

### **Kertas Asli/Original Articles**

## **Retrospective Study of The Outcome of Primary Repair of Arteriovenous Fistula (AVF) Aneurysm and Pseudoaneurysm in Secondary Hospital Setting** (Kajian Retrospektif Pembaikan Primer Ateriovenous Fistula (AVF) Aneurisma dan Pseudoaneurisma di Hospital Sekunder)

#### ABSTRACT

*Aneurysms and pseudoaneurysm are commonly encountered with arteriovenous vascular access for haemodialysis. They are difficult complications to manage. Due to the limited number of vascular centers available, patients were unable to seek treatment until further complications arise. The technique of partial aneurysmectomy and primary repair was adopted as the method of repair in this study. A total of 20 cases underwent the surgery from 2019 to 2020. Among the 20 cases, one patient had two pseudoaneurysms at different location which requires her to undergo the procedure twice. The successful cannulation rate post repair was 70% whereas the overall complication rate was 35% which might be attributed to the small sample size. Overall, this study demonstrated that AVF aneurysm and pseudoaneurysm can be safely treated with this approach and can be done effectively in non-vascular centers by general surgeons.*

*Keywords: pseudoaneurysm, aneurysm repair, arteriovenous fistula*

#### ABSTRAK

*Aneurisma dan pseudoaneurisma biasanya ditemui dalam kalangan pesakit yang memakai fistula arteriovenous untuk dialisis dan merupakan komplikasi yang sukar untuk dirawat. Disebabkan oleh kekurangan hospital pakar dalam bidang vaskular, pesakit tidak dapat menerima rawatan pada peringkat awal sehingga komplikasi yang lebih rumit berlaku. Kami berkongsi pengalaman kami dalam rawatan komplikasi tersebut melalui kajian kami. Kami menggunakan teknik 'partial aneurysmectomy and primary repair' sebagai teknik rawatan. Sejumlah 20 kes melalui pembedahan menggunakan kaedah tersebut dari tahun 2019 sehingga tahun 2020. Dalam 20 kes tersebut, seorang pesakit mempunyai two pseudoaneurisma di two tempat yang berbeza yang memerlukan pembedahan dijalankan sebanyak dua kali. Kadar kejayaan untuk hemodialisis selepas pembedahan adalah 70% manakala kadar komplikasi pembedahan adalah 35% mungkin disebabkan oleh bilangan pesakit yang kecil. Secara keseluruhan, kajian ini menunjukkan bahawa aneurisma dan pseudoaneurisma boleh dirawat secara selamat dengan teknik ini dan pembedahan jenis ini boleh dilakukan oleh pakar pembedahan am di hospital separa pakar.*

*Kata kunci: pseudoaneurisma, pembaikan aneurisma, fistula arteriovenous*

### **INTRODUCTION**

Aneurysms & pseudoaneurysm are complications that arise from arteriovenous vascular access used in haemodialysis. They do not affect fistula function for hemodialysis. However, they can be associated with complications that increase the risk of fistula bleeding and function loss.

A pseudoaneurysm, also known as "false aneurysm" is an accumulation of blood between the tunica media and tunica adventitia of the artery. An aneurysm on the other hand is an abnormal artery dilation that involves all three layers of the arterial wall (tunica intima, media and adventitia)

The primary repair of aneurysm & pseudoaneurysm are not common procedures undertaken by the general surgeons especially in secondary hospitals which is a non-vascular center. With the increasing number of end-stage renal failure (ESRF) patients requiring dialysis, the number of patients developing arteriovenous fistula (AVF) aneurysm & pseudoaneurysm are also on the rise.

Due to the limited vascular center available in Malaysia and patients' logistic issues, mainly financial; they tend to seek treatment for their AVF aneurysm/pseudoaneurysm only when complications arise such as ruptured or bleeding aneurysm. In these situations, the AVF might not be salvageable. In addition to that, the recent

COVID-19 outbreak further complicates the process. A new fistula might often need to be created which delays the patients' hemodialysis and put them at risk of catheter related infections.

Although various approaches have been used for managing these complications, the fistulae are often ligated, especially when the integrity of their structures is compromised. Studies of AVF aneurysm & pseudoaneurysm repair showed promising post-operative patency rate<sup>[1,2,3,4,5]</sup>. One of the surgical techniques described was partial aneurysmectomy and primary repair (with a single continuous suture). The basic concepts include resection of unhealthy or excessive tissue over the fistula, reconstruction of the vascular access lumen using in situ vascular wall followed by closing the overlying skin. This technique has been chosen for the management of AVF aneurysm/pseudoaneurysm.

In this article, the experience of primary AVF aneurysm/pseudoaneurysm repair using the technique above is discussed. All repairs were done in a secondary hospital setting by general surgeons. This study is aim to determine whether the outcome is comparable to those done in other centers overseas.

## METHODOLOGY

A retrospective review of medical records from AVF clinic was done in Hospital Taiping. Total of 19 patients who underwent AVF aneurysm repair from 2019 to 2020 were identified. All surgeries were done by general surgeons in a secondary hospital setting. An ultrasound assessment of the AVF and AVF aneurysm/pseudoaneurysm was done prior to surgery and on the day of the surgery as well. Almost all cases were done under regional anesthesia (supraclavicular block).

The technique used for the aneurysm repair was partial aneurysmectomy and primary repair (with a single continuous suture). An elliptical incision was made over the aneurysm without puncturing it. Dissections were done over the proximal and distal end of the fistula limbs. Vessel loops were placed over the vessels for hemostatic control. Subsequently, the aneurysm/pseudoaneurysm was completely skeletonised. An incision was then made over the aneurysm/pseudoaneurysm. Blood clots were removed

and the excess tissues were excised. Fistula was then flushed with heparinised solution. The defect was closed with a continuous suture using monofilament non absorbable suture 5/0 or 6/0, depending on vessel thickness of fistula. Finally, the skin was opposed with simple interrupted sutures.

The repaired AVF was rested for at least 2 weeks until all sutures have been removed and the wound well healed. All patients were reviewed in AVF clinic about 2 weeks post-operative for assessment of the wound and viability of the fistula. A trial of cannulation was allowed after the assessment, usually 1 month post-operative.

## RESULTS

A total of 20 cases (One patient underwent the procedure twice for 2 different aneurysm, counted as 2 cases) were identified to have undergone partial aneurysmectomy and primary repair of the AVF aneurysm/pseudoaneurysm from 2019 to 2020. Each patient has at least one other co-morbid (diabetes mellitus, hypertension or dyslipidemia) in addition to ESRF.

TABLE 1. Patient's demographic

Demographics		Frequency	Percentage (%)
Gender	Male	6	31.6
	Female	13	68.4
Age	Mean	50.2 years	
Ethnicity	Malay	16	84.2
	Chinese	2	10.5
	Indian	1	5.3

TABLE 2. AVF age and post-surgery flow rate

AVF		
Age	Median	4 years
	Max	14 years
	Min	0.25 years
Flow rate post-surgery	Median	2294.9 ml/min

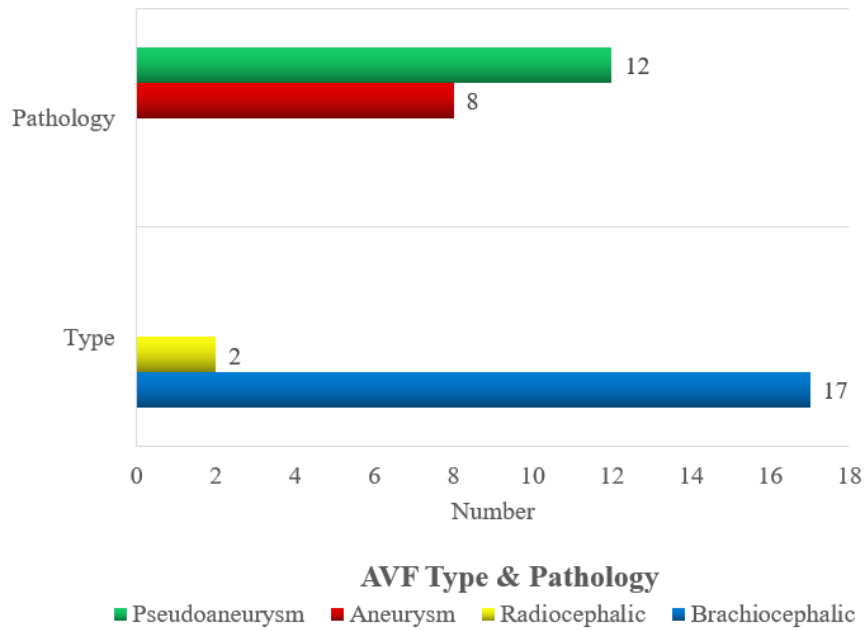


FIGURE 1. AVF type and pathology

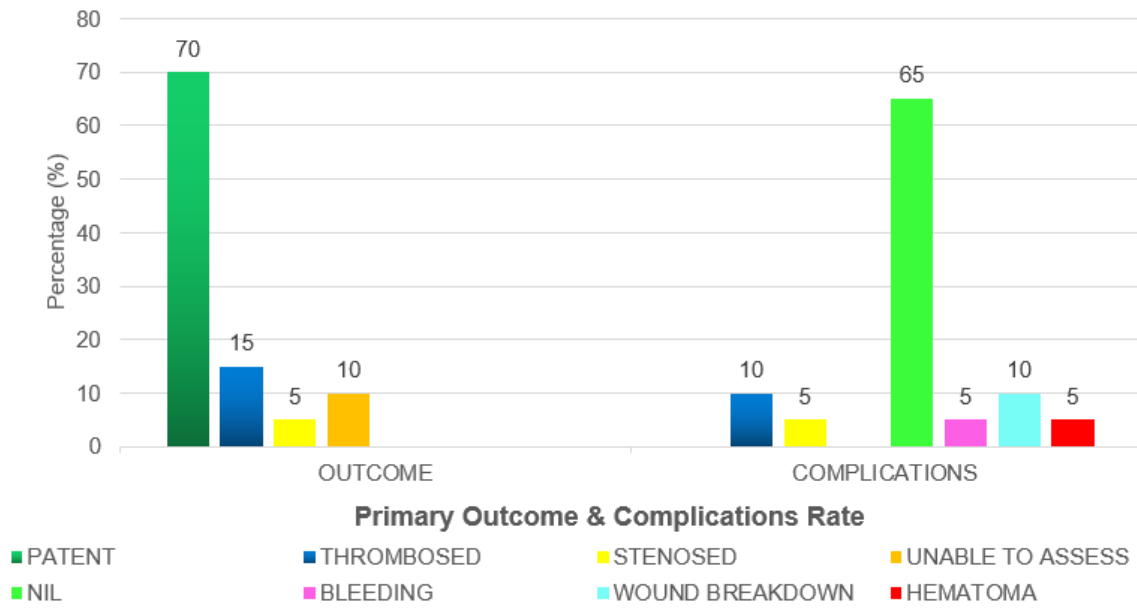


FIGURE 2. Percentage of primary outcome and complication rate

There were a total of 19 patients of whom one underwent the procedure twice. There were 13 female and 6 male patients with the mean age of 50.2. A majority (84%) of the patients were Malay with median age of the AVF was 4 years. (Table 1 and 2) The aneurysm/pseudoaneurysm was assessed with duplex ultrasound prior to operation. All the AVF in this study was in the upper limb. Brachiocephalic fistula comprised the majority of the AVF (89.5%). Of the 20 cases studied, 60% were pseudoaneurysm while 40% cases were aneurysm. (Figure 1)

Duration of post-operative follow-up was variable due to logistics reasons as stated above. Seven of the 20 cases in this study developed complications post-operatively. Two (10%) of them developed superficial surgical site infections, one (5%) had bleeding over the operative site while another one (5%) had hematoma collection over operative site which required evacuation of clots. The remaining three (15%) cases were complicated with stenosis over the venous limb, thrombosed AVF and no flow over venous limb respectively. Overall, 65% of cases

underwent the surgery without any post-operative complications. (Figure 2). The median flow rate post primary repair was 2294.9 ml/min. The successful cannulation rate post primary repair was 70% however two of the 19 patients passed away due to infective endocarditis and fluid overload respectively along this study.

## DISCUSSION

Aneurysm formation is one of the complications of AVF for hemodialysis, with a highly variable reported incidence of 6% to as high as 60%.<sup>[6,8,10]</sup> These are generally a mixture of true and pseudoaneurysms which occur as a result of the puncture techniques used.<sup>[9]</sup> Repeated punctures weaken the wall of the fistula and prone for the development of cannulation aneurysm and stenosis<sup>[11]</sup>. Proximal stenosis due to a central venous occlusion may also accelerate aneurysm formation by raising the pressure into the fistula. An enlarged aneurysm sac leads to thinning of the overlying skin and necrosis on dermal tissue over time. The aneurysm sac can rupture, resulting in fatal hemorrhage.

The complications of AVF aneurysm/pseudoaneurysms include rupture and bleeding which could lead to function loss of fistula. Early interventions is advised in order to preserve the fistula and prevent complication.<sup>[2,5,6]</sup> Among the 20 cases, only one patient actually presented with acute bleeding episode (ruptured aneurysm) which required emergency surgery. We managed to salvage his fistula and it was able to be cannulated for dialysis before he was discharged.

Various approaches have been used to manage aneurysms and pseudoaneurysms such as plication, stapling, aneurysmorrhaphy with mesh, resection followed by anastomosis, interposing prosthetic or autogenous or bioengineered grafts.<sup>[1-5,8]</sup> However, not all the methods described were readily available in secondary hospital setting without a dedicated vascular unit. Partial aneurysmectomy and primary repair was chosen as the approach of choice as it does not require specialized resources that are not available in non-vascular centers. The technique is also not overtly challenging to perform. However, a major drawback of this technique is that it leaves the patient without an immediate functional mode of dialysis. The nephrology unit in the setting was involved to establish a temporary route for dialysis for the patient while awaiting the wound to heal prior to the trial of cannulation.

Of the 20 cases studied, one patient underwent the procedure twice which were two separate pseudoaneurysm, in which one of them was impending rupture. The other pseudoaneurysm was scheduled to be repair at a later date.

The second aneurysm was repaired during the course of this study. Unfortunately, the patient passed away due to infective endocarditis 10 months post-operative. Of the 20 cases, three (15%) were thrombosed during reassessment in AVF clinic post-operative. Post repair thrombosis can be multi-factorial, for example operative and patient factors. Intra-operative manipulation and damage to vessel wall can predispose it to thrombosis. In addition, ESRF patients are prone to develop thrombosis<sup>[12]</sup>, this might be further exaggerated by the other pro-thrombotic co-morbidities they have.

One (5%) of the patient developed bleeding from the operative site which was managed conservatively. Another patient had hematoma collection over the repair site day 4 post-operative which required surgical intervention for evacuation of clots. There were two cases (10%) complicated with wound dehiscence post-operative. They were treated with oral antibiotics and daily normal saline dressing. The wound eventually healed without further complications. The skin over aneurysm site is often scarred due to repeated cannulation. Healing of scarred skin under tension is poor<sup>[2]</sup>. Therefore, adequate resection of the unhealthy skin is necessary for healing post-repair. Infection may be introduced during the cannulation process for vascular access during dialysis. More so if the skin is necrotic due to a chronically dilated aneurysm. A pre-existing infection increases the rate of wound breakdown and delayed wound healing. However, this complication can be attributed to patient factor as well. Diabetes mellitus is known to result in poor wound healing and increase risk of infection<sup>[13]</sup>.

One (5%) patient developed long segment stenosis of the venous limb one month post primary repair. The patient was referred to a vascular center for venoplasty. The patient subsequently defaulted to follow-up at AVF clinic.

The successful cannulation rate post primary repair in this study however was 70%. A direct comparison between our study with those done abroad is not possible due to a few limitations. The main limiting factor was logistics. Most of our patients are not from our center but rather the cluster hospitals which was covered by our center. Some of them had trouble for regular follow-up and the situation was made worse by the COVID-19 pandemic. In view of these difficulties faced by them, decision was made to discharge them once the primary aim of the treatment was achieved i.e. the fistula is able to be cannulated for dialysis. Majority of them had less than 6 months follow-up post-operative.

Repair of cannulation aneurysms as well as pseudoaneurysms can be very challenging, and its success is multi-factorial due to postulated etiology of the development of aneurysms in these patients, as well as their pre-existing co-morbidities. Therefore, the higher

complication rate of this study. The overall small number of case studied can also attribute to the complication rate.

From the literature review, a study by Shouwen and Michele (2017) reported the largest sample size (n = 185) among all the studies with primary patency rate of 59% at 6 months post-operative<sup>[2]</sup>. Karen Woo et. al (2010) and ZimingWan et.al (2019) studies had much fewer cases (n = 19; n = 41) with a primary patency rate of 73% and 100% at 6 months post-operative respectively.<sup>[3,4]</sup> In Ahmed Hossny (2014) study, 10 patients had more than one aneurysm repair surgery done. However, surprisingly the study exhibits a high cumulative patency rate of 92.9% at 6 months post-operative. There is no similar study done locally for comparison.

With these limitations, a direct comparison of the outcome from our study to those done abroad is not feasible. A future prospective study with a larger sample size can be continued to determine the primary, assisted primary and secondary patency rate from our intervention, and can better outline the actual complication rate from the surgery.

## CONCLUSION

Despite the limitations, this retrospective study has shown that AVF aneurysm/pseudoaneurysm can be safely managed effectively in non-vascular centers by general surgeons.

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## DECLARATION OF CONFLICT OF INTERESTS

The author(s) declare(s) there is no conflict of interest.

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