ORIGINAL ARTICLE

Outcome of Radiologically Placed Tunneled Haemodialysis Catheters

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ABSTRACT

Objective: To study the outcome of radiologically placed double lumen tunneled haemodialysis catheters for the management of renal failure.

Study Design: Case series.

Place and Duration of Study: Interventional Suite of Radiology Department at the Aga Khan University Hospital, Karachi, from April 2010 to June 2011.

Methodology: All consecutive patients who were referred to the department of radiology by the nephrologists for double lumen tunneled haemodialysis catheter (Permacath) placement during the study period were included. Patients with septicemia, those for whom follow-up was not available, those coming for catheter exchange or who died due to a non-catheter related condition were excluded. A radio-opaque, soft silicone double lumen catheter was inserted through a subcutaneous tunnel created over the anterior chest wall. The catheter tip was placed in the right atrium via the internal jugular vein. Ultrasound guidance was used for initial venous puncture. The rest of the procedure was carried out under fluoroscopic guidance. Technical success, catheter related bacteremia rates, adequacy of dialysis, patency, and adverse events were analyzed.

Results: Overall 88 tunneled haemodialysis catheters were placed in 87 patients. Patients were followed-up for duration of 1 – 307 days with mean follow-up period of 4 months. Immediate technical success was 100%. The procedural complication rate was 5.6% (5 catheters). Eight patients died during the study period, seven from causes unrelated to the procedure. One patient died due to septicemia secondary to catheter related infection. Of the remaining 69 patients, 50 (72.4%) predominantly had uneventful course during the study period. Twelve patients developed infection (17.3%); two were successfully treated conservatively while in 10 patients catheter had to be removed. Seven catheters (10.1%) failed due to mechanical problems. In 3 patients the internal jugular veins got partially thrombosed. One catheter was accidentally damaged in the ward and had to be removed.

Conclusion: Radiological guided tunneled haemodialysis catheter placements are a safe and reasonable means of providing temporary vascular access for haemodialysis patients.

Key Words: *Haemodialysis. Arteriovenous fistula. Permacath.*

INTRODUCTION

Arteriovenous fistulae are the standard vascular access channels for haemodialysis treatment.[1] The dialysis outcome quality initiative (DOQI) guidelines for vascular access recommend that long-term access in the form of dialysis catheters should be less than 10%.[2] However, dialysis catheters still form an important part in the management of renal failure patients.[3] Tunneled type of haemodialysis catheters are widely used as a bridge between the creation and maturation of a dialysis arteriovenous fistula or graft, as these catheters can be used for a relatively longer duration.[4-6]

Permacath (Medcomp) is a tunneled type of double-lumen silicone dialysis catheter which is widely used for dialysis purposes. It is mostly inserted via the internal jugular vein (IJV), since subclavian route is associated with a high incidence of central venous thrombosis.[7,8] The catheters are now routinely placed by interventional radiologists with satisfactory outcome. No data has been published from Pakistan regarding the placement of tunneled catheters by radiologists.

The object of the study was to determine the outcome of radiologically placed double lumen tunneled haemodialysis catheters for the management of renal failure, in terms of initial success rate, bacteremia rates, adequacy of dialysis, patency of the catheter, and adverse events.

METHODOLOGY

This descriptive study was carried out at the Interventional Radiology Section of the Aga Khan University Hospital, Karachi, Pakistan. Data was reviewed for a period of 15 months from April 2010 to June 2011. All patients who were referred to the department of radiology for Permacath placement during the study period were included in the study.

Data regarding demographics, indication for catheter placement, insertion site, success rate and compli-

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Figure 1: Tunneled catheter can be seen with tip in right atrium. The point of insertion is below clavicle as compared to non-tunneled catheter which enters into the vein directly.

cations of the procedure as well as the catheter patency duration and infection rates were obtained from the medical records. Telephonic follow-up was obtained from the patients who were undergoing dialysis outside the institute or were not following-up with institutional nephrologists. Patient death or loss to follow-up was recorded.

Technical success was described as the ability to successfully insert the catheters and position it appropriately. Procedural complications included those which occurred during the procedure, for example: pneumothorax, air embolism, bleeding etc. Delayed complications include infection, catheter malfunction, and venous thrombosis which could result in catheter removal. Catheter patency duration was taken as the time duration from the placement to removal due to any reason.

Permacath is a radio-opaque, soft silicone double lumen catheter with internal diameter ranging from 12.5 to 14.5 Fr. The standard catheter used was 36 cm in length designed for placement in distal superior vena cava and right atrium mostly via internal jugular vein after creation of a subcutaneous tunnel (Figure 1).

All the catheter insertions were performed by trained interventional radiologists with 1-15 years of experience in interventional radiology and catheter placement. The procedures were carried out in an interventional radiology suite equipped with angiographic machine Siemens Axiom Artis and an ultrasound machine having a 7-MHz high frequency linear array transducer, attached to it.

The patients were evaluated before the procedure. Platelet count and coagulation profile was checked. Platelet count above 7500 per μL and INR of less than 1.5 was required for the procedure. Note was made of any allergies and prior catheter or central line placement. All the procedures were performed under local anaesthesia. In only a few patients, conscious sedation was given. General anaesthesia was not given in any of the patients.

Informed consent was obtained in all cases. Pulse oximetry, blood pressure and cardiac monitoring were performed during the procedure. The patients were prepped and draped using standard surgical techniques. Local anaesthesia was given in the form of 2% Xylocaine in the supraclavicular region at the site of venous puncture, and Xylocaine 1% with Adrenaline (Epinephrine) 1:200,000 was given over the anterior chest wall in the region of planned tunnel. The internal jugular vein was accessed with an 18-gauge needle under ultrasound guidance and later a regular 0.038-inch J-shaped guide wire was advanced into the inferior vena cava under fluoroscopic guidance. During this time the patients were monitored for arrhythmias. Over the guide wire, the tract was serially dilated under fluoroscopic guidance and a peel-away sheath (a 14 or 16 Fr sheath for 12.5 Fr and 14.5 Fr catheters, respectively) was inserted.

Under local anaesthesia, a subcutaneous tract was created over the anterior chest wall using a tunnel. Through this tract, the catheter was pulled out with the help of the tunneler and introduced into the right atrium or superior vena cava via peel away sheath. The Dacron felt cuff was placed at least one cm inside from the exit site of the subcutaneous tract, to anchor the catheter in the tunnel by the growth of fibrous tissue.[10] The position of tip of the catheter was verified fluoroscopically. Both ports were checked for flow using a 20 cc syringe. The lumens of catheter were then flushed with heparinized saline solution and sterile caps were fitted. Externally the catheter was anchored to skin with prolene sutures. A chest X-ray was taken at the end of the procedure to document the final position of the catheter as well as to look for complications like pneumothorax.

When required, catheter removal was carried out in the interventional radiology suite. After taking aseptic measures and given Xylocaine 2% for local anaesthesia, the catheter cuff was dissected free from the subcutaneous tissues and the catheter was gently pulled out. At the time of catheter removal, the reason for the removal and any delayed complications were recorded. The data was analyzed in Statistical Package for Social Sciences (SPSS) software. Frequency and percentage was given for categorical variables. Mean and Standard deviation was given for continuous variables.

RESULTS

During the study period, 88 catheters were placed in 87 patients. Forty four were females and 43 males. Mean age was 55.6 years ranging from 21 to 83 years. Indications for placement of the Permacath dialysis catheter system included: end-stage renal failure in 64

patients and acute renal failure in 13 patients. Patients were followed-up for duration of 1 – 307 days with a mean follow-up period of 4 months.

The catheters were placed in patients awaiting maturation of surgical arteriovenous access in 45 (51%), failure of access for surgical arteriovenous fistula in 17 (19%), new requirement for haemodialysis in 14 cases (16%) and replacement of a previously placed Jo-cath in 11 cases (12%).

In 87 patients, 88 catheters were placed for vascular access. One patient had the procedure twice. Venous access was obtained via the right internal jugular vein in 64 cases and via the left internal jugular vein in 24 patients. In 3 patients, there was partial obstruction of both internal jugular veins. However, the obstruction could be negotiated using a guide wire. Initial technical success was achieved in 88 of 88 cases (100%).

There were 5 (5.6%) complications and one (1.1%) catheter related mortality; 2 patients had small air embolism. These patients were immediately placed in a left decubitus position and were started on oxygen; they responded to these measures and recovered well without any further interventions. One patient developed uncontrolled oozing of blood at the catheter exit site. This patient's initial platelet levels were within normal limits. However, later he developed low platelet count due to Dengue fever. The symptoms improved after transfusion of platelets. There were two episodes of inadvertent common carotid artery puncture which did not require any intervention.

Out of 87 patients, 10 were lost to follow-up. Seven patients died during the study period due to other co-morbid conditions and were excluded from the study. One (1.3%) patient died from catheter-related septicemia.

Out of remaining 69 patients, 50 (72.4%) had uneventful course during the desired period and functioning catheters were removed. Infection occurred in 12 patients (17.3%). Two of them were successfully treated conservatively resulting in complete resolution of symptoms and the catheters remained functioning till their arteriovenous fistula became functional, in remaining 10 patients the catheters had to be removed. One patient's catheter accidentally got cut in the ward while changing the dressing and had to be replaced. Seven catheters (10.1%) failed due to mechanical problems. Out of these, 3 patients had partially blocked internal jugular veins on presentation, which may have an effect on the early thrombosis and blockage of the catheters.

In 31 (44%) patients, either because of maturation of fistula or improvement in renal functions the catheter was no longer required and was subsequently removed. In 19 patients (27%), the fistula were working at the time of follow-up. Median duration of catheter patency was 121 days ranging from 1 to 307 days.

DISCUSSION

Haemodialysis catheter are an integral mean of dialysis in patients requiring haemodialysis with acute renal disease and in patients with chronic renal failure who cannot tolerate a high-flow arteriovenous shunt due to peripheral vascular and cardiac problem or in whom there is a delay in its formation or maturation.[11,12]

Permacath can be inserted with a high degree of success under fluoroscopic and ultrasound guidance. Here, the success rate was 100% which is similar to that reported by other interventional radiologists.[13]

The incidence of procedural complications in our series was 5.6%. This rate is slightly lower than that reported by Prabhu *et al.* i.e. 8%.[14,15]

The most common periprocedural complication, 2 of 88 in this series was air embolism without any serious consequences. Similar rates of clinically non-significant air embolization while inserting dialysis catheters were reported by Lund *et al*. and Trerotola *et al*.[16,17]

Challenging aspects in Permacath placement in patients with end-stage renal disease include bleeding which may be profuse during insertion of a Permacath or other tunneled catheter because of poor platelets function despite normal blood levels. Bleeding from the insertion and exit sites are usually controlled well during the procedure by manual compression. In one of these patients with renal failure secondary to complication of Dengue fever had a platelet count within normal limit initially, however, his bleeding from the exit site did not stop even after applying purse string suture and other compression techniques. Repeat platelet level dropped to 40,000 and transfusion was required for maintenance of haemostasis. One of the patients had renal failure as a complication of Dengue fever. He had continued bleeding from the catheter exit site despite applying purse string suture and other compression techniques. His initial platelet count was within normal limits; however, a repeat current tunneled catheters possess many of the characteristics of an ideal catheter; however, infection and malfunction are the prime factors that bound the use of these as long-term means of access and can result in removal of catheters in upto two third of the cases.[18] Infections can occur in upto 54% of the cases[19-21] and may be life-threatening. In this study, catheters were removed prematurely in 20 of 69 (28.9%) patients because of infection or malfunction.

Trerotola *et al*. compared two types of dual-lumen dialysis catheters i.e., silver-coated and non-silver-coated and reported a catheter removal rate of 11% and 14% respectively,[22] due to infection over a 3-month follow-up. In another study, the risk of catheter infection during a 9-month follow-up was reported to be as high as 40%.[23] A local study showed an infection rate of 30% in double lumen catheter on microbial analysis.[24]

The other limitation of tunneled catheters is failure to deliver adequate blood flow as a result of development of fibrin sheath around the catheter pores or catheter thrombosis.[25,26] Catheter had to be removed in 7 of 70 (10%) due to mechanical problems. The arterial port gives problem in most of the cases. Occasionally, by inverting the arterial with the venous limb resulted in adequacy of flow, however, detailed analysis in this aspect is not available as it is usually done by the Dialysis staff.

Thrombolytic agents have been utilized for relieving thrombotic obstruction. However, these agents are not routinely used in the department as these are costly and are associated with an increased risk of haemorrhage. Catheter stripping is another technique described to remove fibrin sheath from around the catheters to improve flow, in which case a snare is introduced usually through the femoral vein and the fibrin sleeve on the shaft of the catheter is mechanically striped. This is also not practiced in our setup due to the same reason.

Mean duration of the catheter patency was low as compared to other studies i.e. 121 days vs. 141 days by O'Dwyer,[26] which may be due to non-utilization of anti-thrombotic therapies.

Removal of the catheter is usually simple but it can be damaged by blunt dissection especially as it becomes soft at the body temperature. No complications were encountered during or after catheter removal.

There was a fixed length of catheter which was a limitation. To overcome this problem, the length of the subcutaneous tunnel was kept variable as well as position of the Decron cuff from the exit site. Keeping in view the average height of patient population, this technique worked well. In a few cases where the cuff was too far from the exit site and the patients came after a longer interval of time for catheter removal, there was difficulty in freeing the cuff from subcutaneous tissues. However, all the catheters could be removed without any complications.

CONCLUSION

Permacath provides an important alternative means of vascular access for haemodialysis. Radiological guided placement can be accomplished safely in most cases. It is an acceptable but not optimal means of providing vascular access for haemodialysis.

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