DOI: 10.21608/ASJS.2023.285716

Tunnelled Femoral Vein Catheter for Long Term Haemodialysis in Exhausted Accesses; does High Tip Placement Differ than Low Tip Placement?

Ahmed M El Mahdi, MD;[1] Sherif Omar Elkerdawi, MD;[1] Amr M Aborahma, MD;[2] Rasha I. A. Gawish, MD;[3] Ahmed O Korany, MD[4]

[1]Vascular Surgery Unit, Faculty of Medicine, Helwan University, Egypt
[2]Vascular Surgery Unit, Faculty of Medicine, Tanta University, Egypt
[3]Nephrology Unit, Internal Medicine Department, Faculty of Medicine, Alexandria University, Egypt
[4]Vascular Surgery Unit, Faculty of Medicine, Alexandria University, Egypyt

Background: Tunneled dialysis catheters (TDCs) are inserted for hemodialysis (HD in patients with chronic kidney diseases (CKD), with failed arterio-venous fistula (AV). Tunneled femoral vein catheters are commonly used with exhausted internal jugular or subclavian veins catheters.

Aim of study: To evaluate flow rate and complications associated with femoral vein catheters for long term HD and to compare the effectiveness of hemodialysis (HD) in cases of high tip versus low tip placement of the catheter.

Patients and methods: 40 cases with the only vascular access is the femoral veins. The flow rate, complications and difference between high and low placement of the catheters were investigated.

Results: Among the mean URR of the studied cases was 63.58 (±7.62 SD) with range (52-74.8), the mean Kt/V was 1.03 (±0.22 SD) with range (0.73-1.38) and the mean Kt/V was 238.5 (±33.51 SD) with range (182-297).

Conclusion: The complication rate of femoral venous catheters appears to be acceptable. Flow rate is better in high tip placed catheters.

key words: Tunneled haemodialysis catheter, femoral vein, primary patency rate, catheter-related problems.

Introduction

Preserving an effective vascular access is crucial for patients on haemodialysis (HD). With a growing number both in cases on HD as in their survivals, the number of cases with exhausted accesses is increasing. Multi-venous access failure in cases on HD is one of the utmost and most dramatic challenging that nephrologists and patients have to meet.[1]

TDC can be chosen as an alternative vascular access in case an arterio-venous fistula or arterio-venous graft failed or hard to create.[2]

Furthermore, a TDC is apparently beneficial as a vascular access in cases with acute kidneys injuries, cases with end-stage chronic kidneys disorder that requires vascular access for temporary HD earlier to renal transplanting, and cases who should waited for the progress of an arterio-venous fistula or arterio-venous grafting, for HD maintenance thereafter a surgery.[3] A preceding report revealed that a TDC must be utilized in cases who are proposed to have an indwelling HD catheter for more than two weeks.[4]

The favored access location for a TDC is the right internal jugular veins.

Other entree locations comprise the right external jugular veins, the left internal jugular veins, and the left external jugular veins.[5] The subclavian veins must only be utilized when other choices are not accessible. Moreover, tunneled catheters should not be located on the same side of a maturing arterio-venous fistula.[6]

HD access may be a challenging issue in cases who have spent their accessing locations. When the more mutual locations are no more accessible, substitute access locations become essential. These locations comprise the femoral veins, trans-lumbar, trans-renal, and trans-hepatic ways, and inserting catheters to collateral venous path-ways.[7]

When the common ways are no more accessible, we have employed the shared femoral veins as our favored alternate location for HD catheters tunneling.[8]

TDCs were accompanying with a range of mild to severe side-effects, counting catheters-related infection, sepsis, thrombosis, central venous stenosis, occlusion, and dislodgment.[9] TDCs side-effects are accompanying not only with elevated morbidities but as well with hospitalization and health care resources usage.[10]

Material and methods

This was a retrospective cohort study that has been done on 40 cases who experienced insertions of a TDC via the shared femoral veins. All patients had been with subclavian or internal jugular vein central lines, which accidentally or secondary have been removed owing to obstruction or infection. The conventional access sites had been exhausted in 40 patients because of the inability of placement of new catheter via the internal jugular veins, or the subclavian veins also had suffered from superior vena cava thrombosis or strictures. Informed written consent was obtained from each patient to be included in this study.

Demographic data were sex, ages, preceding period in HD, number of preceding catheters, type and site.

Tunneled hemodialysis catheter insertion method: All cases experienced sonographic assessment to find out the patency of femoral veins. Right sided femoral venous access was measured to be better than left-sided femoral venous accessing. Under fluoroscopy, polyurethane dual-lumen tunneled catheters have been introduced, which were 55-cm in overall length, with tip to cuff 36 cm long, having 13.5-French diameter in 25 patients with high tip placement, and 40 cm in 15 patients with low placement tip **(Figures 4,5)**, Catheters were inserted under strict aseptic conditions in the major operating room using povidone-iodine at the supplement location. The tip of the catheter was placed in Inferior Vena Cava or in cavoatrial junction in high tip placement catheters to ensure maximum blood flow, and in the iliac vein in case of low tip placement catheters. The tunnel was subcutaneously fashioned by the catheter's retrograde passage through the cannula to preselected site point of exit in the ipsilateral thigh; it was directed laterally to be away from the patients' private area. The distance separating the cutaneous puncture site from the venous entry had to be ~9–12 cm. Every 48–72 hours, the dressing was changed. Inspection of the catheter dressings was done at least twice per week for excluding local signs of infection. It was not allowed to take medications or blood samples through the catheter.

Primary flow rate and complications of TDC: Catheter dysfunctions was described when the blood flowing rate was less than120 ml/min in spite of a try to save the catheter by urokinase injections into the catheter. When catheter dysfunctions were detected, the catheters were detached. Catheter-linked infection comprised exit location infection and blood-stream infection. Exit location infections was described as the attendance of flares, swelling, and presence of pus at the exit location in the skin. When exit location infections was identified, the exit location was cleaned with saline solution. Blood-stream infections were detected when blood cultures were positive for bacterial pathogens and other infectious locations weren't detected or not probable to be the origin of the bacteria. When blood-stream infection was identified, the catheters were detached.

Cases were allocated in two groups according to placement level: The first group had 20 patients with catheter tip placed in high level and the second group had 20 patients with catheter tip placed in low level. The difference between both groups was evaluated if were statistically significant or not.

Parameters of HD: Single pooled KT/V (SpKT/V) values have been estimated every 30 days by formerly reported formulae. (11) The median spKT/V was determined for every case thereafter assignment of the indwelling TDC. SpKT/V identifies the effective removal of a specific solute (Clearance K) as a result of a treatment given in a certain time (t) for a patient (with a specific volume of distribution V for the solute considered).

Statistical analysis: Collected data was statistically analyzed via the windows-based SPSS-20 (IBM, USA). In accordance to the kind of data qualitative introduces as numbers and percentages, quantitative continues group introduced as mean ± SD, the next examinations have been utilized to test variances for significance; comparison among frequencies and percentages in groups were done using Chi-square testing. comparison among parametric quantitative non-dependent groups by student t testing P-value was significant at <0.05 & high significant at < 0.001.

Results

The mean age of studied group was 52.75 (±14.47 SD) with range (18-88) years, among the studied group there were 16 (40%) females and 24 (60%) males, there were 13 (32.5%) femoral vein inserted catheters because of failed trials of central neck venous access, 12 (30%) due to severely infected central neck venous catheter and 15 (37.5%) because of central neck venous occlusion, there were 26 (65%) inserted in left femoral vein, 14 (35%) in right femoral vein. There were 15 (37.5%) low tip placed catheters and 25 (62.5%) high tip placed. **(Table 1)**

Among the studied group there were 5 (12.5%) inserted under general Anesthesia and 35 (87.5%) with local anesthesia, there were 30 (75%) with ultrasound guided insertion. The size of the catheter in 25 patients was 13.5F*55 cm (62.5%), while it was 13.5F*40 cm in 15 patients (37.5%). **(Table 2)**.

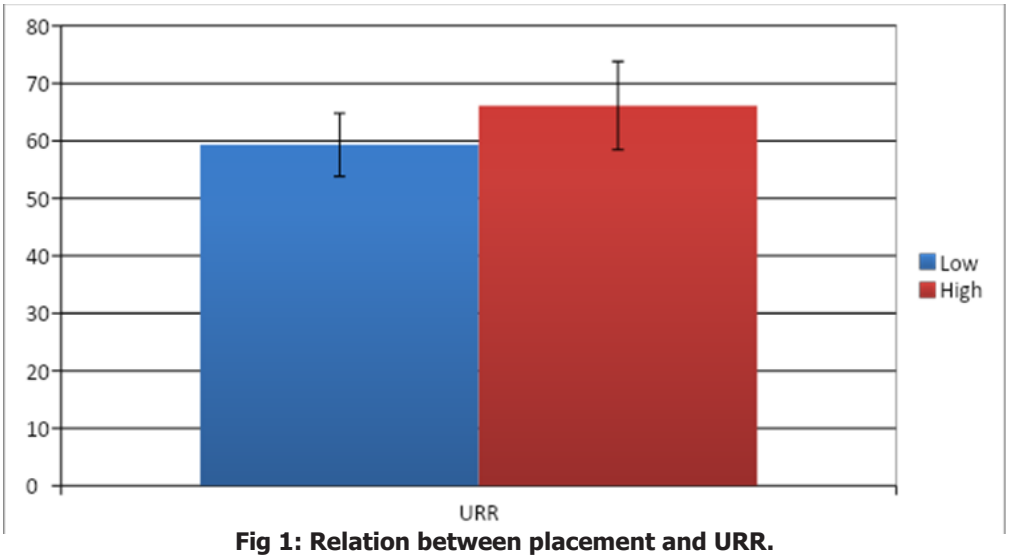

Fig 1: Relation between placement and URR.

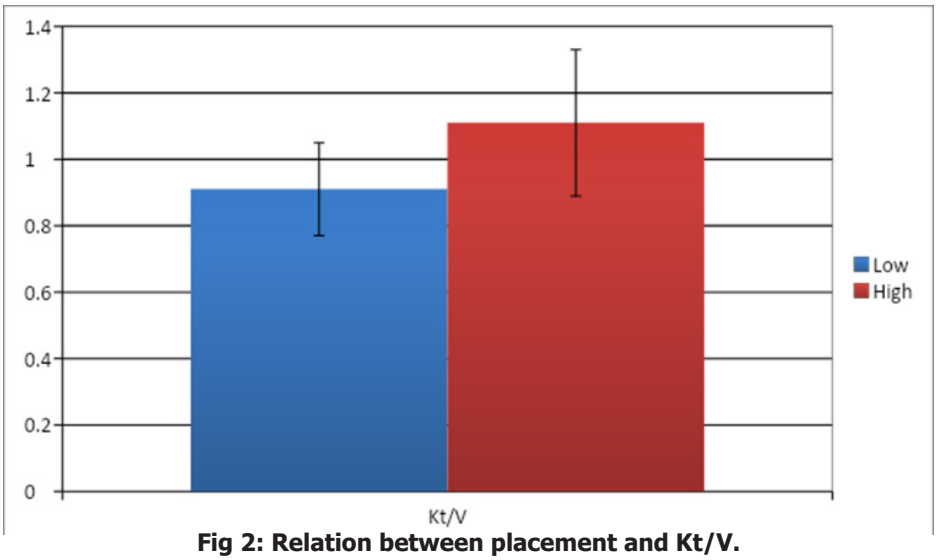

Fig 2: Relation between placement and Kt/V.

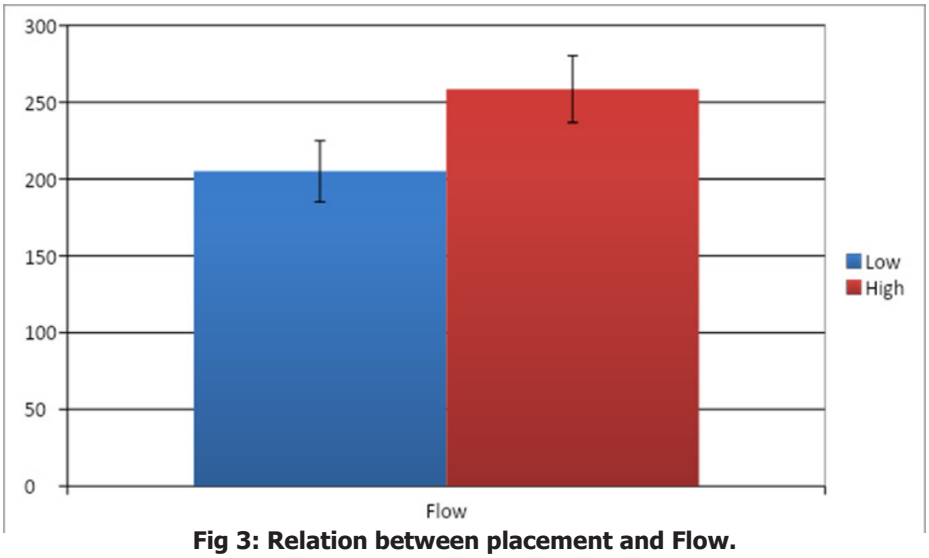

Fig 3: Relation between placement and Flow.

The mean Urea Reduction Ratio (URR), which means the reduction in urea as a result of dialysis, of the studied cases was 63.58 (±7.62 SD) with range (52-74.8), the mean Kt/V was 1.03 (±0.22 SD) with range (0.73-1.38) and the mean Kt/V was 238.5 (±33.51 SD) with range (182-297). **(Table 3).**

There were six patients (15%) had septicemia, 3 (7.5%) had deep vein thrombosis, 9 (22.5%) had skin inflammation and 3 (7.5%) had perforation of the iliac vein (One in the right side, 2 in the left side) and the mean time of function was 4.73 months (±2.06 SD) with range (1-9). **(Table 4).**

A significant correlation among tip placement and outcome data as URR, Kt/V and flow were higher in high tip placement group. **(Table 5) (Figures 1-3)**.

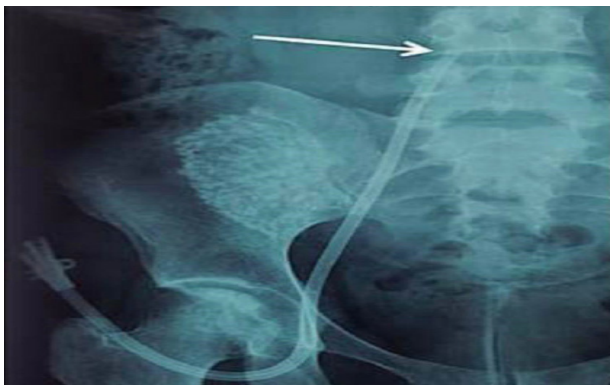

Fig 4: A case of tunneled low tip placement femoral catheter.

Fig 5: A case of tunneled high tip placement femoral catheter.

Table 1: Distribution of studied cases according to history data

History data	Cases	
Age (years)		
Range	18.0 – 88.0	
Mean ± SD	52.75 ± 14.47	
Sex		
Female	16	40.0
Male	24	60.0
Causes of femoral insertion		
failed trials of central neck venous access	13	32.5
severely infected central neck venous catheter	12	30.0
central neck venous occlusion	15	37.5
Site of procedure		
Left femoral vein	26	65.0
Right femoral vein	14	35.0
Placement tip		
Low	15	37.5
High	25	62.5

Table 2: Distribution of studied cases according to insertion data

Type of Anesthesia		
General Anesthesia	5	12.5
Local Anesthesia	35	87.5
Ultrasound guided		
No	10	25.0
Yes	30	75.0
Size of catheter		
13.5F*55 cm	25	62.5
13.5F*40 cm	15	37.5
15.5 F*40 cm	15	100.0

Table 3: Distribution of studied cases according to outcome data

Outcome data	Cases
URR	
Range	52.0 – 74.80
Mean ± SD	63.58 ± 7.62
Kt/V	
Range	0.73 – 1.38
Mean ± SD.	1.03 ± 0.22
Flow (ml/min)	
Range	182.0 – 297.0
Mean ± SD.	238.5 ± 33.51

Table 4: Distribution of studied cases according to complications and time of function

Septicemia	6	15.0
Deep Vein Thrombosis	3	7.5
skin inflammation	9	22.5
late hemorrhage	0	0.0
Iliac vein perforation	3	7.5
Time of functioning		
Range	1.0 – 9.0	
Mean ± SD.	4.73 ± 2.06	

Table 5: Relation between catheter tip placement and outcome data

outcome data	Low (n=15)	High (n=25)	T	P
URR				
Range	52 – 67.8	53.7 – 74.8	3.008	0.005*
Mean ± SD	59.32 ± 5.49	66.14 ± 7.66		
Kt/V				
Range	0.73 – 1.13	0.77 – 1.38	4.121	0.003*
Mean ± SD.	0.91 ± 0.14	1.11 ± 0.22		
Flow (ml/min)				
Range	182 – 240	222 – 297	7.767	<0.001*
Mean ± SD.	205.07 ± 19.9	258.6 ± 21.77		

Discussion

Tunneled Dialysis catheters (TDC) are utilized for temporary vascular access in cases pending placements or maturations of a permanent vascular accessing (A-V fistulae or grafts). They are, as well needed as long-term access in cases who have experienced failure of permanent accesses in the arms. TDCs are frequently located in a central vein in the neck, commonest in the internal jugular veins, and less frequently in the subclavian veins. While, when extended usage of upper extremity dialysis catheters results in bilateral occlusions of the central vein, it was essential to locate a TDC in the femoral vein.[11]

Because of their closeness to the groin, one should expect that femoral veins catheters should be more prone than internal jugular veins catheters to difficulties with lower dialysis blood flowing, losses of patency, and catheter-linked bacteremia. While, there is only one serie found in literature addressing this issue.[12]

We were preserving a prospective, computer data-base of all vascular access operations accomplished at our centers. By means of this data-base, we have recognized all femoral TDCs applied throughout an interval of 5-year.[13]

The present study aimed to assess flow rate and complications associated with femoral vein catheter for long term HD in exhausted accesses and to compare high tip placement versus low tip placement.

This study showed that the mean age of studied group was 52.75 (±14.47 SD) with range (18-88) years, among the studied group there were 16 (40%) females and 24 (60%) males, there were 13 (32.5%) utilized femoral insertion because of failed trials of central neck venous access, 12 (30%) severely infected central neck venous permcath and 15 (37.5%) central neck venous occlusion, there were 26 (65%) inserted in left femoral vein,[14] (35%) in right femoral vein and there were 15 low tip placed catheters (37.5%) and 25 with high tip placed (62.5%).

IVAN et al.[14] by means of a prospective, computerized vascular accessing data-base, they recognized all femoral TDCs located at the University of Alabama throughout a 5-year interval. The clinical parameters, catheter patency, and side-effects in these cases were matched to those detected a matching control group with internal jugular vein TDCs. They revealed that throughout the 5-years research interval, an entire of 1489 new TDCs have been located. Of these, 27 catheters (Or 1.8% of all) have been located in the femoral veins. The 2 groups were matching as regard ages, gender, race, diabetic status, and risk-factors. As predictable, the cases with femoral catheters were on dialysis over 2 years more than the controls. Previous to getting a femoral TDC, the cases had a mean of 4.3 ± 2.5 permanent vascular accessing.

Restrepo et al.[15] showed that throughout 103-mths (From Feb. 2009 to Sep. 2017), 30 femoral TDCs were applied in 19 cases; 15 in each group, ages mean was 56.3-yrs. 68.4% were males. The entire number of earlier fixed catheters was 63; 28 in G1 (Mean 1.9/case), and 35 in G2 (Mean 2,4/case). Preceding locations for G1 were: Jugular 17, axillary three, innominate one, non tunneled femoral seven; for G2 there were jugular 23, axillary three, innominate zero, non tunneled femoral.[10]

This study reported that among the studied group there were 23 (57.5%) utilized general Anesthesia and 17 (42.5%) utilized local anesthesia, there were 30 (75%) were ultrasound guided and the size in all patients was 15.5F*40cm.

Deitel et al.,[16] revealed a malposition rate of 29% in the lack of radiologic guiding.

This study shows that among the mean URR of the studied cases was 63.58 (±7.62 SD) with range (52-74.8), the mean Kt/V was 1.03 (±0.22 SD) with range (0.73-1.38) and the mean flow was 238.5 (±33.51 SD) with range (182-297). There were 6 (15%) who had septicemia, 3 (7.5%) who had deep vein thrombosis,9 (22.5%) who had skin inflammation and 3 (7.5%) who had perforation and the mean time of function was 4.73 (±2.06 SD) with range (1-9).

Zaleski et al.[17] showed that all catheters functioned adequately after initial placement, with an average flow rate of 272 mI/min (Range, 200-300 ml/min). Both 40- and 55-cm catheters were able to provide adequate flow rates of 300 ml/min, which was the maximum rate utilized during the study period for HD. Catheter length did not have any effect on catheter function.

Restrepo et al.[15] showed that the mean usage period for G1 was 132±164 day, and 234±172 day, the interval was superior for G2, but was non-significant among groups. As regard side-effects, any group had major hemorrhage, both throughout insertions or retirements. The operation of retirement has been accomplished for one nephrologist, with local anesthesia in minor operating room.

This study revealed that there was significant relation between placement and outcome data as URR, Kt/V and flow were higher in high placement group.

Bagul et al.[18] showed that the favored location for catheter insertions is the right interna jugular veins, as anatomic, this delivers the shortest path to the superior vena-cava and right atrium, and is accompanying with improved patency and less side-effects than other locations.

Insertion into the left internal jugular vein is accompanied with elevated frequency of central stenosis and inferior patency. Up to the present time, there are no randomized prospective trials matching the frequency of side-effects among these two ways. In particular sub-groups, in which all other ways were consumed,

TDCs could be located into the external iliac vein, the femoral veins and even the inferior vena-cava via a trans-hepatic or trans-lumbar method Frequently the catheter is situated in non-appropriate beds like lumbar ascendant veins, hemiazygos accessory veins, is consequently significant to recognize the site of the tip with a simple abdominal plain radiograph, mostly if functioning is insufficient. The embedding is connected with side-effects like Phlegmasia Cerulea Dolens, retroperitoneal haematoma, abdomen compartment condition, and iliac a femoral veins stenosis.[15]

Zaleski GX et al,[19] in their 3-year practice with 41 catheters and with length ranged between 40 and 55 cm were common managements by various reasons and an elevated exposure to infections Chow Km et al,[20] in 14 catheters reported better longstanding permeabilities, with sensible survival, and a minor infection.

Falk A ,[21] in his 3-years practice with 86 catheters revealed low permeabilities and a significant number of side-effects.

Maya et al,[22] revealed in 22 cases with femoral TDC low longstanding permeabilities versus jugular catheters and elevated danger of deep vein thrombosis, while similar infection danger.

To summarise, the complication rate of femoral venous catheters appears to be acceptable. However, in cases who rely on longstanding central venous catheterization and whose thoracic access sites have been exhausted, the common femoral vein can be safely utilized for tunneled permanent HD access, with more efficient dialysis in high tip placed catheters with high flux dialysis membrane and high blood flow rate than low tip placement catheters, which is evidenced by the significant relation between URR and Kt/V.

References

1. Pereira M, Lopez N, Godinho I, et al: Life-saving vascular access in vascular capital exhaustion: single center experience in intra-atrial catheters for haemodialysis. ***Brazilian Journal of Nephrology.*** 2017; 39(1): 36-41.

2. Shindo M, Takemae H, Kubo T, et al: Availability of right femoral vein as a route for tunneled haemodialysis catheterization. ***Medical Devices (Auckland, NZ).*** 2018; 11: 233.

3. Coryell L, Lott JP, Stavropoulos SW, et al: The case for primary placement of tunneled haemodialysis catheters in acute kidney injury. ***Journal of Vascular and Interventional Radiology.*** 2009; 20(12): 1578-81.

4. Weijmer MC, Vervloet MG, ter Wee PM: Compared to tunneled cuffed haemodialysis catheters, temporary untunnelled catheters are associated with more complications already within 2 weeks of use. ***Nephrol Dial Transplant.*** 2004; 19(3): 670–677.

5. Clark E, Kappel J, MacRae J, et al: Practical aspects of nontunneled and tunneled haemodialysis catheters. ***Canadian Journal of Kidney Health and Disorder.*** 2016.

6. Engstrom BI, Horvath JJ, Stewart JK, et al: Tunneled internal jugular haemodialysis catheters: Impact of laterality and tip position on catheter dysfunction and infection rates. ***Journal of Vascular and Interventional Radiology.*** 2013; 24(9): 1295-302.

7. Zhu LN, Mou LJ, Ying-Hu, et al: Failure to place a tunneled haemodialysis catheter due to malformation of right internal jugular vein draining to subclavian vein. ***Journal of International Medical Research.*** 2018; 46(6): 2481-8.

8. Herzallah AM, Madkour MT, ElShanshoury TS, et al: Femoral tunneledhaemodialysis catheter a s a permanentaccess for haemodialysis patients. ***Journal of Medicine in Scientific Research.*** 2018; 1(2): 106.

9. Poinen K, Quinn RR, Clarke A, et al: Complications from tunneled haemodialysis catheters: A Canadian observational cohort study. ***Am J Kidney Dis.*** 2019; 73: 467-75.

10. Castro V, Farber A, Zhang Y, et al: Reasons for long-term tunneled dialysis catheter use and associated morbidity. ***Journal of Vascular Surgery.*** 2021; 73(2): 588-92.

11. Murea M, Geary RL, Davis RP, et al: Vascular access for haemodialysis: A perpetual challenge. ***In Seminars in Dialysis.*** 2019; 32: 527-534.

12. Guillermo-Corpus G, Ramos-Gordillo JM, Peña-Rodríguez JC: Survival and clinical outcomes of tunneled central jugular and femoral catheters in prevalent haemodialysis patients. ***Blood Purification.*** 2019; 47(1-3): 132-139.

13. Mong-Slezak E: Association of patient to nurse ratio and hand washing stations and infection-related hospitalizations in haemodialysis patients. ***Universite de Montereal.*** 2019:1-103.

14. IVAN D, MAYA, MICHAEL ALLON: Outcomes of tunneled femoral haemodialysis catheters: Comparison with internal jugular vein catheters. ***Kidney International.*** 2005; 68: 2886–2889.

15. Restrepo, Cesar & Arango, José & Villa, Carlos. Tuneled catheters in femoral vein: does the length makes any difference?. ***Revista Colombiana de Nefrología.*** 2018;5:137. 10.22265/acnef.0.0.304.

16. DEITEL M, MCINTYRE JA. Radiographic confirmation of central venous catheters. ***Can J Surg.*** 1971;14:42e52.

17. Zaleski G, Funaki B, Lorenz J, et al: Experience with tunneled femoral haemodialysis catheters. ***AJR.***

American Journal of Roentgenology. 1999;172:493-6. 10.2214/ajr.172.2.9930810.

18. Bagul A, Brook NR, Kaushik M, et al: Tunnelled Catheters for the Haemodialysis Patient. 2007; 33(1): 105–112.
19. Zaleski GX, Funaki B, Lorenz JM, et al: Experience with tunneledfemoral haemodialysis catheters. *AJR Am J Roentgenol.* 1999; 172: 493–496.
20. Chow KM, Szeto CC, Leung CB, et al: Cuffed- tunneled femoral catheter for long-term haemodialysis. *Int J Artif Organs.* 2001; 24: 443–446.
21. Falk A: Use of the femoral vein as insertion site for tunneled haemodialysis catheters. *J Vasc Interv Radiol.* 2007; 18: 217-225.
22. Maya ID, Allon M: Outcomes of tunneled femoral haemodialysis catheters: Comparison with internal jugular vein catheters. *Kidney Int* 2005; 68: 2886–2889.