



Case Series

Accessory veins related hand ischemia: A case series

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ABSTRACT

Introduction: Arteriovenous fistula is considered as a lifeline for chronic kidney patients undergoing maintenance hemodialysis.

Objective: To study the outcome of ligation of the accessory vein causing hyperperfusion and ischemia of the ipsilateral limb.

Method: ology: A single institution, single surgeon, in-hospital, retrospective case series of patients presented with alarm symptoms in postoperative period following arteriovenous fistula.

Results: A total of 800 AVF were created between 2016 and 2019, out of which 6/800 (0.75 %) patients presented with alarm symptoms related to venous hypertension and underwent accessory vein ligation. All showed normal recovery with complete resolution of symptoms postoperatively.

Conclusion: Timely ligation of the accessory vein in patients with arteriovenous fistula with accessory vein related alarm symptoms showed salvage of lifeline and limb with no residual complications during follow-up.

Grants

No funding

Conflict of interest

None.

Author's contribution

MMP conceived the design. MMP was the attending surgeon and had supervised all residents performing the surgery; Patients were evaluated, worked up, discussed, and operated by AS, MM, RG Demography of the patients, clinical details, preoperative, intraoperative, and post-operative data were collected by AS, MM, RG, JA, NR & SM Excel sheet was prepared by AS, MM, RG Editing of the image was performed by AS, MM, RG, JA, NR & SM. Data was analyzed by MMP. The manuscript was prepared by AS, MMP, MM, RG, JA, NR & SM. Article was written, critically analyzed, revised, and uploaded by MMP and AS. Final approval of the article has been provided by AS, MMP, MM, RG Overall responsibility and the corresponding author is MMP.

Ethical clearance

Ethical clearance was taken from ethical committee for post graduate All India Institute of Medical Sciences New Delhi India.

What does this article add?

The manuscript enumerates delayed presentation of a complication related to arteriovenous fistula that is not routinely discussed in the English literature, and how early detection and surgical ligation had an impact on patients functioning of arteriovenous fistula.

Introduction

Since the original description by Brescia et al., in 1966, arteriovenous fistula (AVF) has become the vascular access of choice for long-term hemodialysis [1]. A functioning AVF is a major requirement for successful long term HD. AVF is considered to be a lifeline in patients with chronic kidney disease on maintenance hemodialysis (HD). However, complications related to AVF may require hospitalization and treatment. It is necessary to have adequate knowledge about the complications related to AVF so that timely measures can be taken to prevent deleterious consequences ranging from morbidity to mortality [2]. Hand

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ischemia in patients with AVF is a serious complication as it can lead to limb loss. Furthermore, venous ischemia is under-reported and is a cause of litigation and compensation [3]. Hence, it is important to keep a close follow-up so that timely intervention could be performed. In this case series we report six cases that presented with alarm symptoms leading to hand ischemia and underwent ligation of accessory veins.

Patients and methods

This study is registered with following registry.

1. Name of the registry: CTRI
2. Unique Identifying number or registration ID: CTRI/2021/04/032692
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): <http://ctri.nic.in/Clinicaltrials/showallp.php?mid1=54591&EncHid=&userName=CTRI/2021/04/032692>

Study population: six patients who developed alarm symptoms related to venous ischemia following AVF surgery performed between 2016 and 2019.

Operational definition: Following were considered as alarm symptoms: refractory pain, edema, discoloration (hyperpigmentation or acral cyanosis), skin thickening, ulcer, and loss of motor function in the ipsilateral hand distal to the AVF which lasted for more than 2 months approximately.

Pre intervention optimization: Dialysis was done one day prior to intervention.

Intervention: Accessory vein ligation in patients presented with alarm symptoms.

Inclusion criteria: All patients who had undergone AVF surgery between 2016 and 2019, aged 18–65 years and complained of alarm symptoms on direct and digital follow-up were included in the study.

Exclusion: Patients with normal functioning AVF and undergoing hemodialysis regularly without any clinical problems were excluded from the study. Patients with central venous stenosis and patient who were non-compliant to follow-up were excluded.

Design of the study: A single-institution, retrospective case series.

Maturation of AVF: Clinical maturation was defined as an adequate use of AVF for repetitive hemodialysis (i.e., more than three hemodialysis).

The accessory vein was defined as the venous tributary with retrograde flow joining the draining vein of AVF [4].

Threatened limb due to venous hypertension was defined as the presence of two or more alarm symptoms: refractory pain, edema, pre-gangrenous changes, decreased or loss of digital movements, acral cyanosis, and desaturation of the ipsilateral limb distal to the AVF.

Primary outcome: To study the effect of accessory vein ligation in patients presenting with alarm symptoms.

Procedure: ligation of the accessory vein.

Methodology: All parameters before the surgery, during operation, and in the follow-up period were extracted from hospital records. Pre-operative parameters included age, gender, and presence of comorbidity (diabetes, hypertension, chronic renal failure, stroke, and cardiovascular vascular disease). Perioperative details such as the site of fistula, condition of limb, intraoperative diagnosis, and the details about surgery performed were taken from the operation theater register. Post-operative symptoms such as pain, edema, reduced or loss of digital movement, acral cyanosis, tissue loss, and desaturation of the limb were taken from follow-up clinic notes.

Surveillance protocol - All AVF patients are followed up on day 2, day 14 and day 60 following surgery. Additionally, at the time of dialysis if any alarm symptoms were noted.

Diagnosis: involved clinical and radiological. Patients with alarm symptoms underwent duplex sonography to confirm diagnosis.

Clinical component: a vein in the proximity of the draining vein of

AVF running in variable direction with a palpable thrill or audible bruit.

Radiological component: variable vein with retrograde flow connected to draining vein of AV.

Procedure: ligation of the accessory vein.

Operation procedure-the patient was operated under local anesthesia. In supine position with the arm abducted. Surgical site was painted and draped. Accessory vein was identified with the help of markings done by duplex scanning. A centimeter incision was put on the site of thrill or site marked using DUS. Accessory vein was ligated with silk 3-0 suture. Surgical incision was closed using nylon 4-0 suture.

All the work has been reported in line with the PROCESS criteria [20].

Result

The study population consisted of CKD patients who undergone AVF for maintenance HD. During the 4-year study period, 800 AVF's were created in 712 patients. There were 6/160 (3.8 %) cases that presented with alarm symptoms (Table 1) due to venous hypertension and underwent accessory vein ligation (Fig. 1). Post-operatively they showed a dramatic improvement in the function of the ipsilateral limb. All six showed complete resolution of symptoms (Fig. 2) following ligation of accessory veins. .

Discussion

AVF is a lifeline for patients with chronic kidney disease requiring maintenance HD. Fistulas have longer patency and lower rates of complications compared with arteriovenous grafts and catheters [5]. Immediate complications related to HD catheter insertion account for 5 % of the cases and the most common being vessel injury and hematoma [5]. Delayed complications related to catheter and or graft are recurrent infection, sepsis, central venous stenosis, and ipsilateral limb edema secondary to central venous stenosis [5].

Hand ischemia in the setting of arteriovenous access on the ipsilateral side was for many years referred to simply as steal syndrome. However, hyperperfusion due to accessory vein leading to massive edema, reduced or loss of motor function of digits and venous ischemia is another cause of concern associated with AVF [6]. Hand ischemia in patients with AVF is a serious complication. It can lead to loss of limb and life [7]. Arterial cause of steal syndrome could present in a few hours or days after the surgery and is characterized by refractory pain, progressive loss of function of the ipsilateral hand and desaturation. Chronic arterial ischemia may lead to tissue loss needing amputation and permanent loss of limb.

Pathophysiology of venous ischemia: Venous hypertension is the result of the development of accessory veins and retrograde venous flow leading to increased pressure in the distal veins of the limb [8]. High pressure in the accessory veins leads to arterialization of veins, significant swelling (edema due to raised hydrostatic pressure and accumulation of fluid in the extracellular space), pain (due to lack of removal of end products of metabolism), hyperpigmentation (due to accumulation of hemosiderin, fibrin and collagen), skin induration (lipodermatosclerosis), and tissue loss (due to tissue hypoxia or ulceration); similar to that seen in the lower extremity afflicted with chronic venous insufficiency [9]. This disability can be easily cured by early recognition and ligation of the offending accessory vein, as mentioned in our study.

Pathophysiology: High venous pressure leads to capillary proliferation and extensive capillary permeability that occurs as a result of the widening of inter-endothelial cell pores resulting in extravasation of RBC's, WBC's, fibrin, collagen, and fibronectin out of capillaries. Hemoglobin released from RBC's releases hemosiderin (hyperpigmentation) and biliverdin (eczema and itching). Monocytes and macrophage extravasate out of capillaries and release proteolytic enzymes that cause skin breakdown and ulceration [10]. Transcapillary leakage of osmotically active particles such as fibrinogen, collagen and fibronectin results

Table 1
Case series of 6 patients who underwent accessory vein ligation for alarm symptoms and their outcome.

Cases	Age (years)	Sex	Site of AVF	Duration of presentation after AVF surgery	Reversal of symptoms (in months)	Duration of symptoms (in months)	Refractory pain	Refractory edema	Reduced motor function	No loss of temperature	Hyperpigmentation and skin induration present	Desaturation in ipsilateral limb	Intervention relieved symptoms and AVF functioning
1	38	M	Left RCAVF	7 Months	3	3	+	+	+	+	-	-	+
2	36	F	Left RCAVF	1.5 Years	4	4	+	+	+	+	+	-	+
3	36	F	Right RCAVF	2 Years	3	4	+	+	+	+	+	-	+
4	49	F	Right BCAVF	1 Years	1	2	+	+	+	+	+	-	+
5	42	M	Left RCAVF	6 Months	2	3	+	+	+	+	+	-	+
6	31	F	Left BCAVF	3 Years	4	2	+	+	+	+	+	-	+

in deposition around capillary beds and elevation of intravascular pressure. This causes enlargement of endothelial pores resulting in further increased fibrinogen deposition in the interstitial space. All this leads to thickening of tissues and extravascular fibrin cuff formation that prevents diffusion of oxygen, nutrients, and tissue hypoxia causing impaired wound healing. The “fibrin cuff” which surrounds the capillaries in the dermis decreases oxygen permeability by 20-fold [11].

Various growth factors and inflammatory cells trapped in the fibrin cuff promote severe uncontrolled inflammation in surrounding tissue that prevents proper regeneration of wounds [12]. Leukocytes trapped in capillaries release proteolytic enzymes and reactive oxygen metabolites that cause endothelial damage. These injured capillaries become increasingly permeable to various macromolecules and accentuate fibrin deposition leading to occlusion, ischemia, tissue hypoxia, and reperfusion damage [13]. Dysregulation of various pro-inflammatory cytokines and growth factors [such as tumor necrosis factor (TNF)- α , TGF- β , and matrix metalloproteinases] lead to the chronicity of the ulcers [14].

Currier et al., 1986, proposed a standard nomenclature for procedures related to AVF's and developed a classification of the degree of severity of venous hypertension into no severity, mild, moderate, and severe [15]. The signs of progressive chronic venous insufficiency developed within a few months in all patients with AVF associated accessory vein flow in our study. Furthermore, a complete reversal of most of the signs was seen in all six cases following surgical ligation of the accessory vein. Nonetheless, not detecting these complications related to AVF and lack of timely intervention to salvage the limb would be considered as negligence and a cause of litigation and compensation [16].

The following are the limitations of our study

This was a retrospective study with a short term follow-up duration conducted at a single center. Response to treatment recorded was clinical with a few objective findings that could be made available in the immediate period. Follow-up was done by physical attendance and by telephonic conversation, and whatever the patient told about his clinical condition was considered true. The primary outcome of the study was clinical improvement of signs and symptoms.

Conclusion

Timely ligation of the accessory vein in six patients with AVF presented with alarm symptoms showed complete recovery with no residual complications noticed immediately after treatment and during the follow-up period.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Informed consent

Verbal consent was taken from all patients for publication of data and pictures.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.amsu.2021.102593>.



Fig. 1. Limb edema and hand blackening due to venous ischemia post AVF.



Fig. 2. Post accessory vein ligation.

Data statement

The authors confirm that the data supporting the findings of this study are available within the article [manuscript and tables].

To protect study participant privacy, information about identity cannot be shared.

Ethical approval

Ethical approval was given by All India Institute of Medical Sciences. Ref no.: IECPG-282/March 24, 2021.

Sources of funding

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Author contribution

MMP conceived the design. MMP was the attending surgeon and had supervised all residents performing the surgery; Patients were evaluated, worked up, discussed, and operated by AJ, MM, RG Demography of the patients, clinical details, preoperative, intraoperative, and post-operative data were collected by AJ, MM, RG, JA Excel sheet was prepared by AJ, MM, RG Editing of the image was performed by AJ, MM, RG, JA Data was analyzed by MMP. The manuscript was prepared by AJ, MMP, MM, RG, JA Article was written, critically analyzed, revised, and uploaded by MMP and AJ. Final approval of the article has been provided by AJ, MMP, MM, RG.

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Guarantor

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