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## Tunneled Catheter for Hemodialysis: Denovo Insertion vs. Conversion of Uncuffed Catheter

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### Abstract

*Aims and Objectives:* To compare the two techniques of tunneled catheter (TC) insertion for hemodialysis; denovo and conversion of uncuffed catheter. *Methods:* The patients who underwent tunneled catheter insertion from August 2014 to December 2016 at EMS memorial co-operative hospital & research center, Perinthalmanna, Kerala, were included in the study. Technical success, complications, hemodialysis records and clinical outcomes were analyzed. *Results:* The study group consisted of 42 patients (26 males and 16 females) with age of 58.19±11.72 years. In 28 patients uncuffed catheters (UC) were placed initially & were converted later TC, with minor oozing in 3 (10.71%) subjects. The duration on UC ranged from 3-296 days (Range:3-296, Mean: 52.82, SD: 66.36) prior to their conversion to TC. In 14 patients the TC were inserted denovo, with one (7.14%) of them developing pneumothorax and another (7.14%) having minor oozing. The total number of follow-up days with TC was 12,946 (Range:3-872, Mean: 308.24, SD: 245.30). Ten patients had blood culture proven sepsis, yielding a catheter infection rate of 0.77/1000 catheter days, one among them required TC removal due to unresponsive septicemia (0.08/1000 catheter days). The patency rate of TC was 97.62% at 30 days after insertion, with 20(47.62%) catheters functioning at the end of the study period. Sixteen(38.09%) patients died with working catheters of causes unrelated to catheter and one (2.38%) had CRBSI along with other comorbidities at time of death. The catheters removed in 5 (11.90%) patients when they were no longer needed. There was no statistically significant effect of technique of TC insertion (denovo insertion or conversion of uncuffed catheter) on its durability (p: 0.43), post-procedure complications (p:0.34), CRBSI (p:0.30) and (patient mortality (p:0.29). *Conclusions:* Thus both techniques of TC insertion are safe and effective. The conversion of a UC to a TC using the same venous insertion site is safe, does not increase the risk of infection, and allows conservation of other central venous access sites.

**Keywords:** Hemodialysis; Uncuffed Catheter; Tunneled Catheter.

### Introduction

Hemodialysis (HD) or peritoneal dialysis (PD) is a life-saving and life-sustaining procedure in those with end stage renal disease (ESRD), who are unable to undergo renal transplantation. The majority of

patients begin hemodialysis treatment with a central venous catheter (CVC) as their initial vascular access in India and elsewhere in the world [1-4]. The majority of patients who begin hemodialysis treatment using an uncuffed catheter (UC) in India will undergo creation of an arteriovenous (AV) fistula as their permanent vascular access [3,4]. The

tunneled catheter (TC) is one of the vascular access options in patients with multiple failed attempts at AV fistula creation [5,6]. A study from Iran showed an increasing trend towards use of permanent catheters for hemodialysis [7]. The TC may be inserted de-novo or may be converted later over guide-wire using peel away sheath with same venotomy site [5-11]. There is limited published data regarding the use of TC as permanent access for HD from India [8]. This study was done to compare the two techniques of TC insertion for hemodialysis (denovo and conversion of UC to TC) and to analyze its effect on outcomes.

### Material and Methods

This retrospective study involved patients who underwent TC insertion from August 2014 to December 2016 at EMS memorial co-operative hospital & research center, Perinthalmanna, Kerala. Twenty eight patients were started on hemodialysis after insertion of UC (14F x 15cm, polyurethane, pre-curved or Raulerson internal jugular double lumen catheter by Medcomp®, Harleysville, PA, USA) in internal jugular vein (IJV) (27 right and 1 left sided) as they were unfit for TC insertion or lacking mature AV fistula. Fourteen patients underwent denovo placement of TC in right IJV as they lacked alternative permanent access for hemodialysis. Both the UC to TC conversion and denovo placement of TC were performed by Nephrologist under local anesthesia in operation theater with the guidance of C-ARM, if attempts to create AV fistula failed due to poor vasculature. The TC used were manufactured by Medcomp®, Harleysville, PA, USA (14.5 F x 36 cm, hemo-flow®, polyurethane). Heparin (5000 U/ml) along with Cefazolin (10 mg/ml) in ratio of 1:1 were used as locking solution and Mupirocin ointment was applied at exit site for both UC & TC after each dialysis to reduce the incidence of catheter related blood stream infections (CRBSI). Technical success, procedural complications, hemodialysis records and clinical outcomes were evaluated. Statistical analysis was done using SPSS 17 for Windows, by SPSS Inc. IL, USA. The quantitative variables (age) have been described as mean ± SD and range. The confidence interval was 95%, and a two tailed  $P < 0.05$  was used for statistical significance.

#### *Technique of UC to TC Conversion*

An cutaneous incision measuring 4-5 cm, was made at site of UC to expose the subcutaneous plane. A subcutaneous tunnel was created with one end

below the clavicle and other-end exiting at the site of UC insertion. The TC passed through the tunnel using the tunneler provided with the catheter kit with Dacron cuff about 2 cm from the exit site and its position is secured. The guidewire is advanced through venous lumen of existing UC and UC was removed after confirming the position of guidewire in right atrium. The next step consisted of placing a peel-away sheath/dilator combination over the guidewire. The dilator and guidewire were removed and the catheter was inserted centrally through the sheath, which was peeled away. The denovo insertion of TC was done using standard procedure technique. The TC was positioned so that its tip is in right atrium under guidance of C-ARM. All patients were given Amoxicillin-clavulanate 625 mg twice daily for 3 days after the procedure. The patient was monitored in ICU for 12 hrs after the procedure.

### Results

The patients age, gender, and duration on TC are presented in Table 1 and comorbidities are presented in Table 2. The study group consisted of 42 patients (16 females and 26 males) with age of  $58.19 \pm 11.72$  (range 40-82) years. The diabetes mellitus was the commonest cause of ESRD in the study with majority of the patients having macrovascular complications involving coronary, cranial and peripheral arteries, the reason the inability to create a successful AV fistula.

The post-procedure complications are tabulated in table 3. In 28 patients uncuffed catheters (UC) were placed initially & were converted later TC, with minor oozing 3 (10.71%) subjects. The duration on UC ranged from 3-296 days (Range:3-296, Mean: 52.82, SD: 66.36) prior to their conversion to TC. In 14 patients the TC were inserted denovo, with one (7.14%) of them developing pneumothorax and another (7.14%) having minor oozing. The total number of follow-up days with TC was 12,946 (Range:3-872, Mean: 308.24, SD: 245.30).

Ten patients had blood culture proven sepsis, yielding a catheter infection rate of 0.77/1000 catheter days, one among them required TC removal due to unresponsive septicemia (0.08/1000 catheter days).

The patency rate of TC was 97.62% at 30 days after insertion, with 20(47.62%) catheters functioning at the end of the study period. One (2.38%) patient needed repositioning of TC due to poor blood flow within one week after insertion. Sixteen (38.09%) patients died with working catheters of causes unrelated to catheter and one (2.38%) had CRBSI

along with other comorbidities at time of death. The catheters removed in 5 (11.90%) patients when they were no longer needed. Three patients required replacement with new TC (septicemia in one and due inadvertent removal in two).

There was no statistically significant effect of technique of TC insertion (denovo insertion or

conversion of uncuffed catheter) on its durability (p: 0.43), post-procedure complications (p:0.34), CRBSI (p:0.30) and (patient mortality (p:0.29). The Kaplan-Meier survival graph of TC based its insertion technique is shown in figure 1 and means and median survival times (days) are tabulated in Table 4.

**Table 1:** The age, gender and duration on tunneled catheter (TC)

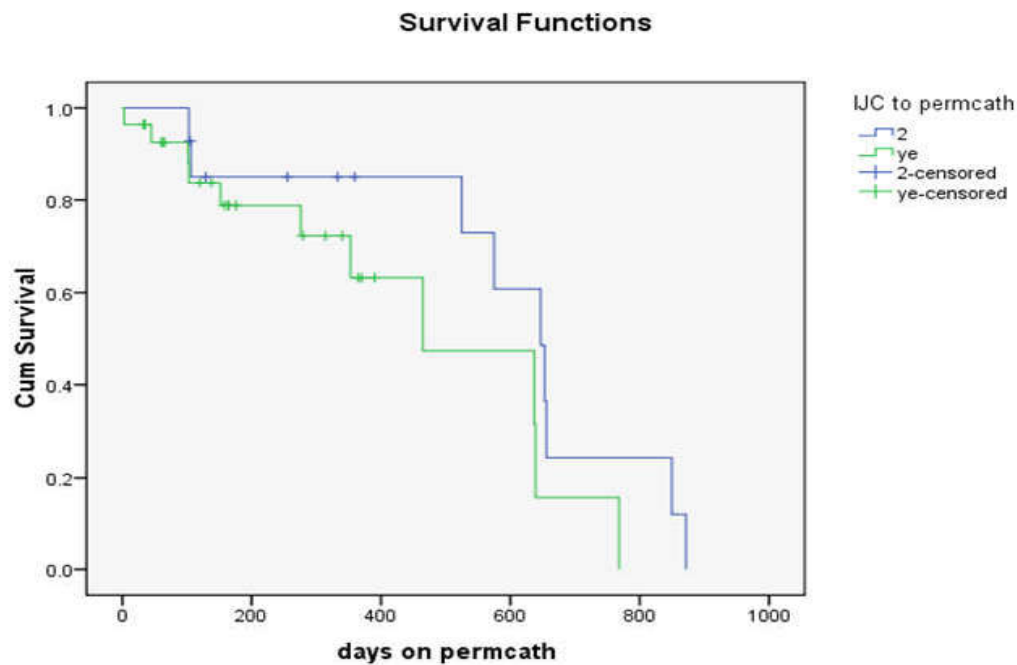
	Patient number	Mean±Std. Deviation (range)	
		Age (years)	Durationon TC (days)
Females	16	53.88 ± 10.65 (40-74)	279.63 ± 211.48 (3-296)
Males	26	60.85 ± 11.74 (45-82)	325.85 ± 266.46 (3-850)
Combined	42	58.19 ± 11.72 (40-82)	308.24 ± 245.30 (45-872)

**Table 2:** The comorbidities in patients undergoing TC insertion

Co-morbidity	Females (n: 16)	Males (n: 26)
Diabetes mellitus	12	22
Hypertension	16	26
Coronary artery disease	6	13
Cerebrovascular disease	2	3
Peripheral vascular disease	5	7

**Table 3:** The technique of tunneled catheter (TC) and complications

Complications	Technique of TC insertion	
	Denovo TC (n:14)	Conversion of UC to TC (n:28)
Minor oozing	1	3
Pneumothorax	1	0
Need for intervention due poor blood flow or catheter malfunction	0	1
CRBSI	2	8



**Fig. 1:** The Kaplan-Meier survival of TC and its relation to technique of placement (2=denovo TC insertion, ye=conversion of UC to TC)

**Table 4:** Means and Medians for Survival Time of TC

TC technique	Estimate	Std. Error	Mean <sup>a</sup>		Estimate	Std. Error	Median	
			95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound			95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Denovo	596.558	72.626	454.210	738.905	647.000	54.088	540.988	753.012
UC to TC	464.974	64.171	339.199	590.749	465.000	147.844	175.226	754.774
Overall	524.298	49.000	428.258	620.338	637.000	67.780	504.151	769.849

<sup>a</sup>. Estimation is limited to the largest survival time if it is censored.

## Discussion

The tunneled catheters serve as a critical permanent access when all other options have been exhausted for continuation of hemodialysis. This retrospective study, compared the two techniques of TC insertion. Both techniques achieved 100 % success; however the advantage with conversion is that it uses the same venotomy site with least complication rates, and also sparing other central venous sites for future use; similar to previous reports [8-12].

In this study, the right IJV was the site of choice for access for both techniques of TC insertion similar to other studies [8-12]. The the mean duration on UC was 52.82 days prior to their conversion to TC; one of the highest reported till date. The median duration of TC in one of the published studies was 4 and 14 days in two study cohorts, respectively [12].

One the major concerns of the study was infections due longer duration of UC prior to its conversion to TC. There was no statistically significant difference in rates of CRBSI based on technique of TC insertion. Other studies have reported similar infection rates (per 1000 catheter days), ranging from 0.4 to 5.5 after denovo PC insertion and 0.8-3.0 after TC to PC conversion [5-12]. About 1.4% of the patients had early CRBSI needing catheter removal in an earlier study [12]. Falk et al have reported even higher 30-day infection incidence (9.4%) and rate (3/1,000 catheter-days) [10]. Therefore, overall infection risk after UC to TC conversion in the present study similar to that of denovo catheter placement.

The efficacy of prophylactic antibiotic administration to prevent infections in TC procedures is controversial. The Cefazolin significantly reduced catheter-related infections, bacteremia, and catheter loss over placebo in one study [13] and there was no advantage of cefazolin over vancomycin in another study [12]. In the present study use of Cefazolin has significantly contributed to the reduced incidence of CRBSI. The TC related sepsis, change of access to AV fistula or AV graft, improvement in renal function were the indications for PC removal in the study

similar to previous reports [8-13].

## Conclusions

The TC are one the important permanent access for hemodialysis, if there are no alternatives. The TC may be inserted both denovo or conversion at a later date by using existing venotomy site. Both the techniques of TC insertion for hemodialysis are equally effective, with comparable results. The technique by itself doesn't increase the the risk of complications. The conversion of a UC catheter to a TC, also allows preservation of other central venous access sites for use in future.

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