Use of Tunneled Central Catheters for Hemodialysis Access (Ten Years Experience)

Hemodiyaliz Amaçlı Tünelli Santral Ven Kateterizasyonu (10 Yıllık Deneyim)

Özcan GÜR,[a]
Selami GÜRKAN,[a]
Habib ÇAKIR,[b]
Volkan YÜKSEL,[c]
Serhat HÜSEYİN,[c]
Suat CANBAZ,[c]
Turan EGE[c]

[a]Department of Cardiovascular Surgery, Namık Kemal University Faculty of Medicine, Tekirdağ
[b]Clinic of Cardiovascular Surgery, Adana Numune Training and Research Hospital, Adana
[c]Department of Cardiovascular Surgery, Trakya University Faculty of Medicine, Edirne

Geliş Tarihi/*Received:* 16.08.2012
Kabul Tarihi/*Accepted:* 03.03.2013

Yazışma Adresi/*Correspondence:*
Özcan GÜR
Namık Kemal University
Faculty of Medicine,
Department of Cardiovascular Surgery,
Tekirdağ,
TÜRKİYE/TURKEY
ozcangur@hotmail.com

ABSTRACT Objective: Tunneled central catheters(TCCs) are frequently used in patients with end stage renal disease who do not have an arteriovenous shunt as vascular access for hemodialysis. Here we aimed to present data of our patients with TCCs that were inserted between the years 2001 and 2011. **Material and Methods:** Between January 2001 and July 2011, a total number of 107 TCCs were inserted to patients with end stage renal disease, for whom the arteriovenous shunt operation failed. A detailed Doppler ultrasonographic examination of the possible access sites was carried out prior to the selection of the vein to rule out stenosis or thrombus. The position and angle of the catheter was checked by X-ray after the procedure. **Results:** Of 107 patients, 58 (54.2%) were male and 49 (45.8%) were female. The mean age of the patients was 56.07±3.8 (14-84). Arrythmia and hypotension were the most common early complications, occurring in 11(10%) of patients, followed by hematoma in 8 (7.4%) patients, early thrombosis in 8 (7.4%) patients, and catheter infection in 6 (5.6%) patients. The arrythmia and hypotension were managed by slight pullback of the guidewire. Bleeding was also managed by local compression like pressure bandage necessitating no blood transfusion or removal of the catheter. **Conclusion:** In patients with end stage renal disease for whom there is no arteriovenous shunt for vascular access for hemodialysis, insertion of a TCC is safe and convenient. The right internal jugular vein is the most commonly used site for venipuncture for reduced risk of pneumothorax, thrombotic complications, uncontrollable arterial injury and relatively straight course into the right atrium (RA).

Key Words: Renal dialysis; catheterization, central venous; arteriovenous shunt, surgical

ÖZET Amaç: Kronik böbrek yetmezlikli ve arteriyovenöz şant için uygun girişim yolu bulunmayan hastalarda tünelli kalıcı kateter (TTK)'ler sık kullanılmaktadır. 2001-2011 tarihleri arasında takılan TKK uygulamalarımızı sunmayı amaçladık. **Gereç ve Yöntemler:** Ocak 2001-Temmuz 2011 tarihleri arasında AV şant açılamayan 107 hastaya nefroloji kliniği ile ortak karar verilerek TKK uygulandı. Kateter takılacak bölgeler Doppler ultrasonografi ile incelenerek trombus veya stenoz olan bölgeler dışlandı. TKK uygulanacak bölge tespit edildi. TKK uygulanan hastaların tümü uygulama sonrası X-ray ile değerlendirilerek kateterin yeri ve açısı kontrol edildi. **Bulgular:** Toplam 107 hastanın 58 (%54,2)'i erkek, 49 (%45,8)'u kadın ve yaş ortalaması 56,07±3,8 (14-84) idi. Aritmi ve hipotansiyon en sık gözlenen erken komplikasyon idi. Bu hastalarda "guidewire" geri çekilmesiyle şikâyetler giderildi. TKK uygulanan 11 (%10) hastada aritmi ve hipotansiyon, 8 (%7,4) hastada cilt altı hematom, 8 (%7,4) hastada erken dönemde tromboz ve 6 (%5,6) hastada kateter enfeksiyonu gözlendi. Cilt altı hematom bulunan olgulara baskılı pansuman yapılarak hematom kontrol altına alındı. Cilt altı hematoma bağlı olarak kateterin çekilmesi veya kan replasmanına gerek olmadı. Enfekte ve oklüde kateterler çekilerek başka bir bölgeden tekrar TKK uygulandı. **Sonuç:** Arteriyovenöz şant için uygun bölge bulunamayan veya renal transplant bekleyen, genel durumu kötü olgularda TKK güvenli ve konforlu bir biçimde uygulanabilir. Sağ juguler ven, anatomik olarak uygun, venöz stenoz ve komplikasyon oranlarının düşük ve hasta konforu açısından en uygun bölge olması sebebiyle sık tercih edilmelidir.

Anahtar Kelimeler: Böbrek diyalizi; kateterizasyon, santral venöz; arteriyovenöz şant, cerrahi

Turkiye Klinikleri J Nephrol 2013;8(1):1-5

Patients with end stage renal diseaee (ESRD) for whom renal transplantation is not an option, depend on hemodialysis for survival. Vascular access placement and infectious complications related to the catheters is the major source of morbidity in patients with ESRD.[1] The 4 types of vascular access for hemodialysis are arteriovenous fistula, arteriovenous grafts, temporary caheters and permenant (90 days or longer) catheters. The gold standard vascular access is an arteriovenous shunt in such patients and the guidelines favor the arteriovenous fistula operations in patients with stage 4 ESRD.[2] Nevertheless, the use of catheters for the purpose of hemodialysis are still on the rise. Although an arteriovenous shunt is the prefered vascular access at the first outpatient hemodialysis, more than 80 percent of patients use a catheter at initiation and 20 percent have a catheter along with a maturing internal vascular access.[1] Unfortunately, chronic catheter access is a necessary long term option in patients in whom all other surgical access routes have been exhausted. Despite the higher risk of mortality 21% of chronic hemodialysis patients continue to dialysis using a tunneled hemodialysis catheters.[2] The infectious rates of non-tunneled catheters are even higher and these catheters need to be replaced by a tunneled catheter in 2-4 weeks of use. Early arteriovenous shunt operation is the best way to avoid hemodialysis catheter complications.[3]

In this study we aimed to present ten years experience in usage of tunneled central catheter (TCC) for hemodialysis.

MATERIAL AND METHODS

TCCs were used in patients with no possibility of an AV shunt, and as a bridge in patients waiting for the maturation of the shunt or renal transplantation. The upper and lower extremity veins of the patients were examined by Doppler ultrasonography to evaluate the caliper, intravascular stenosis or thrombi. After the monitorization of the cardiac rhythm in the operating room, the optimal access site was disinfected with povidone iodine and the patient was covered with sterile drapes. lidocaine hydrochloride (2%) was used for local anesthesia before puncture of the vein. The right internal jugular vein was the primary site of catheter placement. In patients with occluded jugular veins, subclavian and femoral veins were used. Intravenous sedation was used if needed. No ultrasonagrapgic guidance was used. A 0.035 inch guidewire was then passed into the superior vena cava through the needle. The guidewire was secured with a thin catheter and a chest wall tunnel was created using the standard techniques. After the control of the free blood flow from the both lumens, the the catheter was positioned and secured with 3/0 prolene sutures, pressure bandage was applied to control possible bleeding. The position of the tip and the angle of the catheter was checked by the X ray (Figure 1). The patients were followed up for 180 (1-320) days for the patency, period of use and possible complications.

STATISTICAL ANALYSIS

Results are expressed as mean values±SD or as numbers and percentages, as appropriate. Student's t-test was used for comparison of continuous data, and the Chi-square test was used for comparison of categorical data. All reported P-values were based on two-sided tests and a P-value of <0.05 was considered significant. All statistical calculations were performed using the SPSS version 19.0 software (SPSS Inc., Chicago, IL, USA).

FIGURE 1: The position of the tip and the angle of the catheter was checked by the X ray (tunneled Central Catheter from right juguler vein).

TABLE 1: Patients profile, etiology and indications.

Patients	n (%)
Age	56.07±3.8
Sex (Female)	49 (45.7%)
Etiology	
Chronic Glomerulonephritis	55 (51.4%)
Diabetic nephropathy	41 (38.3%)
Hypertensive nephrosclerosis	7 (6.54%)
Other	4 (3.7%)
Indications for TVC	
Failed AVF	86 (80.3%)
Bridge Before AVF maturations	18 (16.8%)
Primary Acces	3 (2.8%)

TABLE 2: Catheter placements area.

Placement area	n (%)
Right Jugular Vein	54 (50.4%)
Left Jugular vein	21 (19.7%)
Right subclavian Vein	9 (8.4%)
Left Subklavian Vein	16 (14.9%)
Right Femoral Vein	1 (0.9%)
Left femoral Vein	1 (0.9%)
Inferior Vena Cava	2 (1.8%)
Superior Vena Cava	1 (0.9%)

RESULTS

Between January 2001 and July 2011, 107 patients were treated with TCC in our clinics. The demographic data, and the sites of vascular access are shown in the Table 1 and 2 respectively. The most common indication for the placement of a permenant catheter was the failure to achieve an arteriovenous fistula in 86 patients (80.3%). This was followed by the long maturation time needed for the AV fistula in 18 patients (16.8%) and the initial vascular access in 3 patients (2.8%) waiting renal transplantation. The primary site of vascular access was right internal jugular vein in 54 (50.4%) patients and left internal jugular vein in 21(19.7%) patients. In the remaining 32 patients in whom the Doppler ultrasonagraphic examination proved to have occluded veins, right subclavian vein was used in 9 (8.4%) patients, left subclavian vein was used in 16 (14.9%) patients, right femoral vein was used in 1 (0.9%) patient, left femoral vein was used in 1 patient (0.9%), right common iliac vein was used in 2 (1.8%) patients, superior vena cava was used in 1 patient (0.9%) and inferior vena cava was used in 2 (1.8%) patients. Iliac, inferior vena cava and superior vena cava catheter was inserted by open surgical techniques.

The most common early complication related to the procedure was arrythmia and hypotension caused by the guidewire during the procedure. This was immediately interrupted by the slight withdrawal of the guidewire. The second most common complication was subcutaneous hematoma which was easily controlled by the pressure bandage in 8 patients and catheter thrombosis which was treated by heparin and tPA in 8 patients. The rate of catheter infection was 5% (n=6). The infected catheters were immediately removed and the blood cultures were evaluated in addition to the catheter tip cultures. Central femoral vein catheter infection rate was significantly high (n=2). ($p<0.05$). The offending agent was *Staphylococcus aureus* in 4 patients and *Streptococcus* species in 2 patients and *Escherichia coli* in 1 patient. *S. aureus* was detected in four of six patients and *Streptococcus* species was in the other two patients. The patient that *S. aureus* and *E. coli* were both detected in one patient with central femoral vein catheter. Of 107 catheters placed, only 15 were removed within 7 days of placement.

DISCUSSION

The optimal vascular access for hemodiaylsis is an arteriovenous fistula. Nevertheless, central venous catheters are being more widely used as the definitive mode for vascular access and hemodialysis in a subset of patients who have no other alternative. Different reports show an incidence of central venous catheter use up to 40%.[4] The ideal hemodialysis catheter has to be resistant to development of infection, fibrinous sheath, thrombus or stenosis with flow rates more than 400 mL/dk.[5,6] TCCs are widely used in patients

with limited life expectance, various comorbidities like severe heart failure and thrombosis in lower and upper extremity veins as well as in patients to bridge to renal transplantation or maturation of the AV fistula.[7,8] The average duration of use of a TCC is 6-12 months.[9] The right internal jugular vein is the prefered site of TCC due to its anatomical ease of insertion, vertical position, low rates of venous obstruction and complication. The subclacian vein is more prone to development of venous stenosis and is the second line option for a TCC. The disadvantage of lower extremity vascular venous access is the higher rates of infection, especially in cases which needs catheter for longer than 5 days.

In accorandce with the literature, we used right internal jugular vein in 50.4% of cases. Other insertion sites we employed only after proven thrombosis or stenosis of the right internal jugular vein.

Bleeding and infection are the two most common complications of the TCCs. Pneumothorax, hemothorax, arterial injury and poor positioning and orientation of the catheter are among other complications related to TCCs.[10] The incidence of bleeding in out patients was 7.4% and was only mild necessitating only local compression to control. None of the catheters were removed due to bleeding. This could have been reduced if ultrasonagraphic guidance had been used for venipuncture. The use of ultrasound guidance during tunelled central venous catheterization reduces procedure-related complications to 0.8%.[11]

The mean rate of six months' patency of permanent catheters varies between 48 and 55%.[12] Among the most common reasons for removal of the catheters are infection, kinking of the catheter and insufficient flow. Another cause of early catheter failure was occlusion of the catheter by thrombus or fibrinous sheath.

Eight (7.4%) of the catheters were needed to be removed for this reason. Some, if not all, of these cases may have resolved if tPA had been administered to resolve the thrombi, but only heparin was used without success.

The most common agent isolated in TCC infections is *S. aureus*.[13] In our study group, we encounter 6 cases of catheter infection and the blood cultures isolated *S. aureus* in 3, *Streptococus* species in 2 and *E. coli* in 1 patient. All of the patients recovered after the removal of the catheter. The incidence of the catheter infection in our patients is 5.6%. This is slightly higher than the incidence reported in literature. The possible cause may be the higher rates of insertion sites other than internal jugular vein in our patients.

We have encountered no cases of catheter malpositioning or kinking, as well as no cases of tunnel infection.

CONCLUSION

In conclusion, our ten years experience of TCCs are widely used for the purpose of hemodiaylsis, and the increasing experience prove them to have relatively low rates of infection and complication. The right internal jugular vein is the most commonly used site for patients confort, anatomical venopuncture for reduced risk of pneumothorax, thrombotic and infective complications, uncontrollable arterial injury and relatively straight course into the right atrium.

REFERENCES

1. Collins AJ, Foley RN, Herzog C, Chavers BM, Gilbertson D, Ishani A, et al. Excerpts from the US Renal Data System 2009 Annual Data Report. Am J Kidney Dis 2010;55(1 Suppl 1):S1-420, A6-7.
2. Torun D. [Hemodialysis catheter complications and their management: review]. Turkiye Klinikleri J Nephrol 2012;7(1):18-22.
3. Cakir H, Tor F, Yildiz G, Acipayam M, Karaca S, Ozsoyler I. Arteriovenous access operations: our early results: 38 cases. Turkish Journal of Vascular Surgery 2011;20(3):78-81.
4. Vascular Access Work Group. Clinical practice guidelines for vascular access. Am J Kidney Dis 2006;48(Suppl 1):S248-73.

5. Mickley V. Central venous catheters: many questions, few answers. Nephrol Dial Transplant 2002;17(8):1368-73.
6. Trerotola SO. Hemodialysis catheter placement and management. Radiology 2000; 215(3):651-8.
7. Dittmer ID, Sharp D, McNulty CA, Williams AJ, Banks RA. A prospective study of central venous hemodialysis catheter colonization and peripheral bacteremia. Clin Nephrol 1999; 51(1):34-9.
8. Cetinkaya R, Odabas AR, Unlu Y, Selcuk Y, Ates A, Ceviz M. Using cuffed and tunnelled central venous catheters as permanent vascular access for hemodialysis: a prospective study. Ren Fail 2003;25(3):431-8.
9. Fry AC, Stratton J, Farrington K, Mahna K, Selvakumar S, Thompson H, et al. Factors affecting long-term survival of tunnelled haemodialysis catheters--a prospective audit of 812 tunnelled catheters. Nephrol Dial Transplant 2008;23(1): 275-81.
10. McGee DC, Gould MK. Preventing complications of central venous catheterization. N Engl J Med 2003;348(12):1123-33.
11. Trerotola SO, Johnson MS, Harris VJ, Shah H, Ambrosius WT, McKusky MA, et al. Outcome of tunneled hemodialysis catheters placed via the right internal jugular vein by interventional radiologists. Radiology 1997;203(2):489-95.
12. Jain G, Allon M, Saddekni S, Barker JF, Maya ID. Does heparin coating improve patency or reduce infection of tunneled dialysis catheters? Clin J Am Soc Nephrol 2009;4(11):1787-90.
13. Restrepo Valencia CA, Buritica Barragán CM, Arango A. [Catheter in the superior vena cava for hemodialysis as a last resort in superior hemithorax]. Nefrologia 2010;30(4): 463-6.