

Skin fold technique for central venous catheter fixation; Comparison with conventional method for postoperation infections

Morteza Khavanin Zadeh^{*1}, Hamid Nouri², Yousef Moradi³, Ladan Reza⁴
Rashin Joodat⁵, Shahrzad Arya⁶

Received: 18 May 2015

Accepted: 12 June 2016

Published: 8 October 2016

Abstract

Background: Central Venous Catheters (CVCs) are used not only as a tool to access to central venous system, but also for hemodynamic monitoring, parenteral nutrition, chemotherapy and hemodialysis. The use of CVCs is associated with some complications notably infections that are troublesome both to patient and physician. We conducted this study to examine catheter fixation with skin fold technique and to evaluate risk of catheter infection in this method and compare it to conventional technique.

Methods: This study is a controlled clinical trial (IRCT: IRCT2015081723229N1) and all cases are patients over 18 years, admitted to Hasheminejad Kidney Center from 2011 to 2012, who needed an internal jugular venous catheter for hemodialysis. Finally, two hundred and twenty two patients entered the study. We used chi square test and logistic regression for data analysis. P-value less than 0.05 was considered significant.

Results: In this study Mean±SD age of patients was 54.50±15.71 years. Mean ±SD ages of patients in the case and control group were 54.56±16.43 and 54.42±14.84 years, respectively. The rate of catheter infection significantly decreased with skin fold technique: Five patients (3%) in case group and 13 patients (16%) in control group had infection (p=0.002).

Conclusion: The findings of this study demonstrated that catheter fixation with skin fold could be an appropriate technique in comparison with current conventional method. However, further studies on other possible and unpredictable complications of this technique is required.

Keywords: Central venous catheter, Fixation, Infection.

Cite this article as: Khavanin Zadeh M, Nouri H, Moradi Y, Reza L, Joodat R, Arya Sh. Skin fold technique for central venous catheter fixation; Comparison with conventional method for postoperation infections. *Med J Islam Repub Iran* 2016 (8 October). Vol. 30:419.

Introduction

Invention of Central Venous Catheters (CVCs) in late 1970s was a great change in treatment of patients with end stage renal disease (ESRD) who needed hemodialysis (HD) (1). Based on previous reports, 15 to 50% of ESRD patients start their HD sessions with CVC (2). CVCs are used not only as an access to central venous system, but also for hemodynamic monitoring, parenteral nutrition, chemotherapy, hemodialysis, etc. The use of central venous cath-

eters is associated with some complications that are troublesome both to patient and physician (3-5). In the United States, physicians insert more than 5 million CVCs every year (6). Unfortunately, more than 15% of these catheterizations develop complications. Mechanical complications including arterial puncture, hematoma, hemothorax, pneumothorax and injury to brachial plexus are reported to occur in 5 to 19 percent of patients (7-10). Infectious complications occurred in 5 to 26 percent (7,10-12) and

¹. (Corresponding author) Associate Professor of Surgery, Department of Surgery, Hasheminejad Kidney Center, Iran University of Medical Sciences, Tehran, Iran. mkhavanin@yahoo.com

². Assistant of General Surgery, Department of Surgery, Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran. hnoory86@yahoo.com

³. MSc in Epidemiology, Pars Advanced and Minimally Invasive Manners Research Center, Pars Hospital, Iran University of Medical Sciences, Tehran, Iran. yousefmoradi211@yahoo.com

⁴. Assistant of Emergency Medicine, Department of Emergency Medicine, Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran. ladanreza@gmail.com

⁵. General Physician, Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran. ju_pi_ter_2004@yahoo.com

⁶. General Physician, Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran. dr.shahrzad.arya@Gmail.com

thrombotic complications in 2 to 26 percent (7,8). Early complications such as air embolism and cardiac arrhythmias are rare (13,14). Bassi and colleagues listed malfunction and infection as the most common complications of central venous catheterization (13). Nowadays, CVC is routinely used when a patient without arterio-venous fistula (AVF) needs urgent dialysis (15). The preferred insertion site is the right internal jugular vein (IJV) mainly because in a great majority of cases it does not interfere with probable AVF creation on the ipsilateral upper extremity (16). Although some studies showed catheterization in internal jugular vein and subclavian vein to have lower risk of catheter infection, Marik PE et al showed same incidence of catheter infection in the three veins (17). Some various known infection complications includes local infection in the site of insertion followed by migration of the pathogen along the external catheter surface, intraluminal catheter colonization from contamination of the catheter hub, and infectious thrombophlebitis and catheter-related blood stream infection (CRBSI) (18-19). Infected catheters may be the starting point of bacteremia, sepsis and even metastatic complications such as endocarditis, septic arthritis, and epidural abscess. The relative risk of bacteremia was 7-fold higher in ESRD patients who underwent maintenance HD with temporary catheters compared with those with permanent AVF (20). Risk of catheter infection is reported to be 8.6, 4 and 15.3 per 1000 days catheter stay in internal jugular vein, subclavian vein and femoral vein, respectively (21). Catheter related infections increase hospital stay, morbidity and mortality of patients. It has been estimated that in the United States, more than 200,000 CRBSI happen each year and related mortality has been reported to be 12 to 25%. Risk of developing complications of CVCs is related to sort of catheter, site of insertion, duration of stay, rate of manipulation and patient's health status (19,22). We conducted this study to examine catheter fixation with skin fold

technique and evaluated risk of catheter infection in this method and compared it to conventional technique.

Methods

This is a controlled clinical trial (IRCT: IRCT2015081723229N1) approved by the Ethical Committee of Iran University of Medical Sciences. Code of ethical Committee is 9011245019. Written consent forms were obtained from participants and for patients who were illiterate the consent form was read by researcher then verbal consent was obtained. Sample included all patients over 18 years, admitted to Hasheminejad Kidney Center from 2011 to 2012, who were in need of an internal jugular venous catheter for hemodialysis. The goal of study and interventions explained to all patients and they entered the study after signing the consent form. Patients were free to exit any time during the survey and their private information kept private. Two hundred and twenty two patients entered the study. Patients with systemic infection or those with history of coagulation disorders were excluded. Those cases estimated to have the catheter for less than 5 days and others who did not refer to hospital for follow-up, were also excluded from the study. Patients were randomly divided to skin fold suturing (127 patients) and standard suturing (95 patients) groups. Non-cuffed internal jugular catheter fixed for all patients by same surgeon under ultra-sonography guidance. For skin fold suturing group, skin folds used for fixation and for standard suturing group the catheter was fixed via simple suturing method.

Standard suturing technique: As it can be seen from Fig.1, in standard suturing the eyes of catheter is directly fixed to skin.

Skin fold suturing technique: In this new method according to Figs. 2-4 a fold of skin underneath and above the catheter is created on both sides and sutured to the eyes of catheter so that the catheter is strongly embedded in place and its port of entrance and the free margins of skin are kept far from the surface



Fig. 1. Catheter embedded in place

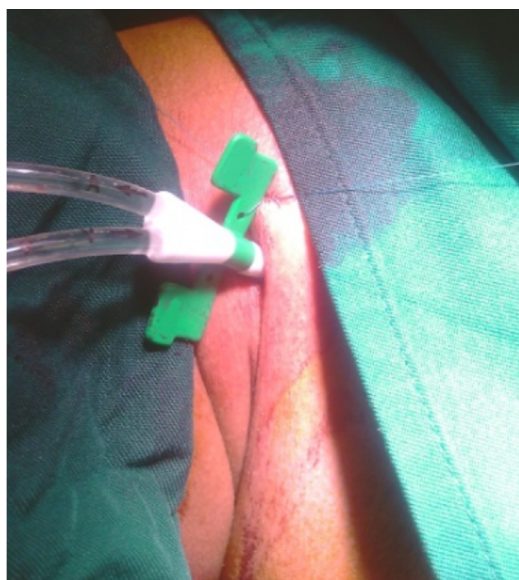


Fig. 2. A fold of skin underneath the catheter

In case of any complication other than infection, catheter was removed and the patient excluded from the study. Patients regularly came to hospital for dialysis session and surgery consultation were interviewed for probable catheter infection. Systemic infection was considered if the patient developed fever, chills, leukocytosis or local erythema. In these cases blood culture was carried out, and in positive cases, the patient was diagnosed with catheter infection and catheter was removed and treatment with broad spectrum antibiotics ensued. A check list made for each patient and demographic data, examination and laboratory data were filled out.

Chi-square (χ^2) test was used for categor-



Fig. 3. A fold of skin above the catheter



Fig. 4. Sutured to the eyes of catheter so it is strongly embedded

ical variables. Logistic regression models were employed to adjust and set the variables sequentially to those included in the models. The main effects of sex, duration of disease, and age simultaneously were estimated while controlling patients' characteristics. P value less than 0.05 was considered significant.

Results

Two hundred and twenty two patients entered this study. Mean \pm SD age of patients was 54.50 ± 15.71 years. Mean \pm SD age of patients in the case and control group was 54.56 ± 16.43 and 54.42 ± 14.84 years, respectively. About 58% (n=74) of patients in case group and 46% (n=44) of the patients

Table 1. Characteristics of study population

	Skin fold suturing (n=127)	Standard suturing (n=95)
Age	54.56±16.43	54.42±14.84
Gender		
Male	74 (58.3%)	44 (46%)
Female	50 (39.4%)	51 (54%)
Duration of treatment	51.60±33.81	50.30±39.97
Infection		
Yes	5	11
No	122	84
Chi-square		
P	0.002	

Table 2. Logistic Regression for main effects of sex, duration of disease, surgery and age on infection (n=222)

Variables	Unstandardized coefficients		OR adjusted	p	95%CI	
	B	SE			Lower	Upper
Age	-0.014	0.017	0.986	0.433	0.953	1.021
Duration	0.003	0.007	1.003	0.658	0.161	1.360
Sex	-0.758	0.546	0.468	0.165	0.989	1.017
Surgery	-1.499	0.557	0.223	0.007	0.075	0.665

in the control group were male. Mean \pm SD duration of catheter stay in the case and control group were 51.6 ± 33.8 and 50.3 ± 39.9 , respectively (Table 1).

Five patients (4%) in case group had infection, while 11 patients (11%) in control group developed infection and Chi-square test showed that rate of catheter infection significantly decreased with skin fold technique ($p=0.002$) (Table 1). We presented the odds ratios interpretation for the main effects and interactions from model to derive separate odds ratios for sex, duration of treatment, and age patient differences (Table 2). Finally, in this study surgery was significant effect on infection in case and control groups. Also flap was a protection factor for incidence infection in case and control groups (OR=0.222, 95%CI=0.075 – 0.665) (Table 2).

Discussion

Previous studies reported the rate of catheter infection from 4 to 25%; depending on site of insertion, usage, duration of stay and patient's health status (22). In a systematic review by Marik and colleagues rate of systemic infection from catheter was 2.5 in 1000 days catheter stay (17). In a study by Beigi et al the most common complication of CVCs was infection in Patients with Re-

nal Failure; which was 15.3% and 13.6% in temporary and permanent catheters, respectively (23). In another study by Beigi et al on 96 burned patients who needed CVC, catheter infection was the most common complication and happened in 12.4% of cases (24). Qureshi et al evaluated catheter infection in sixty ESRD patients. 51.6% of catheters colonized with bacteria and 25% of patients had bacteremia (25). Another study by Shahmoradi et al in Hasheminejad Kidney Center, on 150 ESRD patients undergoing HD with temporary CVC, infection was the most common complication and risk of complications significantly increased by advanced age, anemia, and increased blood urea nitrogen and serum creatinine level (26). Rate of catheter infection in our control group was 11% which is comparable with previous studies on general population; however, it was less than Qureshi's study on ESRD population.

Catheter fixation via skin fold is a new technique and to our knowledge, no study has compared it with simple suturing technique. Significant decrease in rate of systemic infection in our study group shows that this technique can potentially replace the conventional method. However, further studies on other possible and unpredictable complications of this technique is required.

We also suggest clinical trial with greater sample size for comparison between skin fold technique and simple suturing in other sites of accessing central venous system. Considering our patients were ESRD, repeated trial on non ESRD patients would be beneficial.

Conclusion

The findings of this study demonstrated that catheter fixation with skin fold could be an appropriate technique in comparison with current conventional method. However, further studies on other possible and unpredictable complications of this technique is required.

References

1. Pittet D, Tarara D, Wenzel RP. Nosocomial bloodstream infection in critically ill patients: excess length of stay, extra costs, and attributable mortality. *JAMA* 1994;271:1598-601.
2. Arnow PM, Quimosing EM, Beach M. Consequences of intravascular catheter sepsis. *Clin Infect Dis* 1993;16:778-84.
3. Richards MJ, Edwards JR, Culver DH, Gaynes RP. Nosocomial infections in medical intensive care units in the United States. *Crit Care Med* 1999; 27:887-92.
4. Raad I. Intravascular-catheter-related infections. *Lancet* 1998;351:893-8.
5. Merrer J, De Jonghe B, Golliot F, Lefrant JY, Raffy B, Barre E, et al. Complications of femoral and subclavian venous catheterization in critically ill patients: a randomized controlled trial. *JAMA* 2001;286:700-7.
6. Sznajder JJ, Zveibil FR, Bitterman H, Weiner P, Bursztein S. Central vein catheterization failure and complication rates by three percutaneous approaches. *Arch Intern Med* 1986;146:259-61.
7. Veenstra DL, Saint S, Saha S, Lumley T, Sullivan SD. Efficacy of antiseptic-impregnated central venous catheters in preventing catheter-related bloodstream infection: a meta-analysis. *JAMA* 1999;281:261-7.
8. Khavanin Zadeh M, Alemrajabi M, Alemrajabi F. Frequency of central venous thrombosis symptoms and signs in patients who have history of catheter insertion via internal jugular and subclavian veins. *J Vascul Acc* 2012;13(4):542.
9. Mansfield PF, Hohn DC, Fornage BD, Gregurich MA, Ota DM. Complications and failures of subclavian-vein catheterization. *N Engl J Med* 1994; 331:1735-8.
10. Raad I, Darouiche R, Dupuis J, Abi-Said D, Gabrielli A, Hachem R, et al. Central venous catheters coated with minocycline and rifampin for the prevention of catheter-related colonization and bloodstream infections: a randomized, double-blind trial. *Ann Intern Med* 1997;127:267-74.
11. Kingdon EJ, Holt SG, Davar J, Pennell D, Baillood RA, Burns A, et al. Atrial thrombus and central venous dialysis catheters. *Am J Kidney Dis* 2001;38(3):631-9.
12. Poort SR, Rosendaal FR, Reitsma PH, Bertina RM. A common genetic variation in the 3'- untranslated region of the prothrombin gene is associated with elevated plasma prothrombin levels and an increase in venous thrombosis. *Blood* 1996; 88:3698-703.
13. Bassi KK, Giri AK, Pattanayak M, Abraham SW, Pandey KK. Totally implantable venous access ports: retrospective review of long-term complications in 81 patients. *Indian J Cancer* 49(1):114-8, 2012.
14. Morosetti M, Meloni C, Gandini R, Galderisi C, Pampana E, Nicoletti M, et al. Late symptomatic venous stenosis in three hemodialysis patients without previous centralvenous catheters. *Artif Organs* 2000;24(12):929-31.
15. Ibrik O, Samon R, Roca R, Viladoms J, Mora J. Tunneled catheters for hemodialysis of the type «twin Tesio catheters system» by ultrasound-guided technique. *Nefrología* 2006;6(6):719-25.
16. Schillinger F, Schillinger D, Montagnac R, Milcent T. Post catheterization vein stenosis in haemodialysis: comparative angiographic study of 50 subclavian and 50 internal jugular accesses. *Nephrol Dial Transplant* 6(10), 722-724.
17. Marik PE, Flemmer M, Harrison W. The risk of catheter-related bloodstream infection with femoral venous catheters as compared to subclavian and internal jugular venous catheters: a systematic review of the literature and meta-analysis. *Crit Care Med* 2012;40(8):2479-85.
18. DC. McGee, MK. Gould. Preventing Complications of Central Venous Catheterization. *N Engl J Med*. 2003;348:1123-33.
19. Maki DG, Stolz SM, Wheeler S, Mermel LA. Prevention of central venous catheter-related bloodstream infection by use of an antiseptic-impregnated catheter. A randomized, controlled trial. *Ann Intern Med* 1997;127(4):257-66.
20. Hoen B, Paul-Dauphin A, Hestin D, Kessler M. EPIBACDIAL: a multicenter prospective study of risk factors for bacteremia in chronic hemodialysis patients. *J Am Soc Nephrol* 1998;9(5):869-876.
21. Graham AS, Ozment C, Tegtmeyer K, Lai S, Braner DAV. Videos in clinical medicine. Central venous catheterization. *N Engl J Med* 2007;356:e21.
22. Charalambous C, Swoboda SM, Dick J, Perl T, Lipsett PA. Risk factors and clinical impact of central line infections in the surgical intensive care unit. *Arch Surg* 1998;133(11):1241-1246.
23. Beigi A, Ghaheri H, Davaroanah A, Alavi L.

The Efficacy and Complications of Temporary and Permanent Central Venous Catheters in Patients with Renal Failure. *J of Isfahan Med School* Jan 2012;29(163).

24. Beigi A, Sayyadi M, Yousefzadeh M, Babakhani A. Evaluating the central venous catheter complications of burned patients in Imam Mousa Kazem Hospital of Isfahan during 2007-8. *Feyz, J Kashan Uni Med Sci* 2011;14(5):483-487.

25. Qureshi AL, Abid K. Frequency of catheter related infections in haemodialysed uraemic patients. *JPMA* 2010;60(8):671.

26. Shahmoradi MK, Khavaninzadeh M, Mousavi K. Catheter related complications and survival among Iranian ESRD patients treated in Hasheminejad hospital; 2010-2011. *Razi J of Med Sci* Feb-Mar 2013;19(105):21-27.