Subclavian vein dialysis access catheter– complications are low

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ABSTRACT

Internal jugular vein has been recommended as the vascular access for haemodialysis because it is associated with less thrombotic/stenotic complication. Despite this recommendation, subclavian vein access is still being frequently used. This paper aims at reviewing the rate of complications associated with temporary double lumen subclavian vein dialysis access catheter in a personal series. It is a prospective observational study. Patients undergoing haemodialysis through a temporary double lumen subclavian catheter, all inserted by author, in the haemodialysis unit of B and B Hospital, have been included. Catheters inserted into the internal jugular vein or femoral vein have been excluded. Catheter was inserted by Seldinger technique and a chest X-ray was routinely obtained after the insertion. Patients were observed and followed up prospectively for the possible mechanical, infective and thrombotic complications at the time of catheter insertion and into each subsequent dialysis visit that ranged from 2 weeks to four and half months when the catheter was removed or replaced by native arteriovenous fistula. During the last five and half year (Jan 2004 to July 2009), a total of 203 suvclavian vein catheters were inserted into 105 males and 98 females. The mean age was 53 years (range from 18 to 80 years) and most of the patients had catheters for chronic renal failure (95.0%). Insertion related complications in the form of arterial puncture (3.0%), inability to cannulate on the right side (2.0%) and both right and left side (1.0%), malposition (3.0%), pneumothorax (0.5%) and accidental removal of catheter (0.5%) were noted. Similarly, 6.0% catheter related infection, 2.0% thrombosis/stenosis and 6.0% catheter malfunction were observed. Fortunately, there was no catheter related mortality. These complications appear quite low and well comparable to internal jugular vein access as reported in the literature. The most quoted evidence of symptomatic subclavian vein thrombosis/stenosis is lower in Nepalese patients. Hence, subclavian vein access may be recommended as a safe alternative access for haemodialysis.

Keywords: Haemodialysis, subclavian vein access, central venous catheter, complication, thrombosis.

INTRODUCTION

Haemodialysis requires a reliable and recurrent access to the systemic circulation that can be achieved via arteriovenous fistula (AVF), arteriovenous graft (AVG) or central vein catheter (CVC).[1] Though the clinical practice guideline of the National Kidney Foundation's Dialysis Outcome Quality Initiative (NK-F/DOQI) recommends the use of AVF or AVG over the CVC,[2] nearly two thirds of incident haemodialysis patients use CVC at the time of initiation of haemodialysis compared to fewer than 15.0% of AVF.[3] Even at our institution, 89.0% of incident haemodialysis patients started dialysis via CVC.[4] The use of CVC becomes mandatory in these situations. A CVC can be inserted easily at bed side and is ready for use immediately after insertion. It was commonly inserted into subclavian vein (SCV), however, citing a high thrombotic and/or stenotic complication rate for SCV access that might preclude future AVF creation on that arm, internal jugular vein (IJV) access has been recommended.[1,5] However, there are definite advantages of the SCV access. The catheter care is easy, patient's neck mobility is not restricted and the dressing is well hidden under the garments. This author has been using SCV access exclusively for the last five and half year. This paper aims at describing the complication rate for temporary double lumen SCV dialysis access CVC in a personal series.

MATERIALS AND METHODS

This is a prospective observational study, carried out at B and B Hospital for the last five and half year (Jan 2004 to July 2009). Patients with acute or chronic renal failure, referred to dialysis unit who required temporary dialysis CVC, were included in this study. All CVCs were inserted into the SCV by the author. Catheters inserted elsewhere or into the IJV and femoral veins were excluded.

CVC was inserted on the right side, infraclavicularly, by the Seldinger technique under local anaesthesia without using an electrocardiographic monitor. A chest X- ray was always obtained following the catheter insertion. Insertion related complications were recorded

and patient followed up for other possible complications in each subsequent dialysis visit. Patients were discharged after the dialysis session except in those cases that had acute renal failure.

Catheter malposition was immediately corrected, failure to cannulate on the right side was attempted to the left and catheter exit site was dry dressed. Catheter was removed and replaced to the opposite side once there was diffuse respective upper extremity swelling, persistent fever suspected to be of catheter in origin and gross exit site infection. Catheter related infection was further treated by systemic intravenous antibiotic. Catheter tip culture was requested only in those suspected cases of catheter related infection. Finally, patients with chronic renal failure were counseled for creation of AVF, which replaced the existing catheter.

RESULTS

During the last five and half year, a total of 203 temporary double lumen SCV dialysis access CVCs were inserted at B and B Hospital. There were 105 males and 98 females with the mean age of 53 years (range from 18 to 80 years). Twenty one patients (10.0%) required reinsertion into the opposite side due to the catheter related infection or malfunction. Hundred ninety two catheters (94.0%) were inserted for chronic renal failure while 11 (5.0%) had catheters for acute renal failure, 4 each for crush syndrome and prerenal azotemia and 3 for obstructive uropathy.

Insertion related complications in the form of arterial puncture (3.0%), inability to cannulate on the right side (2.0%) and both right and left side (1.0%), malposition (3.0%), pneumothorax (1.0%) and accidental removal of catheter (0.5%) were noted. The pneumothorax was not significant, both radiologically and clinically, hence patient required overnight observation only. Clinical evidence of SCV thrombosis in the form of ipsilateral upper extremity swelling was noted in 4 (2.0%) catheters; of them two were confirmed by Doppler ultrasound. Swelling of the extremity resolved completely after removal of the catheter. Catheter related infection was suspected in 6.0% of catheters and proven by culture and sensitivity in 2.0% only; all after one month of insertion, of them 2 had gross exit site infection and further 2 had sepsis. Catheter malfunction in the form of single lumen block were seen in 6.0%, of them 3 functioned after a few centimeter withdrawal of catheter length and 9 required replacement to the opposite side. There was no catheter related mortality.

The average length of catheter in use was 5 weeks with the range from 1 week to 4 months.

Table-1: Showing thrombotic and stenotic complications of SCV and IJV access in different series

Thrombotic and stenotic complications	%	%
Author (Ref)	SCV	IJV
Schwab *et al*[1]	42-50	0-10
Wilkin *et al*[25]		25.9
Vanholder *et al*[11]	0	
Bourkuia *et al*[13]	3	
Vanherweghem *et al*[19]	2.5	
Present series	2	

DISCUSSION

CVC is being used worldwide as the temporary haemodialysis vascular access.[5] According to Dialysis outcome and patient pattern study (DOPPS), only 25.0% patients in Europe and 46.0% in the United States arrive at the first dialysis session with a permanent vascular access.[6] Another study reports that nearly two thirds of incident dialysis patients start their haemodialysis via dialysis catheters.[3] These catheters are of two types: acute or temporary catheters and chronic or permanent catheters. Most of the temporary catheters are non cuffed, non tunneled, double lumen catheters composed of polyurethane which is strong and stiff at room temperature that facilitates its insertion but softens at body temperature.[7] Femoral catheters are used rarely in patients with a high risk of bleeding and cardiorespiratory problems especially in bed bound patients. Right IJV access has been preferred to SCV access recently because of higher reported incidence of SCV thrombosis or stenosis that might preclude future AVF creation in that arm.[1,5]

During the last five and half year, SCV has been used exclusively as the dialysis vascular access at our hospital. SCV access is simple, post insertion catheter care is easy, and dressing is hidden under the garment which is more cosmetic. Free neck mobility after SCV access makes patient more comfortable as compared to IJV access.

Dialysis vascular access related complications may be divided into mechanical, infective and thrombotic or stenotic groups. Mechanical complications include arterial puncture, malposition, local haematoma, pneumothorax, haemothorax, air embolism, arrhythmias, accidental removal and failure of catheterization. Similarly other mechanical complications are vessel perforation, atrial perforation and catheter malfunctions.

Mechanical complications tend to decrease along with the increasing experience of the operator. Even in the hands of experienced surgeons, complication rate as high

as 5.9% has been reported.[8] Ultrasound assisted insertion (UAI) has been found to have decreased insertion related complications especially in IJV access. Denys *et al*[9] evaluated UAI of IJV access over the external landmark technique in 302 patients. UAI had 100% successful cannulation as compared to 88.1% in the landmark group. The vein was punctured on the first attempt in 78.0% of UAI group compared to 38.0% of landmark group. Insertion related complications were also substantially lower in the UAI group.

Arteries are commonly punctured during the catheterization but the event is usually self limiting. The incidence is more frequent to IJV access than SCV, being 6.0% and 0.5-4.0% respectively.[10] Of them, nearly 30.0% may become symptomatic in the form of local haematoma, haemothorax and neurologic deficits.[7,10] Most of these punctures and injuries occur due to a poor technique, kinking of the guide wire and unsafe use of dilators which should only be used to dilate the skin and subcutaneous tissue. Author always likes to confirm the status of the guide wire by moving it in and out smoothly while using the dilator. Six arterial punctures (3.0%) in this series favors very well with the literature. The initial arterial hit may be due to the overangulation of the needle, which should be inserted as superficial as possible with minimal angle under the clavicle, a step that can be facilitated by putting a pillow under the interscapular region.

Malposition of CVC has been associated with problems of local toxicity, perforation and venous thrombosis.[10] Overall; the incidence is higher for SCV as compared to IJV.[10] SCV catheter may be malpositioned into the ipsilateral IJV, contralateral SCV and right atrium. In a series of 394 SCV dialysis catheters, 6 cases had malposition while the incidence is not reported or none in other series.[7,11-13] Malposition may cause either catheter malfunction or injury to the corresponding vessel especially if it is in the right atrium. Six cases of malposition (3.0%), 2 each into the ipsilateral IJV, contralateral SCV and right atrium were noted in this series and corrected immediately.

Pneumothorax is one of the most common complications of CVC insertion and the incidence varies from 1 to 3.0% for dialysis access catheters.[7] The incidence is higher in SCV (0-2%) catheterization as compared to IJV.[10, 11-13] A case of pneumothorax, in this series, detected on routine chest X-ray was not significant and required overnight observation only.

Air embolism that may have a mortality rate from 23.0-50.0% has the incidence of 0 to 1.3% and can occur during the time of insertion, exchange and/or removal of the catheter.[7,10] It was fortunate to have no air embolism in this series but author always feared of this potentially lethal complication.

Since the CVC was inserted without a cardiac monitor in this series, the actual incidence of dysrhythmias could not be reported. However, there were no symptomatic events. Dysrhythmias though occur fairly often with CVC, are usually asymptomatic.[10] However, there is always a risk of complete heart block and even sudden death while inserting the guidewire.[10]

One catheter in this series was accidentally removed during the night in a patient who was restless and had acute renal failure. He lost nearly 200 ml blood.

Catheter malfunction is defined as a failure to attain and maintain an extracorporeal blood flow sufficient to perform haemodialysis without significantly lengthening the haemodialysis treatment. Early malfunction is due to the malposition of the catheter tip or subcutaneous kinking of catheter while the late malfunction is usually due to thrombosis.[1] A partial or complete catheter malfunction is reported to occur in 30.0-60.0% of haemodialysis catheters.[14] If there is either an inflow or outflow malfunction, author withdraws the catheter by one or two centimeters so that the tip lying against the wall or the thrombus at the tip will get dislodged and catheter starts functioning. If this maneuver fails to correct malfunction, the catheter is either exchanged over a guidewire or replaced into the opposite side. Of the 12 (6.0%) catheters malfunction in this series, 3 functioned after withdrawal of catheters, 9 required replacements into the opposite site. Other measures described to treat catheter malfunction are local thrombolysis and fibrin sheath stripping by using dormia basketing.[15]

It was not possible to catheterize both SCV and IJV in one patient who was extremely obese. Subsequently, femoral vein catheter was inserted and dialysis performed. Similarly in 4 patients, catheterization was failed on the right side that required insertion into the left SCV. Inability to catheterize the innominate vein may reach as high as 16.5%, which may be due to a poor technique, anatomic variation and gross puncture site oedema or obesity of the patient.[12]

Dialysis access CVC related infection is a serious complication and has become the most common cause of morbidity and second most common cause of mortality in haemodialysis patients.[1,5] Vascular access site accounts for more than 70.0% of bacteremia, of them, 48.0-73.0% are due to the use of dialysis catheters.[16,17] The rate of infection has been found higher for temporary catheters because they are neither cuffed nor tunneled.[7] The reported incidence of catheter exit

site infection, catheter related bacteremia and distant site infection is 10.0%, 9.0% and 1.6% respectively.[7] For IJV, the incidence is 5.4% after 3 weeks and rose to 10.3% after 4 weeks of catheter insertion.[18] For SCV, in a series of 200 cases 17 had catheter related bacteremia,[19] in 302 catheters 7 had sepsis,[20] and in another 394 catheters 9 had sepsis.[11] In contrary, out of 605 SCV catheters, early infection rate of 15.0% and delayed infection rate of 39.0% was reported.[12] The most commonly isolated organisms are staphylococcus aureus and staphylococcal epidermidis.[15] In another report of 123 cases of catheter related bacteremia: nearly 85.0% had gram positive cocci, 33.0% gram negative organisms, 2.0% had acid fast organisms and 17.0% had polymicrobial infection.[21]Catheter related infections increase over the time in an exponential fashion for temporary catheters.[7] For non dialysis CVCs, the SCV access has been considered as a better route than IJV for preventing infection.[10] National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF-K/DOQI) guideline recommends limiting the temporary catheter use in IJV for 3 weeks and in femoral vein for 1 week[2] however, in clinical practice these catheters have been used for a longer period of time, even for months or years without serious complications.[22] In the presence of infection, the catheter is removed and appropriate intravenous antibiotic is used.[7] Use of povidone iodine or mupirocin ointment along with dry gauge dressing at the site of catheter exit, has been found to be effective in reducing the catheter related bacteremia.[23,24] The incidence of catheter related infection in this series was 4.0% (8 out of 203 patients), of them, only 4 were culture positive, required removal of catheter and systemic antibiotic.

SCV access has been reported to have the long term complication as thrombosis or stenosis in the range of 42.0-50.0% as compared to 0 to 10.0% for IJV access.[1] This has become the most frequently cited evidence against the SCV access. In the contrary, only a few studies have attempted to report the prevalence of thrombosis or stenosis in the IJV. A recent study reported higher rate (25.9%) of right IJV thrombosis.[25] On the other hand, the incidence of SCV thrombosis or stenosis is not always high (Table-1). In a report of 394 single lumen SCV catheters, there was not a case of SCV thrombosis but 2 cases of vena caval thrombosis.[11] Similarly, in another 164 SCV catheters, only 5 cases had clinical evidence of thrombosis that was confirmed later by venography.[13] In another review of 200 SCV catheters, 5 cases had SCV thrombosis.[19]In the present series, the clinical evidence of thrombosis was noted in 4 (2.0%) cases, of them 2 were confirmed by Doppler ultrasound. This may not mean that the incidence is low, because routine Doppler or venography of each access vein was not used after insertion that can document the true incidence of thrombosis/stenosis. This is one of the major limitation of the present study.

The central venous obstruction may remain asymptomatic because of extensive venous collaterals formation. However, in case of SCV or innominate vein thrombosis or stenosis, when an arteriovenous fistula is created distal to the obstruction, the collateral transport capacity may be overloaded, that can cause subsequent arm swelling and puncture site bleeding during the dialysis.[15] In addition, SCV obstruction has been reported to be associated with failure or loss of distal arteriovenous fistula. In a series of 302 SCV catheters, 5 of 44 AVF created had vein stenosis, of them 3 fistulas failed.[20]It is difficult to estimate whether the failure is due purely to vein stenosis or other confounding factors unless the evidence comes from a good control study.

There are few limitations to the present study. Firstly, it is a personal series, whether the results are reproducible or not may be argued. Secondly, this is not a case controlled study, so the evidence obtained is not strong. Lastly, the diagnosis of venous thrombosis/stenosis in this series is primarily clinical; only 4 cases were proven by Doppler study.

Complications of SCV dialysis access CVC in this series appear quite low and well comparable to IJV access as reported in the literature. The most quoted evidence of symptomatic SCV thrombosis/stenosis is lower in Nepalese patients. Hence, SCV access may be recommended as a safe alternative access for haemodialysis.

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