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Role of interventional radiology in management of central venous obstruction: Angioplasty and stenting

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Abstract

Background: Central venous disease is a serious complication in patients undergoing hemodialysis, often presenting with symptoms of venous hypertension. Treatment is aimed to provide symptomatic relief and to maintain hemodialysis access site patency.

Aims: The objective of this study was to describe our initial experience in the endovascular treatment of central venous disease in patients with prolonging hemodialysis fistula.

Methods: A prospective study included 19 patients with chronic renal failure who underwent hemodialysis fistula in the upper limb and presented with signs and symptoms of central venous disease or stenosis and referred from the cardiovascular surgery clinic during the period from November 2019 to May 2021. Their age ranged from 24-70 years. Patients underwent Doppler ultrasound examination of the upper limb and prepared for fistulography and subsequent PTA (Percutaneous transluminal angioplasty).

Results: 19 patients presented with signs of central venous disease were included in this study, 13 are males and 6 are females. Their ages ranged between 24-70 years.

The total number of lesions detected was 27 as some of the patients had 2 or three lesions. The majority of lesions and limb swelling were on the RT side and represent 79%, while regarding the anatomical locations of these lesions, the majority were involving the brachiocephalic and subclavian veins and this represent 74% of the lesions

Regarding the severity of stenosis detected by fistulography, the majority of lesions were either severe stenosis or total occlusion and this represents 44.4% and 37% respectively. PTA was done in only 15 patients, 13 patients underwent PTA using traditional PTA using armada Balloon of size ranging from 8x40mm for smaller lesion or as start with balloon in the tight lesion, while 14x40 mm balloon was used for subclavian, brachiocephalic and SVC lesions, there is good response seen in 13/15 lesions (86.6%), one failed attempt seen in a patient with total right brachiocephalic occlusion, and last one had significant recoil with good contrast run on angiography.

Conclusion: endovascular treatment of central venous disease using PTA is an efficient, safe, and cost-effective method in the treatment of upper limb +/- head and neck swelling in patients with hemodialysis and reliable in decreasing the hemodialysis session time and post-procedure prolong bleeding, thus decreasing the rate of future surgical intervention and substitute creating new fistula in other limbs.

Keywords: Angioplasty, central venous stenosis, endovascular, hemodialysis

Introduction

One of the major concern in patients with chronic renal failure who underwent hemodialysis is the development of central venous disease, the latter includes either stenosis or occlusion [1], which usually seen in about 50% of patient with prolonging hemodialysis route [2], the obstruction greater than 50% is usually symptomatic and usually involved the axillary vein, Subclavian vein, brachiocephalic or may extend to involve the superior vena cava [3]. It was reported incidence of about 25-40% [4] and the cause of this obstruction was attributed to repeat cannulations and puncture resulting in platelets aggregation and thrombi formation with prolong high flow through the arteriovenous fistula, all resulting in intimal damage, hyperplasia, and subsequent stenosis or occlusion of the venous lumen [5].

The site of insertion of central venous catheter is one of major risk of central venous disease, with that being inserted in subclavian vein has a highest risk of occlusion reaching to 42% in comparison to internal jugular venous catheter 0-10% [6].

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As a sequel of previous pathophysiological changes the patients presented with ipsilateral upper limb swelling, prolong hemodialysis session and bleeding time, multiple collaterals seen along the chest wall, and subsequent failure of fistula function [7].

Treatment aims to relieve the symptoms of the patient and to maintains the function of the hemodialysis fistula and thus before establishing the endovascular management using PTA and stenting surgical procedures were used, the surgical repair of the central venous lesion had a high success rate reaching 80-90%, however, is carry high morbidity and mortality [8].

The endovascular method is now considered the modality of choice in the management of central venous disease in hemodialysis patients, this method usually includes PTA, self-expandable metallic stent, and covered stent [9] and now being a solid recommendation of the National Kidney Foundation Disease Outcomes Quality Initiative guidelines in the management of the central venous disease [10].

Aim of the study

To assess the efficiency of PTA in symptomatic relieve of signs and symptoms of central venous disease in hemodialysis patients

Materials and Methods

Patients and method

This was a prospective study that enrolled 19 patients with chronic renal failure on chronic hemodialysis program who complained of upper limb swelling, head and neck edema or prolongs hemodialysis session and post-dialysis puncture site prolong bleeding, all were referred from the hemodialysis clinic to interventional Radiology clinic in Ghazi Al-Hariri subspecialties hospital, Medical City Complex, Baghdad during the period from November 2019 to May 2021. Their age was between 24-70 years.

Inclusion criteria

Patient with chronic renal failure on chronic hemodialysis program.

Exclusion criteria

Acute renal failure, arterial insufficiency of fistula limb. All patients after Doppler ultrasound examination by a

specialist interventional radiologist were prepared for fistulography and the possibility of subsequent PTA.

Fistulography technique

Fistulography was done through the dilated ascending venous limb of fistula using 18G or 20G cannula, then under fluoroscopy device (GE optima IGS 330, INDIA), of 20-40 ml of ultravist (370mg I / ml) contrast media using road map technique to outline the venous system of the upper limb and central veins up to superior vena cava, the site of diseased central vein, the number and degree of stenosis or occlusion were all recorded and planning for PTA was done using over the wire Balloon (Armada) oversized 10-20% and in range between 10x40mm to 14x40mm, noncompliance high-pressure balloon was used in two cases.

Angioplasty technique

The PTA was performed either in the same session of fistulography or as a subsequent session, using local anesthesia 2% lidocaine and 6Fr vascular sheath (Merit medical) inserted in the fistula draining vein in the upper limb, then 5fr 100cm length vertebral catheter (Merit medical) and 0.035” hydrophilic wire (Terumo) 150-180 cm were inserted through the sheath up to the site of stenosis which once crossed by wire-catheter combination, flushing of catheter using heparinized saline about 5-6IU/ ml (international unit / milliliter), Amplatz stiff 0.035 wire was inserted through the catheter which acts as a support for the balloon insertion, once the Balloon is in the desired location, the inflation of it using bump was done up to burst pressure for about 2-3 min with 3-5 inflation attempts, when good dilation of the lesion was achieved dynamic angiography was used to assess the success rate.

Results

Nineteen patients presented with signs of central venous disease were included in this study, 13 are males and 6 are females. Their ages ranged between 24-70 years (mean age 47 years), with the majority are in their 7th decade. The details about patients’ age and gender are shown in Figures 1 and 2.

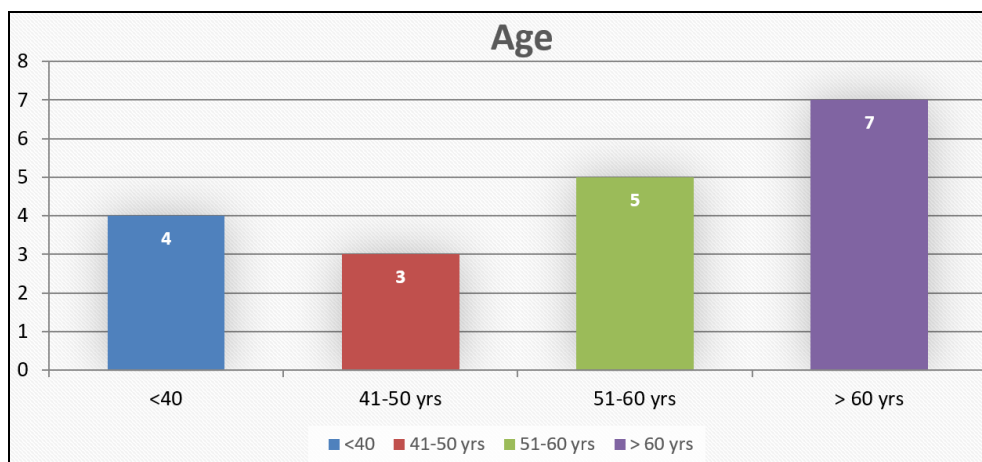


Fig 1: Age Distribution of the Study Population.

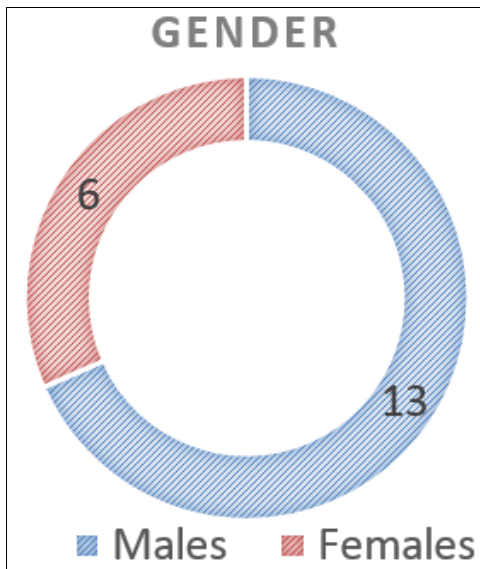


Fig 2: Gender distribution in study population

Fistulography reveals that seven patients had two lesions on the same side and one patient had three lesions on the same side. The total number of lesions detected was 27.

The majority of lesions and limb swelling were on the RT side and represent 15 lesions out of 19, two lesions were involving the superior vena cava (SVC), while regarding the anatomical locations of these lesions, the majority were, and the remaining locations were illustrated in Table 1.

Regarding the severity of stenosis detected by fistulography, the majority of lesions were either severe stenosis or total occlusion and this represents 44.4% and 37% respectively when assessing the site of central diseased vein we found that the majority of lesions were involving the subclavian and brachiocephalic veins and thus represent 74% of the total; details about the side, site, and severity of stenosis were illustrated in Table 1.

After fistulography, the patients were appointed for PTA session, of 19 patients only 15 patients attended the session, 13 patients underwent PTA using traditional PTA using armada Balloon of size ranging from 8x40mm for smaller lesion or as start with a balloon in the tight lesion, while 14x40 mm balloon was used for subclavian, brachiocephalic and SVC lesions, there is good response depicted as

complete effacement of lesion waist, negligible lesion recoiling after balloon deflation and rapid contrast washout after forceful contrast dynamic angiography, this seen in 13/15 lesions (86.6%), one failed attempt seen in a patient with total right brachiocephalic occlusion, and last one had significant recoil with good contrast runoff on angiography, the PTA success rate was demonstrated in Table 2.

Table 1: Locoregional, side and severity distribution of central venous disease in the study sample.

Side	No. (Percent)
Right upper limb	14 (73.6%)
Left upper limb	05 (26.3%)
Total	19 (100%)
Severity of stenosis	
Moderate	01 (3.6%)
Severe	12 (44.4%)
Subtotal occlusion	04 (15%)
Total occlusion	10 (37%)
Total	27 (100%)
Location of lesion	
Axillary	03 (11%)
Subclavian	10 (37%)
Brachiocephalic	10 (37%)
Superior vena cava	02 (7.5%)
Basilic vein	02 (7.5%)
Total	27 (100%)

Table 2: PTA success rate

	No. (%)
Success	13 (86.6%)
Recoil	01 (6.7%)
Failed	01 (6.7%)
Total	15 (100%)

Short-term follow-up one month following PTA session, the majority of the patients 13/15 (86.6%) showing decreased limb swelling with acceptable hemodialysis session time and markedly reduced post-dialysis puncture site bleeding. One patient was subjected to a 2nd PTA session due to restenosis of the Right subclavian vein, using a non-compliance balloon (Atlas™ gold) 14x40mm with good results and 3 months follow-up clinical assessment revealed much improvement of symptoms. Example of our work was depicted in Figure 3.

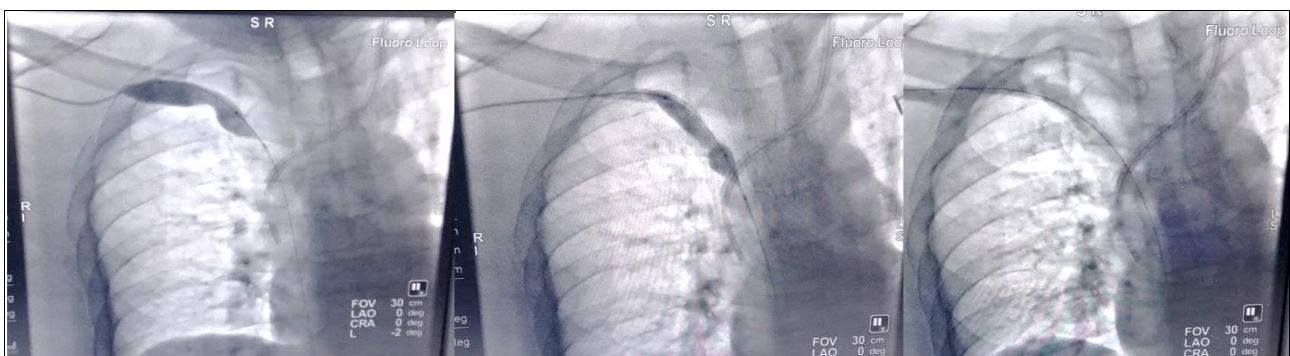


Fig 4: Middle age male with right upper limb swelling, right image showing severe stenosis in RT subclavian vein and similar lesion in RT brachiocephalic vein, LT image showing good flow after PTA

Discussions

Venous hypertension is an important problem for hemodialysis patients that may result in significant limb edema, arteriovenous access malfunction, and may end in

fistula ligation in severe cases [13]. Central venous catheterization increasing the prevalence of central venous disease, particularly which inserted in the subclavian vein, for example, Kundu and Hossny [14, 15] showed that the

incidence of central venous hypertension was dramatically decreased when internal jugular vein catheterization was used instead of subclavian vein.

The dominance of RT upper limb swelling seen in our study was explained that the majority of patients underwent RT sided central tunneled catheter which was used for hemodialysis until the maturation of RT upper limb created fistula, while most of the patients of LT sided swelling gave a history of failed RT upper limb fistula, this was in agree to results showed by Chick JF *et al.* [16]

The most common site of lesion was in the brachiocephalic or subclavian vein and this is in agreement with the study done by Chick JF *et al.* [16] who showed that subclavian and brachiocephalic veins involvement were dominated in the majority of the patients.

The success rate of primary PTA in our study was 86.6% and this is comparable to the study underwent by Yuki Horita [17] which revealed that PTA was successful in 96% in most lesions and 87.8% in chronic subtotal and occluded veins.

Short duration follows up reveals dramatic symptomatic improvement regarding the limb swelling and hemodialysis session duration and good patients satisfaction, one patient had tight stenosis at the Subclavian vein who underwent 2nd session of PTA using non-compliance balloon with good result and short term follow up, these results of patients satisfaction shortly after PTA was in line with these done by Quaretti P [18].

One failed PTA was seen in a patient with total RT brachiocephalic vein occlusion just after the veins confluence despite prolong upper limb trial period and even with a concomitant RT femoral vein approach.

Recommendation

There is a great trend toward prevention of complications occurrence than management of already established complication this is done by a good selection of a patient for arteriovenous fistula establishment, controlling the flow rate through the planned fistula to avoid high flow-related venous wall injury and lastly treating the central venous lesion may accelerate its progression especially when the bare stent was used [19].

Conclusions

Endovascular angioplasty of central venous vascular disease in hemodialysis patient is an efficient, safe, and cost-effective method for management of symptoms related to central venous hypertension and managing the problems related to hemodialysis procedure, it has a high technical success rate and near-zero complications when compared with surgical repair.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Modabber M, Kundu S. Central venous stenosis in haemodialysis patients: An update. *Cardiovasc Intervent Radiol.* 2013;36:898-903.
2. Sprouse LR, 2nd, Lesar CJ, Meier GH, 3rd, Parent FN, Demasi RJ, Gayle RG, *et al.* Percutaneous treatment of

- symptomatic central venous stenosis [corrected] *J Vasc Surg.* 2004;39:578-82.
3. Glanz S, Gordon DH, Lipkowitz GS, Butt KM, Hong J, Sclafani SJ. Axillary and subclavian stenosis: Percutaneous angioplasty. *Radiology.* 1988;168:371-3.
4. Mickley V. Central vein obstruction in vascular access. *Eur J Vasc Endovasc Surg.* 2006;32:439-44.
5. Schwab SJ, Quarles LD, Middleton JP, Cohan RH, Saeed M, Dennis VW. Hemodialysis-associated subclavian vein stenosis. *Kidney Int.* 1988;33:1156-9.
6. MacRae JM, Ahmed A, Johnson N, Levin A, Kiai M. central vein stenosis: a common problem in patients on hemodialysis. *ASAIO J.* 2005;51:77-81.
7. Aytakin C, Boyvat F, Yagmurdu MC, Moray G, Haberal M. Endovascular stent placement in the treatment of up-per extremity central venous obstruction in hemodialysis patients. *Eur J Radiol.* 2004;49:81-5.
8. Surowiec SM, Fegley AJ, Tanski WJ, Sivamurthy N, Illig KA, Lee DE, *et al.* Endovascular management of central venous stenoses in the hemodialysis patient: Results of percutaneous therapy. *VASC Endovascular Surg.* 2004;38:349-54.
9. Bakken AM, Protack CD, Saad WE, Lee DE, Waldman DL, Davies MG. Long-term outcomes of primary angioplasty and primary stenting of central venous stenosis in hemodialysis patients. *J Vasc Surg.* 2007;45:776-83.
10. III. NKF-K/DOQI Clinical Practice Guidelines for Vascular Access: Update 2000. *Am J Kidney Dis.* 2001;37(Suppl 1):S137-81.
11. Uflacker R. *ATLAS of Vascular Anatomy AN Angiographic Approach*, 2nd edition, USA, Lippincott Williams & Wilkins, a Wolters Kluwer business; c2007.
12. Fairchild B, Azizzadah A. The rate of routine venography prior to fistula creation: hemodialysis access; c2016. p. 119-123.
13. Neville RF, Abularrage CJ, White PW, Sidway AN. Venous hypertension associated with arteriovenous haemodialysis access. *Semin Vasc Surg.* 2004;17:50-56.
14. Kundu S. Review of central venous disease in hemodialysis patients. *J Vasc Interv Radiol.* 2010;21:963-968.
15. Hossny A. Brachio basilic arteriovenous fistula: different surgical techniques and their effects on fistula patency and dialysis-related complications. *J Vasc Surg.* 2003;37:821-826.
16. Chick JF, Reddy SN, Yam BL, Kobrin S, Trerotola SO. Institution of a hospital-based central venous access policy for peripheral vein preservation in patients with chronic kidney disease: A 12-year experience. *J Vasc Interv Radiol.* 2017;28:392-397.
17. Horita Y. Percutaneous transluminal angioplasty for central venous stenosis or occlusion in hemodialysis patients. *J Vasc Access.* 2019;20:87-92.
18. Quaretti P, Galli F, Moramarco LP, *et al.* Stent grafts provided superior primary patency for central venous stenosis treatment in comparison with angioplasty and bare metal stent: a retrospective single center study on 70 hemodialysis patients. *Vasc Endovascular Surg.* 2016;50:221-230.
19. Park HS, Choi J, Baik JH. Central venous disease in

hemodialysis patients. *Kidney Research and Clinical Practice*. 2019;38(3):309-317.

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