Exploiting Percutaneous Transluminal Angioplasty during the Insertion of Central Venous Catheter for Hemodialysis in Difficult Cases

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ABSTRACT

Objective*: is to present our experience in making benefit of endovascular angioplasty techniques to insert chronic venous catheter (CVC) in hemodialysis patients who suffer obstruction or stenosis of central veins.*
Patient and methods*: Eight patients on regular hemodialysis for long time and have consumed arteriovenous fistulae (AVF) and graft (AVG) were included. All patients strived to have an adequate access for their hemodialysis that either was not possible due to their co-morbidities or obstructed central veins. The earlier made any surgical intervention risky and the latter prevented insertion of CVC. We could recanalize the central veins by balloon angioplasty and be able to insert CVC down to the right atrium in five patients. Two patients have had their CVC inserted through the common femoral vein (CFV) after being dilated by balloon. The remaining patient had been tried in vain crossing the obstruction in both innominate vein and superior vena cava. Consequently, a CVC was inserted into the left CFV.* ***Conclusion:*** *insertion of CVC in patient who consumed all available AVF & AVG particularly in whom repeated insertion and exchange of CVC were done, can be challenging owing to limitation of available veins. In such situation, catheter insertion should be done with all facilities available to perform angioplasty whenever required.*
Key words: *central veins, venous obstruction, balloon angioplasty, endovascular, hemodialysis access, chronic venous catheter*

INTRODUCTION

Guidelines have stipulated recommendations for hemodialysis that it should be offered by arterio-venous fistula (AVF), if possible, in the first place. Patients resort to tunneled central venous catheter (CVC) whenever an AVF or arterio-venous graft (AVG) fail or their construction is unfeasible.[1]

Repeated catheter insertions and exchange end up by two problems. First, the available veins for catheter insertion become occluded. Second, the patient reaches a point where despite of being dialysis dependent, there is no available access. Following catheter insertion, a fibrin sheath starts to build up in as early as the first 24 hours. Sheath is believed to develop partly due to vein trauma during catheter insertion and partly due to thrombosis around the catheter. Both thrombosis and fibrin sheath formation eventually lead to catheter malfunction and occlusion. Not only the catheter is lost and another one is to be inserted, but the recipient vein occludes as well. Dwindling availability of veins limits the chance of further CVC Insertion.[2]

Methods of CVC insertions have evolved from open surgical techniques to the modern realm of endovascular techniques. Inserting a CVC into a vein after its recanalization by percutaneous angioplasty is a renowned method to establish an access.

[3] In this study, we present our experience with that technique in eight disparate patient who have no available access for hemodialysis. They are considered disparate by virtue of failed previous AVF & AVG, and the presence of serious co-morbidity, prevented construction of further one safely. Most if not all those patients had failed at least one trial of inserting even the short-term catheter for bridge dialysis until they can get a long-term one.

PATIENT AND METHODS

Eight end stage renal disease (ESRD) patients necessitating the insertion of CVC for long term hemodialysis were enrolled in this study. Patient were intended to have angioplasty when appropriate to facilitate the CVC insertion. Patient selection depends on two major indications for the insertion of CVC for hemodialysis (HD): either

multiple comorbidities imposed high surgical risk or patients failed all previous arteriovenous fistulae (AVF) or grafts (AVG) or previous insertion of CVC. The latter occluded, became malfunctioning or were infected and removed. Insertion of CVC in such patients deemed to be the only way for continuing dialysis. Among those patients are candidate for angioplasty to shore up the insertion technique:

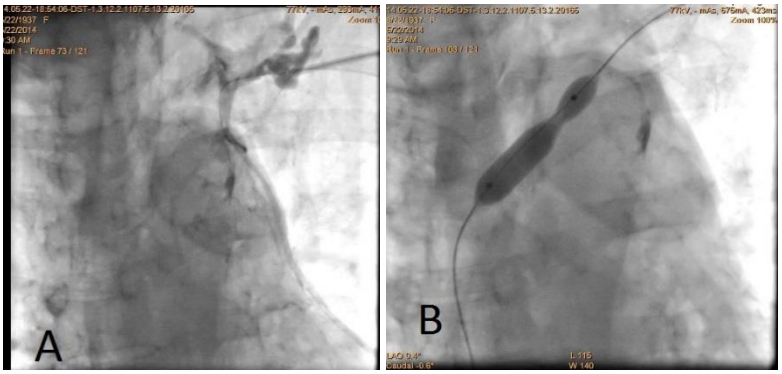
- Long history of multiple catheter insertion for short- or long-term dialysis with scarred primary insertion sites, internal jugular (IJV) and subclavian veins (SCV).
- Failed previous attempt at percutaneous insertion of CVC.
- Presence of clinical suspicion of central venous occlusion (elevated non-pulsating jugular vein, prominent subcutaneous vein over the chest and upper arms, painless non-tender swelling of the face).
- Radiological evidence of central venous obstruction by duplex ultrasound or computer tomography venography (CTV).

All patients were female but one male. The age ranged from 35 to 72 years (average: 63). Catheter insertion was through IJV, SCV and CFV, table (1).

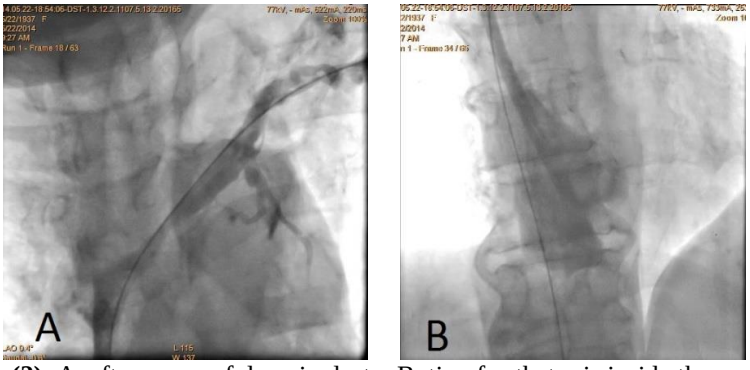
Table (1): CVC insertion sites in all patients

Catheter insertion	*Number of patient*
Lt SCV	2
Rt SCV	1
Rt IJV	2
Lt CFV	3

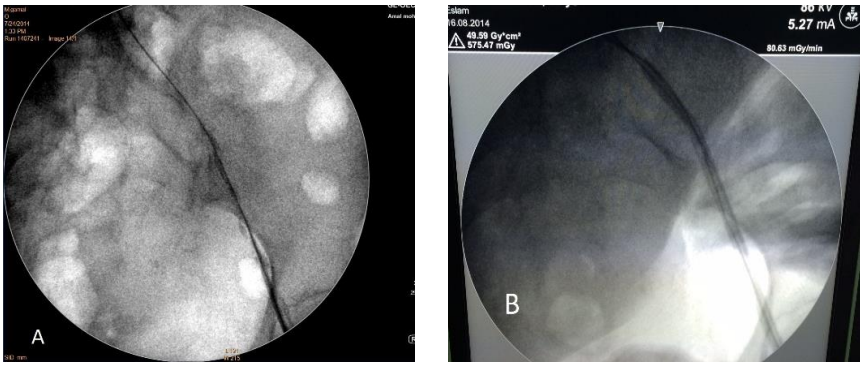
All procedures were done under local infiltration anesthesia. Vein puncture was done by exploiting anatomic landmarks due to unavailability of ultrasound guidance. Full or partial length of standard 11 cm 6F sheath was then inserted, as the circumstances permitted. Venography was obtained by injecting a contrast medium through the inserted sheath (Picture 1 A & 3 A). A 0.035 standard floppy guide wire (Teromu) was used in all patient to negotiate the lesion. After crossing the lesion, balloon angioplasty was done using a balloon of length and size suitable to the vein being treated (picture 1 B & 3 B). No stent was used in any of our patients. Following the successful angioplasty, a check venography was obtained (picture 2,A). The Teromu wire was exchanged by a 0.035 stiff mandrel wire. A peel off sheath was inserted over the wire. A catheter of suitable length was then inserted through the peel off sheath after being tunneled in the subcutaneous tissue. A minimum distance of 2 cm between the Teflon cuff and the catheter exit site was respected. Catheters that were inserted from above (IJV & SCV), their tips reached the upper part of the right atrium (picture 2, B). Whereas, those were inserted though the common femoral vein (CFV) reached the inferior vena cava (IVC) (picture 4). Primary predilection was to the IJV & SCV for inserting the catheters. Whenever we could not pass the obstruction in the more proximal veins (innominate veins and superior vena cava) or IJV & SCV could not be accessed, shift to femoral veins was done. In the latter condition, the catheter was tunneled in the thigh to avoid any sharp curve if lower abdominal tunnel is adopted.



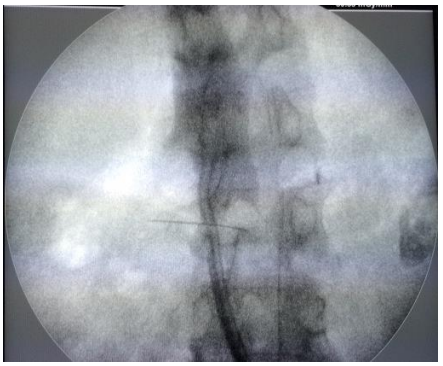
Picture (1): A, venography through a partially inserted sheath into the left SCV depicting obstruction of the left innominate vein. B, during balloon angioplasty using a 12 x 60 mm balloon.



Picture (2): A, after successful angioplasty. B, tip of catheter is inside the upper part of the right atrium.



Picture (3): A, high grade stenosis in the left CFV. B, during balloon angioplasty using an 8 X 100 mm balloon



Picture (4): the tip of catheter inside the IVC

RESULTS

Angioplasty succeeded in five patient to pave the way for insertion of the CVC down to the right atrium, Table (2).

Table (2): cases in whom angioplasty was successful.

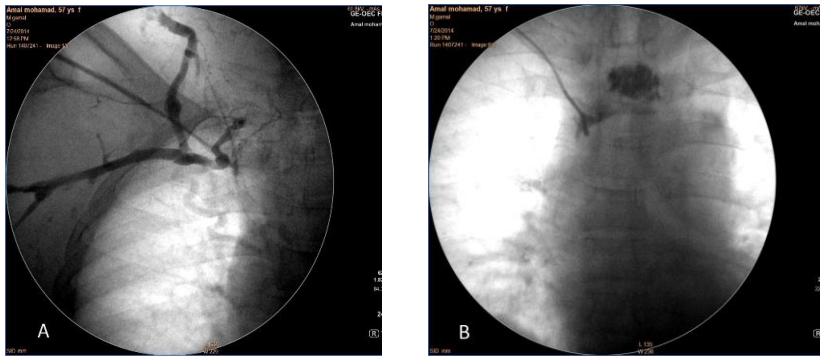
Angioplasty site	*Lesion*	*Procedure*	*Number of patients*
Lt innominate vein	Obstruction	Balloon angioplasty	2
Rt innominate vein	Obstruction	Balloon angioplasty	2
Rt innominate vein	Stenosis	Balloon angioplasty	1

In three cases, we started by the chest veins. We could not cross the lesions there, table (3). We moved to the CFV. The right CFV was not accessible at all in one and right groin infection in another patient forced us to move to the left CFV. In both patient, we found the left ilio-femoral segment stenosed. After successful angioplasty, a catheter of suitable length was inserted into the inferior vena cava after being tunneled in the thigh. Both CFV were pristine in the remaining 35 years old patient. The left CFV was accessed. A trial to pass the obstruction (both innominate and superior vena cava) in chest veins from the femoral access failed, Picture (7). We opted to use the left CFV for access and insertion of the catheter and spared the right ilio-femoral system for a future kidney transplantation if feasible.

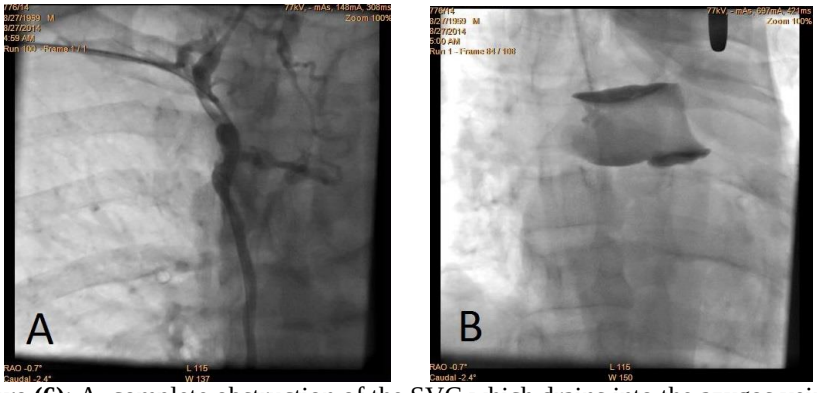
Table (3): cases who were offered CVC through femoral veins.

Site of lesion	*No. of patients*	*Primary access*	*Angioplasty site*	*Final insertion*
Both innominate veins obstruction + left ilio-femoral segment stenosis	2	Both IJV & SCV	Left ilio-femoral segment	Through the left femoral vein
Both innominate veins	1	Both IJV & SCV	Non	Through virgin left CFV

Two cases developed insignificant extravasation in the chest outside the pericardium during insertion of the access sheath and resolved without dread consequences, picture (5) & (6).

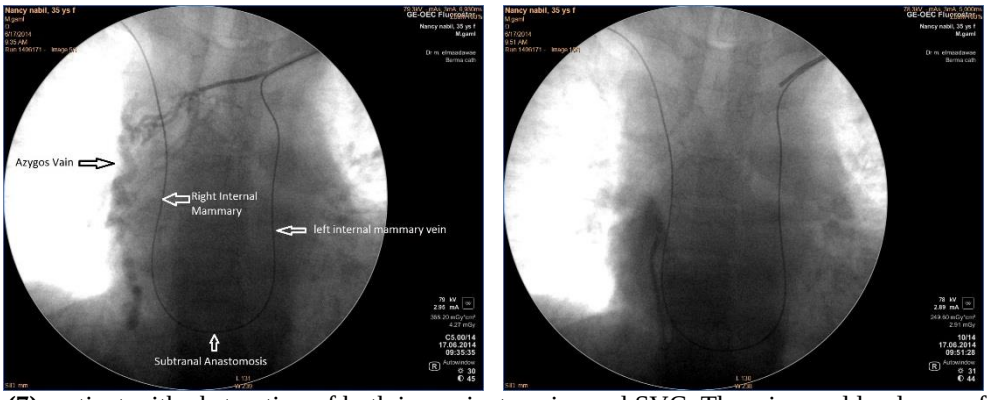


Picture (5): A, depicting the obstruction and B, the site of extravasation



Picture (6): A, complete obstruction of the SVC which drains into the azygos vein and B, perforation outside the pericardium, same patient in A.

A case developed ventricular tachycardia twice as the wire moves far in the right atrium. Both events resolved instantaneously upon wire recession.



Picture (7): patient with obstruction of both innominate veins and SVC. The wire could only pass from the left to the right internal mammary vein through the substernal anastomosis. Note the opacification of the azygos vein. A trial from her left CFV filed to cross the lesion and finally the patient was offered a CVC through her left CFV.

DISCUSSION

In the United States more than 70% of ESRD patients commence their dialysis by tunneled central venous catheter (CVC).[4]

In all ESRD patient about 21% have tunneled CVC for their dialysis. [5]

Patients who failed their multiple AVF & AVG turn to be candidate for CVC insertion. Multiple insertions and/or exchange of CVC ends up by having ESRD patients with no available access. Thrombosis (up to 60%) and fibrin sheath (75%)[6] formation convene to foil a functioning indwelling catheter. The latter begins to develop 24 hours after any catheter insertion even into a periphery vein [7,8]

Fibrin sheath can cover the entire length of a catheter in 5 to 7 days.[9] In our practice peritoneal catheter effectiveness is blemished by the frequent clogging, infection and development of peritoneal adhesions limiting the surface available for solute exchange. In no uncertain terms, patients in a such condition would succumb if access cannot be established. A number of alternative access can be provided e.g femoral vein, direct trans-lumber, trans-hepatic and even collateral venous channels such as the intercostals, azygos and hemiazygos veins.[10,11]

No matter how the catheter reaches its final destination into the right atrium or inferior vena cava so long the access is safe to perform and can be better done under local anesthesia. In addition to changing the access vein for insertion of CVC, recanalization of the central veins by means of percutaneous transluminal angioplasty whenever, possible can solve the problem and provide the patient with additional period of convenient hemodialysis.[12]

A more aggressive alternative comprises a jumble of techniques that proved effective but requires both diligent skills and great zeal of the operator. Ferral et al succeeded in inserting a needle into a patent central vein bypassing occlusion in the SCV and IJV in six patient. In a case report, Murphy and his colleagues presented a case of SCV occlusion which was recanalized using a Rosch-Uchida needle.[13]

The outback catheter which renowned as reentry device in chronic total arterial occlusion was reported to succeed in crossing obstruction of SCV. Our patients were given the chance of insertion of CVC after recanalization of their central veins by means of angioplasty. Due to absence of dialysis for several days and their co-morbidities; open surgical intervention was not possible. Also, the adoption of any of the sharp methods for recanalization which carry the potential risk of complication was not considered. Therefore, the chance of inserting a well-functioning CVC represented a new lifeline for those patients. Angioplasty was able to recanalize the central veins in five patients (Lt

innominate vein in two, Rt innominate vein in three). Although we failed to cross the lesion in three cases (occluded SVC and both innominate veins) our effort had not gone in vain. The information gained through the direct venography succeeded in directing the subsequent insertion into a suitable vein. We did not put a stent in any of our cases. All patients did not suffer the venous obstruction they have and their problem was only the lack of access for hemodialysis. This was in accordance to what Heller et al wrote. They stated that stents should not be placed and angioplasty alone would be sufficient especially in whom the venous obstruction is asymptomatic.[14] Insertion of CVC through the femoral access is not preferred owing to the high rate of infection, which is encountered more frequently whenever the catheter exit site is close to the groin.[15]

In a consort to the Heller el al, we were obliged to insert the CVC through the CFV in three case. Two cases had successful angioplasty to the ilio-femoral segment prior to catheter insertion. In the remaining case, the left CFV was opted to be accessed . After failure to cross an obstruction in the superior vena cava from the femoral access, the CVC was inserted through the left CFV. We spared the right ilio-femoral system in this young woman (35 years) for a future kidney transplantation if feasible. Heller et al assert placement of CVC through the CFV if there is no any other alternative one.[11]

We encountered two incidents of perforation, one happened during the sheath insertion into the right IJV and the other was during negotiation of obstruction in the right innominate vein. Both cases have done well and necessitated no further action. A frequent such complication happens during percutaneous angioplasty due to minor venous rupture and invariably heals spontaneously. In contrast, large venous rupture may require prolonged inflation of a suitable balloon or the insertion of stent graft.

In conclusion, insertion of CVC in patients who consumed all available AVF & AVG particularly in whom repeated insertion and exchange of CVC were done, can be challenging owing to limitation of available veins. In such situation, catheter insertion should be done with all facilities available to perform angioplasty whenever required.

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