Hemodialysis catheter-related complications in Khartoum Teaching Hospital Dialysis Centre.

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Abstract

Background: The use of hemodialysis catheters maybe associated with mechanical and/or infectious complications. The rate of these complications is variable. In this study we looked at the hemodialysis catheter- related complications in Khartoum Teaching Hospital Dialysis Center.

Methods: This was a hospital-based, prospective, cross-sectional study conducted in the Hemodialysis Center in Khartoum Teaching Hospital from September to November 2010. The study population was 100 adult patients who required hemodialysis through central venous catheter.

Results: Internal jugular and femoral veins were used for dialysis access in 83 and 17 patients respectively. Forty five percent of the patients developed complications. Femoral vein was more likely to be associated with infectious complications: 12 out of 17 (70.6%) (P=0,001). Diabetes was a statistically significant predictive factor for the development of complications (P = 0.014).

Conclusion: The use of temporary femoral catheter was considerable. The frequency of the development of complications is increasing. Femoral line and diabetes mellitus were important factors for the development of catheter-related complications.

Introduction

Hemodialysis (HD) is associated with considerable morbidity and mortality. Infections account for approximately 15% of all deaths in this population [(1)]. Despite the efforts to secure permanent access early, catheters remain an essential access to a large number of the hemodialysis patients [(2)]. Tunnelled-cuffed HD catheters are used for long-term vascular access in a small proportion of patients mostly because opportunities for an arteriovenous access are exhausted. However, a significant number of patients require a temporary vascular access because of acute kidney injury; slow maturation or failure of their permanent arteriovenous access; or as bridging to transplantation or peritoneal dialysis. In these situations, un-tunneled catheters might be used.

Recent data of the Dialysis Outcome and Practice Patterns Study showed that 15–50% of patients in Europe and 60% of patients in the US start hemodialysis treatment with catheter as a primary access [(3)]. The major complications of hemodialysis catheters are infection; thrombosis; and malfunction. Marcel et al found that hospitalization rate of patients with un-tunneled catheter was high and it was an independent risk factor for an adverse outcome. The rate of premature removal was higher in un-tunneled femoral catheters, un-tunnelled jugular catheters and tunneled catheter respectively. It is recommended that tunneled catheters should be used whenever it can be foreseen that a hemodialysis catheter is needed for more than 14 days. [(4)]

Currently there is a perception of high rate of HD catheter-related complications in Khartoum Teaching Hospital Dialysis Center.

Objectives

The objectives of this study were to identify central venous catheter-related complications in Khartoum Teaching Hospital Dialysis Centre and to determine factors associated with increased risk of catheter-related complications.

Study design

This was a hospital-based, prospective, cross-sectional study conducted in Khartoum Teaching Hospital Dialysis Center during September to November 2010. One hundred adult patients who required HD through central venous catheter were enrolled. Patients who had a haemodialysis catheter placed were included. Recruitment was an ongoing process throughout the duration of the study. Patients were enrolled based on their presentation and were subsequently followed-up. The data was collected by the co-investigator from patient's records. Personal, demographic, clinical and technical (catheter- related) data were registered. The end-points were death or removal of the catheter.

Probable catheter-related sepsis was defined as significant fever >38.5 C° in a patient with HD catheter for at least 48 hours in the absence of other obvious etiological causes.

End-Stage Renal Disease (ESRD) was diagnosed based on biochemical renal failure and finding bilaterally small contracted kidneys on imaging.

Acute dialysis was defined as a need for dialysis within 48 hours from admission.

Initially the protocol was approved by the Research Committee at Sudan Medical Specialization Board. Written permission was obtained from the Director of Khartoum Teaching Hospital Dialysis Center. Informed consent was taken from the participants. Data was analyzed using computer software. Frequency tables were generated using SPSS program. Continuous data was analyzed using student's t-test and categorical data were analyzed using the chi- square test. The significance levels were set as P less than 0.05.

Results

The study population was 100 patients and the number of catheters were 100, each patient had a single catheter during the study period. Eighteen catheters were cuffed whereas 82 were non-cuffed. Mean age of the patients was 47.73 ±16 years with two thirds (66%) being males. Hypertension and diabetes were seen in 47 and 16 patients respectively, twelve patients had both hypertension and diabetes. Nine out of sixteen (56.3%) diabetic patients developed infectious complications, whereas 33 (39.2%) out of 84 of non-diabetics developed infectious complications. The rate of infection among diabetics was found to be statistically significant (table 1) p=0.026.

End-Stage Renal Disease was the main reason for dialysis in this study (98%). Acute dialysis was performed in 84 patients. Emergency dialysis (within 12 hours of admission) was indicated in 35 patients.

The majority of the catheters: 83 (83%) were inserted into the internal jugular vein. Eighteen (21.6%) were cuffed. The mean duration of catheter utilization was 38 days. There was no significant relationship between the duration of catheter and the development of complications (P=0.08).

Forty five patients had catheter-related complications (table-2). The mean age of this group was 51 ±18 years and the mean catheter duration was 45 days. Thirty-two out of the thirty-nine infected catheters (82.1%) were of the non-cuffed type while the remaining seven (17.9%) were cuffed. Twelve of the infected catheters (28.6%) were femoral; whereas 30 (71.4%) were jugular. Within the femoral site, 12 out of 17 catheters (70.6%) were infected. The site of the catheter insertion was found to be a statistically significant predictor for the development of complications (infectious/ non-infectious (table 3) P=0.001. The majority of catheter-related sepsis (69%) occurred in combination with exit-site infection (ESI). Thirty four of the catheters were complicated by exit site infection(ESI) with mean catheter duration of 47 days.

Seventeen HD catheters were inserted in the femoral vein with a mean duration of 13.9 days. Infectious complications were found in twelve patients (70.6%) (catheter-related sepsis and exit-site infection). Deep vein thrombosis (DVT) was diagnosed in six patients by vascular flow studies. DVT alone was in two patients (11.8%) ;and DVT, with probable CRS, in four patients (23.5%).

Table-1. Correlation between diabetes and the development of catheter-related complications.

	Complications			**Total**
	infectious complication	non-infectious complication	no complication	
DM	9 (56.2%)	2 (12.5%)	5 (31.2%)	16(100.0%)
No DM	33 (39.3%)	1 (1.2%)	50 (59.5%)	84 (100%)
Total	**42 (42%)**	**3 (3%)**	**55 (55%)**	**100 (100%)**

DM Diabetes Mellitus
Fisher sest: P= 0.026

Table-2. Types of Complications associated with haemodialysis catheters of the study population

CRS alone*	7 (7%)
CRS +ESI**	27 (27%)
ESI+/-Tunnel infection	5 (5%)
Thrombosis	6 (6%)
No Complication	55 (55%)
Total	**100**

* CRS= Catheter-related sepsis
**ESI = Exit site infection

Table-3. Correlation between the catheter sites and development of complications

		Complications			**Total**
		Non-infectious	No complication		
site of Catheter	Jugular	30 (36.1%)	1 (1.2%)	52 (62.7%)	83 (100.0%)
	Femoral	12 (70.6%)	2 (11.8%)	3 (17.6%)	17 (100.0%)
Total		**42 (**42.0%)	**3** (3.0%)	**55** (55.0%)	**100** (100.0%**)**

P = 0.001

Discussion

In 1961 temporary HD catheter was introduced for the first time. The catheters continued to be the primary method of acute hemodialysis access [5, 6]. The incidence and risk of infection varied significantly over time and according to the site of insertion. This concept was reflected in the National Kidney Foundation Guidelines on vascular access, which recommended removal of femoral catheters after five days of use and internal jugular catheters after three weeks of use [7]. These guidelines were based on expert opinion.

In this study, ESRD was the main reason for dialysis in 98 patients (98%). All of these patients were dialyzed by temporary catheters. Acute dialysis was done in 84% of the study population. The need for acute dialysis among ESRD patients seems to be a global problem. Mendelssohn et al reported that the prevalence and incidence of temporary catheter in Canada was 33% and 70% respectively [8]. This was strikingly high despite the fact that 85% of Canadian ESRD patients had seen a nephrologist at least once before initiation of dialysis. This problem was also noted in Europe and USA with reported prevalence of 18% and 25%; and incidence of 46% and 66% respectively [8].

In UK it was reported that among patients with chronic kidney disease who required renal replacement therapy, 33% had an acute dialysis [9]. In this study the incidence of acute HD was strikingly high. Further work is needed to find out if this is related to patients, healthcare providers ,or service-related factors.

In this study, internal jugular catheters were used in 83%, but there was a high usage of femoral catheter (17%). This differs from reports by Maya et al [10] and Zaleski *et* al [11] where femoral catheters were placed in only 2%. In those studies, femoral access was used because of bilateral jugular vein occlusion. We wonder if the high rate of using femoral catheters in our study was related to patient's factors (occluded vein or bleeding risk) or doctor's factors (skills).

The study showed 36% of the catheters were removed because of infectious complications (CRS, tunnel infection or ESI). This was high compared to the 16.3% reported by Mark et al, [12], but similar to what was reported by Lukas et al, 41% [13]. Nearly half of the patients (45%) had catheter- related complications. Substantiation of catheter- related blood stream infection requires isolation of the same organism from blood and catheter tip. In this study the diagnosis of CRS was probable. We did not find a single documentation of positive blood culture. This might need to be further evaluated by another study or an audit program.

CRS was reported in jugular and femoral catheters in 69.2% and 30.8% respectively. The majority of CRS (69%) occurred in combination with ESI. ESI might be the source of contamination. Almirall et al [14] reported that three out of nine hemodialysis catheter-related blood stream infections were luminal-related. On the other hand, the rate of ESI was 34%. The majority of ESI (85.3%) was combined with CRS. The study showed that diabetes mellitus was a significant predictive factor for catheter-related infectious complications. Nine out of 16 diabetic patients had catheter-related complications p=0.014.

In the literature, there was a wide variation of blood stream infection incidence for UTCs. It was reported to be 7.6, 5.6 and 2.7 episodes/1000 catheter days for femoral, jugular and subclavian catheters respectively [15-18]. It was reported that the risk of catheter-related complications increases over time, but the threshold at which this happens is not determined [10].

In addition to a high rate of infectious complications associated with femoral catheters, we observed a high frequency of deep vein thrombosis. Almost one third : 6 out of 17 (35.3%) of the patients had DVT in this study which was higher than the 14% and 25% reported in a retrospective study by Zaleski et al[11] and Maya et al respectively[10]. The real frequency of DVT might be underestimated since diagnostic ultrasound was only done in symptomatic patients. Two-thirds of patients with DVT were suspected to have CRS. The diagnosis

of CRS could be confounded by the lack of blood culture; plus the fact that DVT can lead to systemic inflammatory response.

Limitations: Some of the limitations of this study are the small sample size and the lack of blood culture reduce the certainty of CRS.

Conclusion

In this study the use of temporary hemodialysis catheter was considerable in terms of number and duration particularly the femoral line. The frequency of the development of complications is increasing and calls for further investigation and implementation of effective measures. Femoral line was an important and avoidable risk factor unless there were compelling reasons. Since most of the patients had ESRD, it would have been prudent if a permanent access was planned in advance through an effective primary nephrology care unit.

Reference

1- Lafrance JP, Rahme E, Lelorier J, Iqbal S. Vascular access-related infections: definitions, incidence rates, and risk factors. J Kidney Dis. 2008 ;52(5):982-93. Epub 2008.

2- Chan MR. Hemodialysis central venous catheter dysfunction. *Semin Dial. 2008 ;21:516-21. Epub 2008.*

3- Pisoni RL, Young EW, Dykstra DM et al. Vascular access use in Europe and the United States: results from the DOPPS. *Kidney Int 2002; 61: 305–316.*

4- Marcel C. Weijmer, Marc G. Vervloet and Piet M. ter Wee. Compared to tunnelled cuffed haemodialysis catheters, temporary untunnelled catheters are associated with more complications already within 2 weeks of use. *Nephrol Dial Transplant 2004 19: 670–67*

5- Shaldon,S, Chiandussi.L Higgs, B: Haemodialysis by percutaneous catheterization of the femoral artery and vein with regional heparinzation. *Lancet*,*1961; 2: 857-859.*

6- United States Renal Data System: The USRDS Dialysis Morbidity and Mortality Study: Wave 2. Am *J Kidney Dis 1997* ***30****(Suppl): S67–S85*

7- K/DOQI Clinical Practice Guidelines and Clinical Practice Recommendations 2006 Updates Hemodialysis adequacy Peritoneal Dialysis Adequacy Vascular Access. *Am J Kidney Dis. 2006; 48(Suppl 1):S1.*

8- David C. Mendelssohn, Jean Ethier, Stacey J. Elder, et al. Haemodialysis vascular access problems in Canada: results from the Dialysis Outcomes and Practice Patterns Study (DOPPS II) *Nephrol Dial Transplant 2006; 21: 721–728*

9- Jackie Buck, Richard Baker, Ann-Marie Cannaby, et al. Why do patients known to renal services still undergo urgent dialysis initiation? A cross-sectional survey. *Nephrol Dial Transplant 2007; 22: 3240–3245*

10- Maya, Ivan D. - Allon, Michael. Outcomes of tunneled femoral hemodialysis catheters: Comparison with internal jugular vein catheters , Kidney International *Kidney International, 2005; 68: 2886–288*

11- Zaleski, GX, Funaki, B, Lorenz, JM, et al: Experience with tunneled femoral hemodialysis catheters. *Am J Roentgenology* ١٩٩٩ ***172****: 493–49*

12- Little MA, O'Riordan A, Lucey B,etal , prospective study of complications associated with cuffed, tunnelled haemodialysis catheters. *Nephrol Dial Transplant2001;16:2194-200*

13- L K Kairaitis, T Gottlieb Outcome and complications of temporary haemodialysis catheters**.** *Nephrol Dial Transplant 1999; 14:1710-1714*

14- Almirall, J, Gonzalez, J, Rello, J, et al. Infection of hemodialysis catheters: Incidence and mechanisms. *Am J Nephrol. 1989;* ***9****:454–459*

15- Butterly DW, Schwab SJ. Dialysis access infections. *Curr Opin Nephrol Hypertens 2000;9:631–5.*

16- Kairaitis LK, Gottlieb T. Outcome and complications of temporary haemodialysis catheters. *Nephrol Dial Transplant 1999;14:1710–4.*

17- Oliver MJ, Callery SM, Thorpe KE, Schwab SJ, Churchill DN. Risk of bacteremia from temporary haemodialysis catheters by site of insertion and duration of use: a prospective study. *Kidney Int 2000;58:2543–45.*

18- Saad TF. Bacteremia associated with tunneled, cuffed hemodialysis catheters. *Am J Kidney Dis 1999;34:1114–24.*