

Incidence and Risk Factors of Peripherally Inserted Central Catheter-related Complications in Patients with Diabetes: A Retrospective Study

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Abstract: Background: Peripherally inserted central catheters (PICCs) related complications are common in catheterization patients. Many patients with PICC catheterization have diabetes mellitus. The data of incidence and risk factors in diabetic patients are scarce. Methods: A retrospective, multicenter study was performed on diabetic patients with PICC insertion from May 2017 to June 2018. A mobile App was used to collect patients and insertion information. We used univariable and multivariable analysis to examine the risk factors of PICC-related complications. Results: A total of 103 diabetic patients were included with 13 (12.6%) patients developed complications. In univariable analysis, marriage ($P=0.002$), prior surgery ($P<0.001$) were associated with complications. Following logistic regression analysis, marriage (OR 0.13, 95 CI% 0.03-0.58, $P=0.007$) and prior surgery (OR 2.30, 95% CI 2.33-42.68, $P=0.002$) remained to be independent risk factors of complications. Conclusion: For diabetic patients, paying more attention to these who unmarried and have surgery history may reduce the risk of adverse outcome.

Keywords: Peripherally Inserted Central Catheters, Diabetes, Complications, Risk Factors

1. Introduction

At present, about 422 million people worldwide have diabetes [1]. In the past three decades, the prevalence of diabetes has risen dramatically all over the world. In China, there are more than 97 million people with diabetes and the growing trend can't be ignored [2]. Peripherally inserted central venous catheters (PICCs) are widely used in medical practice due to its safety and efficacy especially in cancer patients [3]. However, the incidence of PICC-

related complications is high and previous study reported the incidence up to 24.7% [4]. It has been reported that about 44% of patients with catheterization have diabetes mellitus [5]. There are many complications in diabetic patients themselves, so special attention should be paid to diabetic patients with catheterization. At present, few studies concerned about the incidence of catheterization in diabetic patients. Our study was performed to estimate incidence and identify risk factors of PICC-related complications in diabetic patients.

2. Materials and Methods

2.1. Study Design

In August 2019, we performed a retrospective study on diabetic patients who underwent PICC placement between May 2017 to June 2018 at 126 multicenters in China. We collected data concerning patients' demographic characteristics, comorbidities, insertion characteristics and complication information during insertion and follow-up period by mobile App. All records on mobile App were filled out by professional nurses team. The primary endpoint was PICC-related complications which include phlebitis, thrombosis, infection, bleeding, upperextremity edema and mechanical complications.

2.2. PICC Placement Technique

All PICCs (Cathicoid™, Branden Medical Scientific, Inc.) were placed using standard aseptic precaution by qualified nurses. Catheters used during the study period were 4F, silicone catheters. Portable ultrasonography was performed to evaluate a suitable insertion vein before PICC insertion. Catheter insertions by radiologists were performed in the interventional radiology suite, and confirmation of location of the catheter tip was obtained with fluoroscopy. Catheters were routinely maintained weekly by professional nurses team according to instructions. All patients were followed-up until they met criteria for a PICC-related complication or PICC removal.

2.3. Statistical Analysis

Demographic characteristics and potential risk factors were summarized using descriptive statistics: mean (\pm standard deviation [SD]) for continuous variables and frequency (percent) for categorical variables. Chi square or Fisher exact test and logistic regression analysis were used to estimate the risk factors of PICC-related complications. Enter method was used for logistic regression models. $\alpha=0.05$ was used for the significance to enter the model, and $\alpha=0.10$ was used for significance level to delete from the model. All statistic tests were two sided and P value of <0.05 indicated statistical significance. The statistical analysis was performed with SPSS software (version 21.0, SPSS Inc., IBM, NY, USA).

3. Results

Totally 103 diabetic patients were enrolled in the study of whom 13 (10.3%) occurred PICC-related complications. Table 1 showed the basic characteristics were comparable between diabetic patients with and without complications except marriage ($P=0.002$) and prior surgery ($P<0.001$). The mean age was 58.6 ± 10.8 and male accounted for 43.7% of all objects. Diabetic patients who smoke and drink accounted for 28.2% and 22.3% respectively. The results of other basic variables were showed in table 1.

Table 1. Baseline characteristics of patients and univariate analysis of complications.

	Total N=103	Patients without complications n=90 (89.7%)	Patients with complications n=13 (10.3%)	χ^2	P value
Age*, year	58.6 \pm 10.8	58.6 \pm 10.6	58.3 \pm 12.8	-0.10	0.920
Gender, Male	4 (43.7)	3 (42.2)	(53.8)	0.624	0.430
Weight*, kg	69.0 \pm 21.7	69.4 \pm 22.7	66.7 \pm 13.2	-0.41	0.685
Marriage, married ^Δ	8 (86.4)	8 (91.1)	(53.8)	-	0.002
Smoke ^Δ	2 (28.2)	2 (27.8)	(30.8)	-	1.000
Drinking ^Δ	2 (22.3)	2 (23.3)	(15.4)	-	1.000
Type of disease ^Δ				4.31	0.320
Digestive tract tumor	3 (35.0)	3 (36.7)	(23.1)		
Breast cancer	1 (12.6)	1 (12.2)	(15.4)		
Lung cancer	1 (13.6)	1 (11.1)	(30.8)		
ICU status	(6.8)	(6.7)	(7.7)		
Other diseases	33 (32.0)	3 (33.3)	(23.1)		
Coronary heart disease ^Δ	2 (23.3)	2 (22.2)	(30.8)	-	0.495
Liver cirrhosis ^Δ	1 (10.7)	11 (12.2)	(0.0)	-	0.351
Prior surgery ^Δ	3 (30.1)	2 (23.3)	1 (76.9)	-	<0.001
Site of PICC insertion ^Δ				0.25	0.617
Right arm	6 (60.2)	5 (61.1)	(53.8)		
Left arm	4 (39.8)	3 (38.9)	(39.8)		
Vein of PICC insertion ^Δ				0.28	1.000
Basilic vein	9 (89.3)	8 (88.9)	1 (92.3)		
Brachial vein	(2.9)	(3.3)	(0.0)		
Cephalic vein	(7.8)	(7.8)	(7.7)		
Inserting Length*, mm	41.1 \pm 3.8	41.0 \pm 3.0	41.3 \pm 3.0	0.22	0.825

*: t test; ^Δ: Fisher exact test

The logistic regression analysis result showed married status (OR 0.13, 95 CI% 0.03-0.58, $P=0.007$) was the protective factor and prior surgery (OR 9.98, 95% CI 2.33-

42.68, $P<0.001$) increased the risk of PICC-related complications. Prior surgery had a greater influence on PICC-related complications than marriage. (Table 2)

Table 2. Logistic Regression analysis of complications.

	β	OR	95% CI	P value
Marriage	-2.03	0.13	0.03-0.58	0.007
Prior surgery	2.30	9.98	2.33-42.68	<0.001

4. Discussion

This study was designed to identify patient- and catheter-related risk factors of PICC-related complications in diabetic patients. Based on retrospective study which collected data on 103 diabetic patients in 126 multicenters conducted between May 2017 and June 2018, we found that the total incidence of PICC-related complications was 10.3%, married status could reduce the incidence of complications while prior surgery increase the risk of complications.

PICCs are widely used worldwide and have been an increasingly popular way for long-term intravenous access for patients. However, the high complications rate raised concern of the safety of PICC. Even a previous review reported the complications rate up to 50% [6]. The PICC-related complications can be life-threatening and sometimes interrupt the treatment process and ultimately lead to increased cost and decline in quality of life. Our study found the frequency of complications was relatively low and the lower incidence in our study may benefit from skilled operation, better respect of the maximal sterile barrier precautions, improvement of compliance and properties of PICC. Meanwhile, we can further reduce the incidence of complications by paying more attention to unmarried patients or patients with surgery history.

Previous studies showed catheter type [6], study objects [4] and sample size [7] et al could influence the incidence of complications. However, most of the previous and present studies were conducted in cancer patients [4, 8, 9]. Our study aimed to guide clinical practice for diabetic patients. It is generally known that the diabetic status is related to high risk of vascular disease [10, 11]. The possible mechanisms are as follows: hyperglycemia may accelerate platelet activation, inflammation, apoptosis and endothelial dysfunction and ultimately lead to decreased vascular function [12]. This study demonstrated a reliable result that Cathicoid™ PICC was safe for the long-term use in diabetic patients. However, the event rates of diabetic patients remain considerably higher compared to the general population.

Previous studies have explored risk factors for PICC complications such as gender, body mass index, but no consensus has been reached yet [13-15]. Our study focused on diabetic patients and found married status and surgical history were the influencing factors of PICC-related complications. It is easy to understand that married people can get more care than unmarried people especially in situations like PICC catheterization that need to be taken care of. In addition, relationships and emotions from relatives have an impact on the patient's condition. Therefore, doctors and nurses should take more care to patients when meet unmarried diabetic patients. The health of diabetic patients will further decline if they have undergone operations before

insertion, so many complications including phlebitis, infections and mechanical complications will increase accordingly.

There are several limitations of this study. Firstly, the factors influencing the occurrence of complications in this study are not comprehensive. Secondly, we did not explore the situation of specific complications. These limitation is worthwhile for us to overcome and do further research.

5. Conclusion

The incidence of PICC-related complications was 10.3% in diabetic patients and the influence factors were married status and prior surgery. Married status was the protective factor while prior surgery was the risk factor of PICC-related complications. Married patients can get better care from their families, however, unmarried patients may lack emotional support and care from their partners. Therefore, medical staff should pay more attention to unmarried patients when conducting medical activities. In addition, special attention should be paid to the nursing of patients with a history of surgery. Their physical function may have been impaired, so their physical condition should be closely monitored before and after treatment. For the nursing of other diseases, medical staff also pay attention to unmarried and patients with a history of surgery as much as possible.

References

- [1] World Health Organization. Diabetes [M]. Available from: <https://www.who.int/health-topics/diabetes>.
- [2] National Health Commission of the People's Republic of China. Health China Action [M]. 2019-07-15. Available from: <http://www.nhc.gov.cn/xcs/s7847/201907/704b1ca3555e47c6a677e384a462bd7c.shtml>.
- [3] Tejedor S C, Tong D, Stein J, et al. Temporary central venous catheter utilization patterns in a large tertiary care center: tracking the "idle central venous catheter" [J]. Infection control and hospital epidemiology, 2012, 33 (1): 50-57.
- [4] Bertoglio S, Faccini B, Lalli L, et al. Peripherally inserted central catheters (PICCs) in cancer patients under chemotherapy: A prospective study on the incidence of complications and overall failures [J]. Journal of surgical oncology, 2016, 113 (6): 708-714.
- [5] Chopra V, Ratz D, Kuhn L, et al. PICC-associated bloodstream infections: prevalence, patterns, and predictors [J]. The American journal of medicine, 2014, 127 (4): 319-328.
- [6] Sekold W S, Dwyer T. A comparison of silicone and polyurethane PICC lines and postinsertion complication rates: a systematic review [J]. The journal of vascular access, May-Jun 2015, 16 (3): 167-177.
- [7] Kang J, Chen W, Sun W, et al. Peripherally inserted central catheter-related complications in cancer patients: a prospective study of over 50, 000 catheter days [J]. J Vasc Access, 2017, 18 (2): 153-157.

- [8] Dutia M, White R H, Wun T. Risk assessment models for cancer-associated venous thromboembolism [J]. *Cancer*, 2012, 118 (14): 3468-3476.
- [9] Saber W, Moua T, Williams E C, et al. Risk factors for catheter-related thrombosis (CRT) in cancer patients: a patient-level data (IPD) meta-analysis of clinical trials and prospective studies [J]. *Journal of thrombosis and haemostasis: JTH*, 2011, 9 (2): 312-319.
- [10] D'amico G, Fabris T, Mojoli M, et al. Impact of drug-eluting stent generation on patient- and stent-related adverse events of diabetic patients treated by percutaneous coronary intervention [J]. *Minerva cardioangiologica*, 2014, 62 (1): 9-18.
- [11] Tarantini G, Facchin M, Capodanno D, et al. Paclitaxel versus sirolimus eluting stents in diabetic patients: does stent type and/or stent diameter matter?: long-term clinical outcome of 2, 429-patient multicenter registry [J]. *Catheterization and cardiovascular interventions: official journal of the Society for Cardiac Angiography & Interventions*, 2013, 81 (1): 80-89.
- [12] Ishihara M. Acute hyperglycemia in patients with acute myocardial infarction [J]. *Circulation journal: official journal of the Japanese Circulation Society*, 2012, 76 (3): 563-571
- [13] Al-asadi O, Almusarhed M, Eldeeb H. Predictive risk factors of venous thromboembolism (VTE) associated with peripherally inserted central catheters (PICC) in ambulant solid cancer patients: retrospective single Centre cohort study [J]. *Thrombosis journal*, 2019, 17: 2.
- [14] Jones D, Wismayer K, Bozas G, et al. The risk of venous thromboembolism associated with peripherally inserted central catheters in ambulant cancer patients [J]. *Thrombosis journal*, 2017, 15: 25.
- [15] Paquet F, Boucher L M, ValentI D, et al. Impact of arm selection on the incidence of PICC complications: results of a randomized controlled trial [J]. *J Vasc Access*, 2017, 18 (5): 408-414.