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ENDOVASCULAR TREATMENT OPTIONS IN CENTRAL VENOUS STENOSIS AND OCCLUSION: ANGIOPLASTY OR STENT?

SANTRAL VENÖZ STENOZ VE OKLÜZYONLARDA ENDOVASKÜLER TEDAVİ SEÇENEKLERİ; ANJİOPLASTİ Mİ, STENT Mİ?

Behlül İgüs[1], Ali Fırat, Hüseyin Yüce Bircan[2]

[1]Baskent University Istanbul Hospital, Department of Radiology, Istanbul

[2]Baskent University Istanbul Hospital Department of General Surgery, Istanbul

Yazışma Adresi / Correspondence:

Behlül İgüs (e-mail: dr.bigus@gmail.com)

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Ankara Yıldırım Beyazıt University Faculty of Medicine

Department of Family Medicine

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Öz

Amaç: Bu çalışmada santral ven darlığı veya tıkanıklığı olan hemodiyaliz hastalarının perkütan transluminal anjiyoplasti (PTA) ve perkütan transluminal stentleme (PTS) ile tedavinin etkinliğini ve patensi oranlarının sonuçları karşılaştırılması amaçlanmıştır.

Materyal ve Metot: Yüz kırk iki santral venöz darlığı veya tıkanması olan 71 kronik hemodiyaliz hasta grubunda (36 erkek, 35 kadın) Mart 2013 ile Haziran 2018 arasında 109 endovasküler girişim uygulandı. Hastaların klinik takibi kontrol venografi ile 1, 3 ve 6. aylarda yapıldı ve asemptomatik hastalarda 6 ay intervallerle kontrollere devam edildi.

Bulgular: Tedavi süresince 45 hastada PTA, 26 hastada PTS işlemi yapıldı. Primer açıklık oranları sırasıyla 3., 6., 12. ve 24. aylarda PTA grubunda; % 97,74, %88,23, % 73,76, % 50,76 ve PTS grubunda; % 96,23, %92,34, %65,96, %47 olarak saptandı. Yardımcı primer açıklık oranları sırasıyla 3., 6. ve12. aylarda PTA grubunda; % 97,73, %90,76, %75,92 ve PTS grubunda; %96,25 %84,38, %79,87 olarak saptandı. Primer ve yardımcı açıklık oranları açısından gruplar arasında istatistiksel olarak anlamlı bir fark bulunmadı (p=0,216, p=0,121). PTS grubundaki ortalama müdahale sayısı (2,62 ± 1,23), PTA grubundan (1,43 ± 0,62) anlamlı derecede yüksekti.

Sonuç: Endovasküler tedavi, santral ven tıkanıklığı tedavisinde güvenli ve etkili bir yöntemdir. PTS, tedavide daha uzun açıklık sağlamamakla birlikte aksine tedaviye daha yüksek ek maliyetler ve damar açıklığını sağlamak için daha fazla girişimler getirmektedir. PTS, anjioplasti dirençli veya sık tekrarlayan lezyonlarda tercih edilmelidir.

Anahtar Kelimeler: Santral ven tıkanıklığı, kronik böbrek yetmezliği, perkütan transluminal anjiyoplasti, perkütan transluminal stentleme.

Abstract

Objectives: The purpose of this study was to compare the patency rate outcomes and efficacy of percutaneous transluminal angioplasty (PTA) versus percutaneous transluminal stenting (PTS) for the treatment of central vein stenosis and occlusion in hemodialysis patients.

Materials and Methods: A total of 71 chronic hemodialysis patients (36 males, 35 females) with 142 events of central venous stenosis or occlusion underwent 109 endovascular interventions between March 2013 and June 2018. The clinical follow-up of the patients was performed with control venography at 1, 3, and 6 months, and then at 6-month intervals for asymptomatic patients.

Results: PTA was applied to 45 patients and PTS to 26 patients during the study period. At 3, 6,12 and 24 months, primary patency rates were 97.74%, 88.23%, 73.76% and 50.76% respectively in the PTA group and 96.23%, 92.34%, 65.96% and 47% in the PTS group. Assisted primary patency at 3, 6, and 12 months was 97.73%, 90.76%, and 75.92% respectively in the PTA group and 96.25%, 84.38%, and 79.87% in the PTS group. No statistically significant difference was determined between the groups in respect of primary and assisted patency rates (p=0.216, p=0.121). The average number of interventions in the PTS group (2.62± 1.23) was significantly higher than that in the PTA group (1.43±0.62).

Conclusion: Endovascular treatment is a safe and effective method in the management of central vein occlusion. PTS does not result in longer patency in the treatment, but conversely incurs greater costs and necessitates more interventions to provide patency. Therefore, PTS should only be preferred for PTA-resistant lesions or concurrent lesions.

Keywords: Central venous obstruction, end-stage renal disease, percutaneous transluminal angioplasty, percutaneous transluminal stenting.

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Introduction

Central vein stenosis and occlusion is a frequently seen issue in hemodialysis patients .[1, 2] The most common predisposing factor in central vein stenosis and occlusion has been reported to be prior central vein catheterization.[3-6] Open surgical treatment and endovascular approach are the two main treatment methods in the management of central venous occlusive diseases. However, exposure of the chest and repair of these deep thoracic veins makes the surgical options more difficult and increases mortality rates, thereby limiting surgical procedures. Therefore endovascular treatment is a prominent method in central vein occlusive disease which offers a less invasive and more comfortable method for the patients compared to open surgical methods. [2] Angioplasty and stent placement are the two main current treatment options in the endovascular approach. The purpose of this study was to compare the patency rate outcomes and efficacy of percutaneous transluminal angioplasty (PTA) versus percutaneous transluminal stenting (PTS) for the treatment of central vein stenosis and occlusion.

Materials and Methods

Patients

Between March 2013 and June 2018, 71 chronic hemodialysis patients (36 males, 35 females) with central venous stenosis or occlusion underwent 109 endovascular interventions in our clinic. The average age of the patients was 58 years (range, 24–83 years). All the patients had suspicious central venous occlusive disease symptoms such as swelling of the face and hand that had undergone ipsilateral upper extremity venography to diagnose the central vein occlusive diseases. The total 109 procedures performed in 142 veins comprised 55 brachiocephalic vein occlusion, 33 brachiocephalic vein stenosis, 29 subclavian vein occlusions, and 25 subclavian stenosis. Patients with >50% stenotic segments were included in the study and stenosis ranged from 70% to 95%. In addition to chronic renal failure, the demographic data and comorbidities were evaluated in both groups (Table 1). The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from our hospital's ethical committee for this study (KA19/270).

Treatment Procedure

The endovascular procedure was started after injection of a local anesthetic to the puncture site of the axillary vein under US guidance and a 7F sheath was deployed. The access site was selected on the same side as a stenotic or occluded vein. All patients were administered 2.500 U heparin at the beginning of the procedure and control venography was performed to demonstrate the stenosis or occlusions (Figure 1A). The procedure continued with the 0.035 guidewire (Terumo, Europa) was passed over the stenotic or occluded segment of

the vein with aid of manipulations of the 5F catheter (Kumpe, Cook) under the road map guidance. If resistance prevented passing the stenotic or occluded segment, the guidewire was exchanged for a stiff guide (Amplatz super Stiff, Boston Scientific) wire to enable better advancement. Balloon angioplasty was performed in the stenotic or occluded segments with balloon diameters ranging from 8 to 18 mm at burst pressures of 5 -18 atm (Figure.1B). The balloon diameter selected was 1-2 mm greater than the adjacent normal vein diameter on venography. The indications for stent placement after PTA were as follows; complete recoil, residual stenosis, presence of collateral veins and recurrent stenosis/occlusions to which two or more interventions were applied in a 2-month period. The stent diameter selected was 1 mm greater than or equal to the diameter of the balloon and stent length was determined by the extent and location of the lesion. Self-expandable Nitolol stents were used, ranging from 8 to 14 mm in diameter and 40–80 mm in length. After the intervention, control venography was performed to demonstrate the adequate venous flow (Figure 1C). Hemostasis was achieved with manual compression (approximately 5-10 min). All patients were discharged after 2 hours of observation in the angiography unit. Technical success was defined as the provision of flow without significant stenosis or the disappearance of collateral veins. The clinical follow-up of the patients was performed with control venography at 1, 3, and 6 months and at 6-month intervals thereafter for asymptomatic patients. If there was a symptom recurrence between these intervals, control venography was also performed. Color Doppler sonography was not used for the follow- up imaging as it is not sufficient for the visualization of central veins and has lower sensitivity than venography in central vein stenosis. Repeat angioplasty procedures were performed in cases with >50% stenosis in all symptomatic and asymptomatic patients.

The primary patency and assisted primary patency rates were evaluated for all the patients in the PTA and PTS groups. Primary patency was defined as the interval between the day of the first intervention to adequate flow in the vein until the occurrence of stenosis or occlusion. Assisted primary patency was defined as patency during the interval between the primary intervention and the time of a subsequent intervention required due to stenosis or occlusion.

Study Outcomes

The primary objective of this study was to assess the technical success of the recanalization of the stenotic/occluded central veins. A secondary aim was to compare the patency rate outcomes of PTA versus PTS.

Statistical Analysis

Data obtained in the study were analyzed statistically using IBM SPSS statistics software version 23 (IBM Corp, USA). Descriptive statistics were reported as mean and standard deviation values for variables with normal distribution and median (minimum-maximum) values for variables not conforming to normal distribution.

Kaplan Meier analysis was applied to evaluate Primary and Assisted patency rates in both the PTA and PTS groups. The Log rank test was used to compare patency rates.

Results

A total of 109 procedures were successfully performed in 71 patients. PTA was performed in 45 patients and during follow-up, 17 patients underwent repeat balloon angioplasty and stents were placed in 7 patients. Of these 7 patients, stents were deployed in 3 patients due to concurrent stenosis and in 4 patients because of elastic recoil. PTS was performed in 26 patients as the initial treatment method because of elastic recoil. In this group, 8 patients underwent several repeat interventions and 3 patients had recurrence occlusion in the patency. There was no significant difference between the PTA and PTS groups in terms of age, gender and comorbid factors (Table1). When the two groups were evaluated together, the most commonly treated vessels were brachiocephalic veins (61. 90%), and subclavian veins (38. 10%). All the patients had ipsilateral functional hemodialysis fistula during the diagnosis of central vein stenosis and/or occlusion. The mean follow-up periods for both groups were 22±11 months. Primary patency rates at 3, 6, 12 and 24 months were 97.74%, 88.23%, 73.76% and 50.76% respectively in the PTA group, and 96.23%, 92.34%, 65.96% and 47% respectively in the PTS group (Figure 2). Assisted primary patency rates in PTA group at 3, 6, and 12 months were 97.73%, 90.76% and 75.92% respectively in the PTA group, and 96.25%, 84.38% and 79.87% respectively in the PTS group (Figure 3). No statistically significant difference was determined between the groups in respect of the primary and assisted patency rates (p=0.216 and p=0.121). The average number of interventions to central veins were 1.43±0.62 for the PTA group and 2.62± 1.23 for the PTS group. No complications requiring hospitalization developed in any patient. Access site hematoma not requiring intervention was observed in 3 cases. There were no periprocedural mortalities. During follow-up, one nitinol stent in a subclavian vein collapsed because of extrinsic compression on the vessel, and in this case, the stent was replaced to ensure vein patency.

Table 1. Patient Demographics

Characteristic	PTA Group (n=45)	PTS Group (n=26)	All Patients (n=71)
Sex, no(%) of patients			
Male	23 (51)	13 (50)	36 (51)
Female	22 (49)	13 (50)	35 (49)
Age, Year			
Mean ± SD	58±13	62±12.74	59±13.47
Range	35-89	40-86	35-89
Comorbidities no(%) of patients			
Hypertension	29 (64.44)	16 (61.53)	45 (63.38)
Coronary Artery Disease	20 (44.44)	12 (46.15)	32 (45)
Hyperlipidemia	33 (73.33)	18 (69.23)	51 (71.83)
Diabetes Mellitus	22 (48.88)	12 (46.15)	34 (47.88)

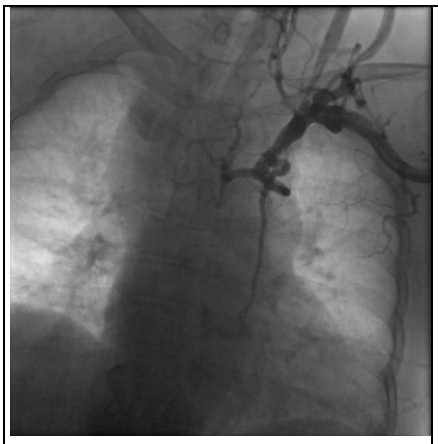

Figure 1A. Venogram image showing complete occlusion of the left brachiocephalic vein and considerable cervical-thoracic collateral circulation.

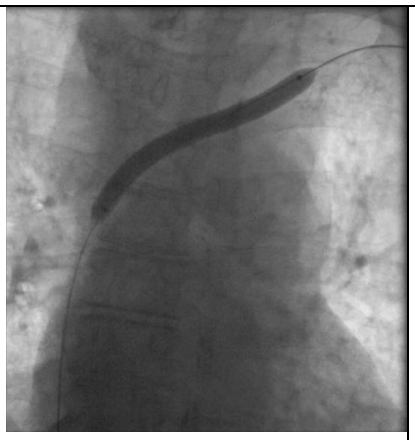

Figure 1B. PTA was performed at the occluded left brachiocephalic vein.

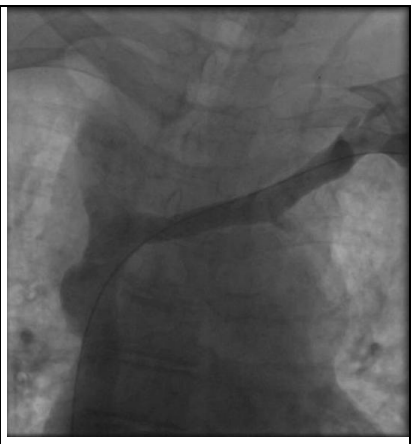

Figure 1C. Venogram image showing normal filling of the left brachiocephalic vein after the procedure.

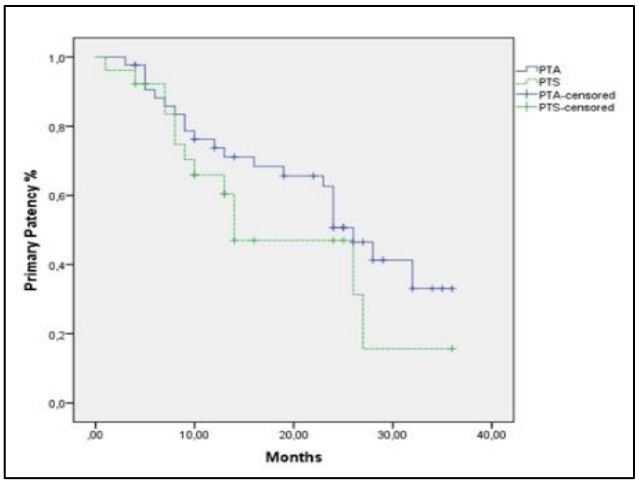

Figure 2. Kaplan-Meir curve showing Primary patency rates of PTA and PTS groups.

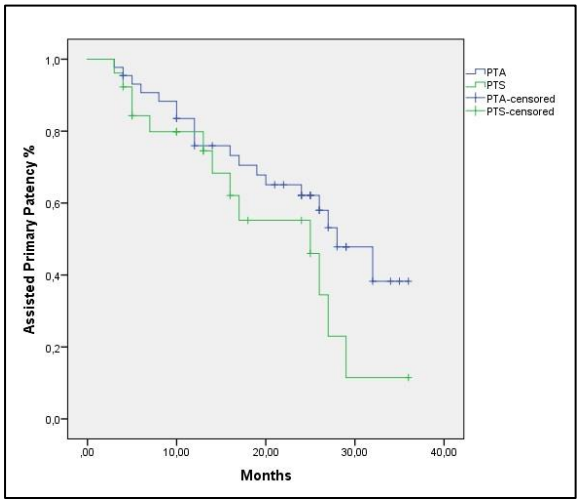

Figure 3. Kaplan-Meir curve showing Assisted primary patency rates of PTA and PTS groups.

Discussion

This study aimed to compare the potency and efficiency of balloon angioplasty and stenting in central vein occlusive diseases. Two main common causes of central venous stenosis and occlusions in dialysis patients have been reported in previous studies; one is a history of subclavian vein catheterization for central venous access and the other is the high-flow state induced by the creation of an arteriovenous shunt, resulting in regions of increased turbulence.[7-10] In the present study, 109 interventions were applied to 71 patients with 142 stenotic or occluded central veins. The primary preferred treatment method was PTA. In cases with a PTA-resistant lesion or frequent concurrent stenosis and occlusions, PTS was performed. In central vein occlusive disease, the open surgical method, which is one of the current treatment options, has been shown to have satisfactory patency rates of 80-85% in 1 year, but also to have significant morbidity rates due to the location of vascular structures in the chest.[11,12] Therefore, endovascular treatment of central venous diseases began to be discussed at the threshold of advances in endovascular treatment towards the mid-1980s .[13] The advantages of the endovascular approach are that it can be performed under local anesthesia, it is more comfortable for the patient and has a shorter hospitalization period when compared to open surgery. In previous studies, endovascular treatment of central venous disease has been reported two main categories; angioplasty with or without stenting after failed angioplasty or due to recurrent stenosis and stenting as the initial therapy. Many articles have been published using primary angioplasty as the initial treatment method in central vein disease, and these have reported primary patency rates ranging from 20% to 77% and assisted patency ranging from 63% to 82%.[14-17] The highest PTA patency rate (The primary and secondary patency rates at 12 months were 77% and 88% respectively) was reported in a study by Ozyer et al. with stenting added to the initial balloon angioplasty procedure to achieve long-term patency as was the procedure in the current study.[17] The main cause of low patency rates in other studies (Nael K et al., Bakken AM et al. and Maya ID et al.) when compared to the results of the current study and the Ozyer et al. study, can be considered to be that stenting was not applied in PTA-resistant lesions. Many researchers have also focused on primary stenting to extend patency due to high recurrence rates with balloon angioplasty in central venous occlusions.

A study conducted by Hagen et al. of 50 patients with central venous diseases, the treatment with wall stents was an evolution in management at that time, and the 1-year patency rate was reported as 56% .[18] There have been many subsequent articles published about the use of wall stents in central venous disease treatment and patency rates have been reported as ranging from 42% to 84% at 6 months but < 31% at 12 months .[19-21] However, in many previous studies, the benefit of stenting on vessel patency has not been well demonstrated. Two studies which compared PTA and PTA with stenting by Quin et al and Bakken at al reported that primary patency rates were equal in each treatment method, as was determined in the current study .[15, 21] In only one article published by Ozyer et al, were primary patency rates reported to be higher in cases treated with balloons instead of primary stenting.[17] In the light of the information in these studies, stenting was applied in the current

study if there was >50% stenosis after initial PTA and recurrent stenosis that required intervention every 1 or 2 months. In our study, we used Nitinol stents in case of stenting. Some studies have shown no difference in patency rates with the use of wall stents and nitinol stents; whereas others have stated that the patency rates of nitinol stent are longer than those of wall stents. A study conducted by Dheeraj K. et al reported 1-year patency of 66. 7% with nitinol stent for central vein occlusion in a small group of patients .[22] In our study, PTS primary patency rates at 6 and 12 months were 92.34 and 65. 96 % respectively. In addition, it has been reported in previous studies that migration and foreshortening is seen with the use of wall stents in central venous segments .[18, 23] Nitinol stents are structured to provide minimum foreshortening .[24] In the current study group, 2 cases of foreshortening were observed but neither required reintervention. Only one stent fracture was observed in a subclavian vein during the follow-up. This complication was thought to have occurred because of the compression between the clavicle and the great vessels. In this patient, a second stent was inserted to provide vessel patency.

A major issue in central vein diseases is frequent recurrent stenosis after treatment. Therefore; the treatment of central venous diseases usually requires more than one intervention. The outcomes of this study showed no significant difference between the PTS and PTA groups in respect of the 12-month primary and assisted primary patency rates. Choosing a stent as a primary intervention does not result in longer patency, but conversely entails additional costs and necessitates more interventions to provide patency. Therefore, PTS should only be preferred in cases with PTA-resistant lesions or frequent concurrent stenosis and occlusions.

Declaration of Conflicting Interests: The authors declare that they have no conflict of interest.

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References

1. Agarwal AK. Central vein stenosis. Am J Kidney Dis. 2013;61(6):1001-15.
2. Osman OO, El-Magzoub A, Elamin S. Prevalence and risk factors of central venous stenosis among prevalent hemodialysispatients, a single center experience. Arab J Nephrol Transpl.2014;7(1):45-47.
3. Surratt RS, Picus D, Hicks ME, Darcy MD,Kleinhoffer M,Jendrisak M. The importance of preoperative evaluation of the subclavian vein in dialysis access planning. AJR Am J Roentgenol 1991;156(3):623-5.
4. Criado E, Marston WA, Jaques PF, Mauro MA, Keagy BA. Proximal venous out flow obstruction in patients with upper extremity arteriovenous dialysis access. Ann Vasc Surg 1994;8:530–5.
5. Maskova J, Komarkova J, Kivanek J, Danes J, Slavíková M. Endovascular treatment of central vein stenoses and/or occlusions in hemodialysispatients. Cardiovasc Intervent Radiol. 2003;26(1):27-30.
6. Oderich GS, Treiman GS, Schneider P, Bhirangi K. Stent placement for treatment of central and peripheral venous obstruction: A long-term multi-institutional experience. J Vasc Surg. 2000;32(4):760-9.
7. Schwab SJ, Quarles LD, Middleton JP, Cohan RH, Saeed M, Dennis VW. Hemodialysis-associated subclavian vein stenosis. Kidney Int 1988;33:1156-9.
8. Vanholder R, Lameire N, Verbanck J, van Rattinghe R, Kunnen M,Ringoir S. Complications of subclavian catheter hemodialysis: a 5 year prospective study in 257 consecutive patients. Int J Artif Organs 1982;5:297-303.
9. Bambauer R, Inniger R, Pirrung KJ, Schiel R, Dahlem R. Complications and side effects associated with large-bore catheters in the subclavian and internal jugular veins. Artif Organs 1994;18:318-21.
10. Dethlefsen SM, Shepro D, D'Amore PA. Comparison of the effects of mechanical stimulation on venous and arterial smooth muscle cells invitro. J Vasc Res 1996;33:405-13.
11. Wisselink W, Money SR, Becker MO, Rice KLi. et al. Comparison of operative reconstruction and percutaneous balloon dilatation for central venous obstruction. Am J Surg 1993;166:200-4.
12. Money S, Bhatia D, Daharamsy S, Mulingtapang R, Shaw D, Ramee S. Comparison of surgical bypass, percutaneous balloon dilatation (PTA),and PTA with stent placement in the treatment of central venous occlusion in the dialysis patient: one year follow-up. Int Angiol 1995;14:176.
13. Glanz S, Gordon D, Butt KM, Hong J, Adamson R, Sclafani SJ. Dialysis access fistulas: treatment of stenoses by transluminal angioplasty. Radiology. 1984;152(3):637-42.
14. Nael K, Kee ST, Solomon H, Katz SG. Endovascular management of central thoracic veno-occlusive diseases in hemodialysis patients: a single institutional experience in 69 consecutive patients. J Vasc Interv Radiol. 2009;20(1):46-51.
15. 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(4):776-83.
16. Maya ID, Saddekni S, Allon M. Treatment of refractory centralvein stenosis in hemodialysis patients with stents. Semin Dial. 2007;20(1):78-82.
17. Ozyer U, Harman A, Yildirim E, Aytekin C, Karakayali F, BoyvatF. Long-term results of angioplasty and stent placement fortreatment of central venous obstruction in 126 hemodialysis patients: a 10-year single-center experience. AJR Am J Roentgenol.2009;193(6):1672-9.
18. Haage P, Vorwerk D, Piroth W, Schuermann K, Guenther RW. Treatment of hemodialysis-related central venous stenosis or occlusion: results of primary Wallstent placement and follow-up in 50 patients. Radiology 1999;212(1):175-80.
19. Oderich GS, Treiman GS, Schneider P, Bhirangi K. Stent placement for treatment of central and peripheral venousobstruction: A long-term multi-institutional experience. J VascSurg 32(4)760–9.
20. Vesely TM, Hovsepian DM, Pilgram TK, Coyne DW, Shenoy S. Upper extremity central venous obstruction in hemodialysis patients: treatment with Wallstents. Radiology 1997;204(2):343-8.
21. Quinn SF, Schuman ES, Demlow TA,et al. Percutaneoustransluminal angioplasty versus endovascular stent placement in the treatment of venous stenoses in patients undergoing hemodialysis: Intermediate results. J Vasc Interv Radiol. 1995;6(6):851-5.

22. Rajan DK1, Saluja JS. Use of Nitinol Stents Following Recanalization of Central Venous Occlusions in Hemodialysis Patients. Cardiovasc Intervent Radiol 2007;30:662–7.
23. Gray RJ, Horton KM, Dolmatch BL, et al. Use of Wallstents for hemodialysis access-related venous stenoses and occlusions untreatable with balloon angioplasty. Radiology. 1995 May;195(2):479-84.
24. Clark TW. Nitinol stents in hemodialysis access. J Vasc Interv Radiol 2004;15:1037–40.