

## Arteriovenous Fistula Aneurysm

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**Background:** Arterio-venous fistula (AVF) provides the best functional patency for patients on regular hemodialysis (HD). Nevertheless, complications such as AVF aneurysms, steal syndrome, venous hypertension and infections are not uncommon.

**Objective:** To evaluate the trends in AVF aneurysm formations, prophylaxis and treatment options.

**Design:** A Retrospective, Descriptive Study.

**Setting:** Hemodialysis Centers, Ministry of Health, Kingdom of Bahrain.

**Method:** Two hundred and eleven patients on hemodialysis via arterio-venous fistula and arterio-venous graft were included in the study.

**Result:** Two hundred and eleven patients were on hemodialysis via arterio-venous fistula and arterio-venous graft. Thirty (14.22%) patients developed arterio-venous fistula aneurysm. Sixteen (53.33%) were males, and the mean age was 57 years. Eleven (36.66%) patients had excision of the aneurysms with interposition graft. Six (20%) patients had excision of the aneurysms with new fistula formation. Six (20%) patients required a change of the cannula insertion site while the remaining 7 (23.33%) patients were waiting for their scheduled date of surgery.

**Conclusion:** Aneurysm formation is the most common complication in post AVF patients on regular HD. AVF aneurysms are at high risk of rupture and fatal hemorrhage. Surgical treatments could safely be performed for high risk aneurysms. The most common cause of aneurysm formation is repeated punctures at the same site.

*Bahrain Med Bull 2016; 38 (3): 142 - 144*

Chronic renal failure patients need renal replacement therapy to sustain their lives. Renal replacement therapy could be either hemodialysis (HD) or peritoneal dialysis (PD). In hemodialysis, a vascular access is created to connect the patient to the dialysis machine; the access could be a central line, a native arterio-venous fistula (AVF) or a synthetic arterio-venous graft (AVG)<sup>1</sup>. AVF provides the best functional patency and the least complications<sup>1</sup>. AVF is the recommended vascular access in patients who need dialysis treatment<sup>2</sup>. Nevertheless, complications, such as AVF aneurysms, steal syndrome, venous hypertension and infections are not uncommon<sup>3</sup>.

A recent study on regular hemodialysis patients revealed that AVF aneurysm formation is the most common complication<sup>3</sup>.

The aim of this study is to evaluate the trends in AVF aneurysm formations, prophylaxis and treatment options.

### METHOD

Two hundred eleven patients were on HD via AVF and AVG. Thirty (14.22%) patients developed post arterio-venous fistula aneurysms. Personal characteristics and other necessary data were documented.

### RESULT

Two hundred eleven patients were on HD via AVF and AVG. Thirty (14.22%) patients developed AVF aneurysms. Sixteen

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(53.33%) were males, and the age range was from 26 to 86 years, the mean age was 57 years.

Eleven (36.66%) patients underwent excision of the aneurysm with interposition graft, see figure 1. Six (20%) patients had excision of the aneurysm with new fistula formation, see figure 2. Six (20%) patients required a change of cannula insertion site while the remaining 7 (23.33%) patients were waiting for their scheduled date of surgery. Figure 3 is a pseudo aneurysm due to repeated puncture at the site.



**Figure 1: Intraoperative Image of Surgical Excision of Aneurysm and Insertion of Graft**



**Figure 2: Intraoperative Image of Aneurysm Excision**



**Figure 3: An Aneurysm at the Site of Repeated Venepuncture**

## DISCUSSION

AVF remains the best and most effective permanent vascular access for end-stage renal patients requiring regular hemodialysis because it provides greater patency rates with the least complications<sup>1-2,4-5</sup>. However, complications do occur. The most commonly reported complication is post AVF aneurysm formation<sup>3-5</sup>. AVF aneurysms are at high risk of rupture, which could lead to fatal hemorrhage. AVF rupture causes massive acute blood loss and life-threatening hemorrhage due to high flow volumes within its dilated vessels<sup>6-8</sup>. Early identification and treatment of AVF aneurysm is mandatory because of the potential risk to the patient<sup>7</sup>. It could also affect the dialysis adequacy by reducing viable sites for cannulations<sup>6</sup>.

In our study, we reported 14.22% post AVF aneurysm. Our results were significantly lower than a study conducted by Derakhshanfar et al who reported an aneurysm formation rate of 51%<sup>4</sup>. Another study by Hong-Yee Lo et al found that the aneurysm incidence was 6%<sup>6</sup>. However, due to the lack of a standardized aneurysm definition, the incidence could range from 5% to 60%<sup>7</sup>.

The definition of an aneurysm varies through different studies. Aneurysms could be pseudo-aneurysms or true aneurysms<sup>7</sup>. Pseudoaneurysms develop over a short period and are usually sacular with thin overlying skin and are formed outside the vessel wall, while true aneurysms are fusiform under the non-ulcerated skin and develop over time<sup>9</sup>. Some authors define the aneurysm as more than three times dilatations of the native vessel diameter size, with the minimum diameter size of 2 cm<sup>7</sup>. Others define the aneurysms compared to the adjacent normal fistula vein segment, and this was the definition we adopted in our study. A focal dilatation of more than two times the vein diameter is defined as an aneurysm<sup>7</sup>. A recent study reported by Valenti et al proposed a new classification for AVF aneurysm based on the morphology of the fistula and classified them type 1 to type 4. Types 1 to 3 are true aneurysms subdivided by vein length, post anastomotic, localized and complex, while type 4 is a pseudoaneurysm<sup>10</sup>. In our study, the aneurysm was defined by clinical judgment and functional status of the AVF.

Aneurysm formation is the most common cause of acute access blood loss in patients on hemodialysis<sup>9</sup>. One of the main factors contributing to the AVF true aneurysm formation is repeated puncture/needling<sup>6,9,11</sup>. It also results in the formation of small fibrous scars which could expand with time and result in localized aneurysms and elasticity impairment<sup>7,9</sup>. Another factor is proximal stenosis which increases the intraluminal AVF pressure and impairs normal hemodynamic<sup>6,7,11</sup>. Shear stress due to high flow through the vessel could contribute to gradual dilatation of the vessel caliber and aneurysm formation<sup>7,9</sup>. In patients with prosthetic grafts, repeated punctures at the same sites result in pseudoaneurysms, but true aneurysms may occur<sup>7</sup>. Other conditions could predispose aneurysm formations such as connective tissue disease, Alport's syndrome, polycystic disease and pregnancy<sup>7</sup>. Aneurysms are at risk of rupture not only by expanding, but also due to infection and thinning of overlying skin<sup>9</sup>.

In our study, patients with AVF aneurysms underwent surgical repair with the ultimate goal of maintaining a vascular access

and preventing subsequent complications. Surgical treatment could be aneurysmectomy followed by the creation of a new AV fistula, use of interposition graft or end-to-end anastomosis. Other options include reducing the aneurysmal sac by stapling or suturing<sup>7</sup>; however, this method was not used for our patients.

In our study, six (20%) patients had aneurysmectomy with new fistula formation, and eleven (36.66%) patients had aneurysmectomy with interposition graft. Karatepe et al revealed that 25 out of 30 patients had aneurysmectomy with plication and arterio-venous anastomosis; three patients had aneurysmectomy and graft interposition, which is less used compared to our study<sup>5</sup>. Similar to our study, a recent study by Belli et al reported the use of interposition graft in 12 of 31 aneurysmal cases, while the remaining 14 patients underwent aneurysmectomy and primary suturing and 5 had ligation of fistula due to other factors<sup>12</sup>. A study by Cingoz et al reported 100% patency rate in 3-years follow-up<sup>11</sup>. Therefore, aneurysmectomy with interposition of graft could safely be used with the advantage of early patent vascular access and low complication rates<sup>11</sup>.

## CONCLUSION

**Aneurysm formation is the most common complication of post AVF in patients on regular HD. AVF aneurysms are at high risk of rupture and fatal hemorrhage; thus, it carries significant threat to the patient and the maintenance of vascular access. Surgical treatments could safely be performed for high risk aneurysms. The most common cause of aneurysm formation is repeated punctures at the same site.**

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**Author Contribution:** All authors share equal effort contribution towards (1) substantial contribution to conception and design, acquisition, analysis and interpretation of data; (2) drafting the article and revising it critically for important intellectual content; and (3) final approval of manuscript version to be published. Yes.

**Potential Conflicts of Interest:** None.

**Competing Interest:** None.

**Sponsorship:** None.

**Submission Date:** 18 April 2016.

**Acceptance Date:** 20 June 2016.

**Ethical Approval:** Approved by Department of Surgery, Salmaniya Medical Complex, Kingdom of Bahrain.

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