arterial opening having smooth and even edges with the desired size and axis. The wrong arteriotomy technique is likely to compromise the patency of the vascular anastomosis. Several arteriotomy techniques have been described and practiced to achieve an ideal arterial opening.[5] Common technique of performing arteriotomy is to give an initial stab incision with a pointed blade, which can then be enlarged.[7]

There are 3 main types of arteriotomy techniques:

1. Slit arteriotomy: Creating a longitudinal or transverse cut in the vessel wall with a stab knife and scissors. The disadvantage of slit arteriotomy is that blood flow across the anastomosis may be restricted and the posterior wall is difficult to visualize during anastomosis.[8,9]

2. "Inside-out" arteriotomy: It is performed with a "micropunch" to create a simple, effective, quick and clean elliptical arteriotomy. However, the disadvantage of this method is the risk of intimal injury to the opposing vessel wall. It also requires a punch of different sizes which is not cost effective.[10,11]
3. Excision arteriotomy: This involves excising from "outside-in" for which several approaches have been described.[4,9] For example In Godina's technique two cuts are made in the vessel using straight micro scissors at a 30° angle to the vascular wall. In Acland technique vessel wall is grasped with a microsuture, and then it is cut in an elliptical manner with a curved microscissor.[12] Conventional Excision Arteriotomy technique consists of the following steps: adventitia is removed, traction suture is applied to the center of the arteriotomy, traction suture is pulled up, the first cut is made at 30 degrees from the perpendicular plane while the second identical cut is made in the other side of the vessel.[5] Improperly performed excision arteriotomy is likely to result in compromised vascular anastomosis.[6] All these techniques are difficult to perform in a diseased vessel.[12]

Godina's technique leads to a diamond-shaped arteriotomy rather than a proper elliptical one. In Acland technique has the chance of inappropriate size and shape of the resulting arteriotomy. In all these excision arteriotomy techniques there are chances of intimal dissection, especially in atherosclerotic arteries. As all previously described excision arteriotomy techniques have some disadvantages. We have described and practiced new double stab excision arteriotomy techniques in which these issues are addressed. We have also compared this technique with conventional excision arteriotomy. Double stab excision arteriotomy results in the formation of, arteriotomy of desired size and shape having smooth margins with very less chances of intimal dissection. The aim of our study was to evaluate whether a double stab excision arteriotomy technique would result in appropriate size arteriotomy with minimum technical problems faced during its creation.

MATERIAL AND METHODS

This was comparative research carried out at the Vascular Surgery Unit of Combined Military Hospital Peshawar between January and September 2022, after approval from the Ethical Committee for Academic Research and Projects.

Patients with chronic kidney disease with an age limit of 18–60 years who were referred to the Vascular Unit CMH Peshawar for AVF formation were included in the study. Both radio cephalic and brachio cephalic end-to-side AVF were considered for recruitment.

Patients with a history of peripheral vascular disease and an arterial or venous diameter smaller than 2 millimetres were excluded from the study.

The first advential layer is stripped off the arterial wall with microsurgical scissors, which leads to the formation of a smooth surface for perfect arteriotomy. A stab is made in an artery with the help of a knife and extended a little with micro scissors. Another stab is created parallel to the first stab at a desired distance (width of the future ellipse). This second stab is extended in a curved manner proximally and distally with micro scissors to form one curve of an ellipse. The first stab is also extended in a similar fashion to form another curve of the ellipse. The two curves meet at both ends, thus resulting in an arteriotomy of the desired size and shape with regular margins at the appropriate place in the artery.

A total of 150 patients having chronic renal failure were enrolled in our study. The patients were randomized into two groups, 75 in each group: those who underwent the Conventional excision arteriotomy method and those who underwent the Double Stab excision Arteriotomy technique. All patients were first examined clinically. After that, a Doppler ultrasound (USG) examination was performed for preoperative vessel mapping and measurements of vessel diameter. Patients were randomized into two groups with the help of computer-based randomly sealed envelopes: the Double Stab Excision Arteriotomy Technique Group and the Conventional Excision Arteriotomy Technique Group. Randomization was achieved by using a 1:1 allocation for our study.

Written/informed consent was taken from all the patients. All the patients included in our study were blinded to the technique of the operation. The procedure was performed under local anaesthesia. All arteriotomies were performed by the same vascular surgeon.

The endpoint of the study was achieving an appropriate arteriotomy of adequate size and shape having regular margins without intimal dissection during its formation or an inappropriate arteriotomy due to size, shape, edges or intimal dissection. The first assistant (Resident Vascular Surgeon) assessed the studied criteria of the arteriotomy and endorsed the data in the proforma. SPSS version 23.0 was used to perform Statistical analysis. Comparisons were performed by using Mann–Whitney U test and unpaired t-test to evaluate the demographic

parameters and primary outcomes. *p*-value ≤0.05 was considered statistically significant.

RESULTS

The ages of patients studied ranged from 30–60 years with a mean age of 52.5 years. There were 82 (54.66%) males and 68 (45.33%) females in the study with a male-to-female ratio of 1.2:1.

In group A (Conventional Arteriotomy) there were 30(40%) inappropriate arteriotomies, while 45(60%) arteriotomies were appropriate. In group B (Double Stab Excision Arteriotomy), there were 69(92%) appropriate arteriotomies while the rest had inappropriate arteriotomies 6(8%). Table-1 & Figure-1

In all 45 (60%) appropriate arteriotomies in Group A the desired size, shape and margins were achieved successfully. In Group A, the most common inappropriate arteriotomy was the larger than desired size arteriotomy; 10 (33.33%) followed by smaller than desired size arteriotomy; 6 (20%), irregular margins 9(30%), intimal dissection 3 (10%) & lateral tear 2 (6.66%) respectively. Figure-2

Among the total 6 (8%) inappropriate arteriotomies in group B were larger than desired size, arteriotomies were 2 (33.33%), smaller than desired size arteriotomy; 1 (16.66%), irregular margins 1(16.66%), intimal dissection 2(33.33%) & no lateral tear respectively. Figure-3

Table-1: outcome of both groups

Outcome	Group A (Conventional)		Group B (Double Stab)		*p*-value
	Frequency	Percentage	Frequency	Percentage	
Desired Arteriotomy	45	60%	69	92	0.003
Inappropriate	30	40%	6	8	0.001

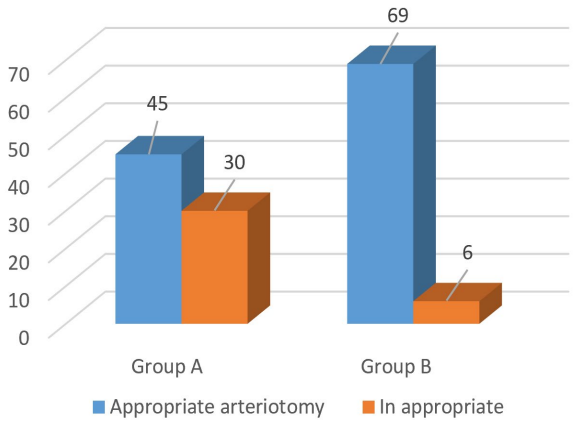

Figure-1: Outcome of both groups

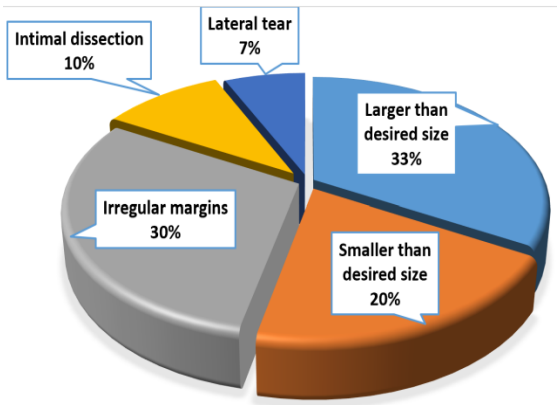

Figure-2: Group A inappropriate arteriotomies

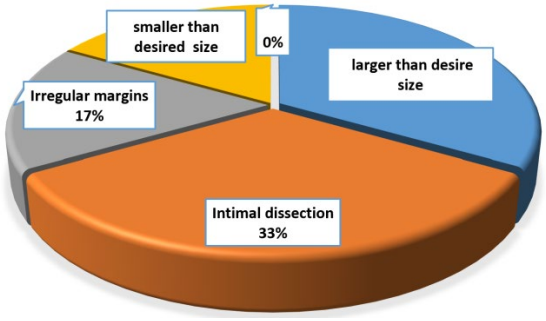

Figure-3: Group B inappropriate arteriotomies

DISCUSSION

Arterial End to side (ETS) anastomosis was first described in 1975 and later on made popular by Godina et al, particularly in lower extremities vascular restoration.[13,14] This vascular reconstruction is now a trustworthy technique for microvascular surgeons enabling them to carry out microvascular anastomosis, particularly in free tissue transfer and making arterio-venous fistula for Hemodialysis, in patients having chronic kidney disease.[3] In comparison with end-to-end anastomosis, end-to-side anastomosis has several advantages: It allows anastomosis of vessels of different dimensions and there are fewer chances of thrombus formation at the anastomotic site.[14] An ideal ETS anastomosis must have a wide opening and smooth angulation thus helping in reducing vascular spasm, thrombogenicity at anastomotic site and blood turbulence.[3]

Arteriotomy should be kept in mind Arteriotomy is the key step in every vascular

anastomosis. Arteriotomy methods in ETS anastomosis are further classified into true arteriotomy by incision (longitudinal or transverse) and arteriotomy by excision. Both methods can be carried out with inside-out or outside-in techniques using different kinds of equipment.[5] For making arteriotomy in, an outside-in technique mainly scissors are used while an inside-out technique is performed with a vascular punch. The main advantage of vascular punch is fewer chances of intimal dissection, which can lead to thrombus formation at an anastomotic site.[15]

There are two main types of arteriotomy techniques used in ETS anastomosis: Hole-type and slit-type.[16,17] In hole-type also called excision arteriotomy, some portion of vascular wall is excised in oval, diamond, elliptical or circular shape.[3,18,19] Advantages of excision arteriotomy are obtaining a clear picture while carrying out anastomosis and decreasing the chances of taking stitches in the posterior wall of the vessel.[3,20] Disadvantages of excision arteriotomy are trouble in achieving desired arteriotomy size, stenosis at the anastomotic site if larger than desired arteriotomy is made or anastomosis is postponed due to some reason.[20] In the slit-type (arteriotomy), a longitudinal or transverse cut is made in the arterial wall according to the vessel size. Gu *et al* believe that slit arteriotomy has numerous benefits, i.e.; it is a straightforward procedure resulting in clean-cut margins of the vessel. The slit can be enlarged or repaired if smaller or larger than the desired size of the arteriotomy is made respectively. In slit arteriotomy, the arterial wall is preserved thus resulting in a bigger area at the anastomotic site.[21] The disadvantages of slit arteriotomy are; there are higher chances to damage the posterior vascular wall, limited exposure area while performing vascular anastomosis and this may result in stenosis at the anastomotic site.[16,20,22]

We have used curved micro scissors in our technique of double stab excision arteriotomy and the results are in accordance with Dash *et al* who performed arteriotomy with curved micro scissors. It has several benefits; it is a simple and effective method which is easily reproducible. It results in the formation of arteriotomy of the desired size and shapes having uniform and smooth edges. There is less chance of readjusting the arteriotomy size and shape.[23] Also, according to Storrie et al making excision arteriotomy of desired size and shape is a technical difficulty with straight microscissors.[24] Some surgeons prefer specialized micro scissors for arteriotomy but these instruments are very expensive.[25]

Zoubos *et al* believe that an elliptical arteriotomy demands more experience as compared to a longitudinal slit arteriotomy and it may need specific instruments.[22] However; we have made an elliptical arteriotomy with simple micro scissors, not using any specialized instruments.

In order to make arteriotomy of desired size and shape with micro scissors, recutting may be required thus leading to intimal dissection. To overcome this problem, Korber designed a special type of angled micro arteriotomy scissors which results in an elliptical shape defect in the vessel wall having clean-cut margins. In his 4-step straightforward technique frequent handling of the vessel is not required, thus reducing the chances of intimal damage.[25] On the other side an inexperienced surgeon may perform arteriotomy of inappropriate size and shape if angled micro arteriotomy scissors are used improperly. It is recommended that surgeons should gain experience by using these specialized scissors in the experimental laboratory before practicing it on actual subjects. In contrast, double stab excision arteriotomy is a simple procedure that can be practiced routinely. Excision arteriotomy is also advantageous in thickened and calcified vessels which are rigid. In these vessels, slit arteriotomy can lead to an inadequate opening in the artery.

CONCLUSION

Arteriotomy technique and anastomosis angle are important factors for the success of vascular anastomosis. To overcome the drawbacks of different arteriotomy techniques and to combine their benefits, we have proposed a method of double-stab excision arteriotomy. The double stab excision arteriotomy technique is superior to the conventional excision arteriotomy technique. The proposed advantages of our technique are its reliability with a short learning curve and can be performed precisely and safely.

AUTHORS' CONTRIBUTION

NI, MI: Conceptualization of the study design. UA, FUK: Data collection, literature search, write-up. QA: Data analysis, data interpretation. RK: Proofreading.

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