SHORT REPORT

The power peripherally inserted central catheter is superior to a central venous catheter in management of patients with esophageal variceal bleeding undergoing devascularization

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Abstract

Peripherally-inserted central catheters (PICC) have a greater retention time and less complications compared to central venous catheters (CVC). The study was conducted from From January of 2014 to December 2015 at Beijing DiTan Hospital, Beijing, China, and comprised 70 patients undergoing devascularisation. Of the total, 36(51.4%) patients underwent placement of PICC (Group A), while 34(48.6%) underwent had CVC (Group B). Venous catheterisation was successful in all patients. The median duration of venous catheterization in Group A was greater than that in Group B (p=0.002). Catheter-associated complications did not differ between the groups (p=0.46). The level of blood platelet (PLT) count, Prothrombin activity (PTA) and white blood cell (WBC) count before venous catheterisation were independent risk factors for bleeding at the puncture site and catheter-related infections. A Power PICC may be a better choice than a CVC in patients undergoing devascularisation requiring catheterisation. For patients with a lower PLT count, a decreased PTA, or a decreased WBC, venous catheterisation should be performed with caution.

Keywords: Portal hypertension, Oesophageal bleeding varices, Devascularisation, Peripherally-inserted central catheters, PICC, Central venous catheterisation, CVC.

Introduction

Peripherally-inserted central catheters (PICC) have a greater retention time and fewer complications compared to central venous catheters (CVC).[1] A typical PICC line cannot handle rapid intravenous (IV) infusion which limits markedly the use of a typical PICC line in major operations.[2] The development of the power-injectable PICC (Power PICC) now allows rapid infusion and causes fewer catheter-related complications than the ordinary PICC.[3] To date, there have been no studies comparing a Power PICC to a CVC in patients undergoing major abdominal surgery. The current study was planned to evaluate the safety and feasibility of CVC versus Power PICC in patients undergoing devascularisation.

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Methods and Results

The study was conducted from From January of 2014 to December 2015 at Beijing DiTan Hospital, Beijing, China, and comprised patients undergoing devascularisation. Of the total 86 patients who underwent devascularisation, 70(81.3%) were selected based on the Practice Guidelines developed by the American Society of Anaesthesiologists.[4] In the preoperative stage, the surgeon and the patient discussed the use of either a CVC or a PICC. The patients made their choices. The Power PICCs (5F dual lumen; Bard Access Systems; Salt Lake City, UT, USA) were placed by a specialised team of nurses under the supervision of interventional radiologists (Group A). The CVC catheters (7F dual-lumen; Arrow International; Reading, PA, USA) were inserted in the operating room immediately preoperatively by experienced anaesthesiologists guided by

Table-1: Demographic and clinical characteristics of the two Groups.

	Group A (n=36)	Group B (n=34)	P value
Sex (M/F)	28/8	30/4	0.345
Age (years)	46 (33-65)	43 (27-60)	0.984
Child-Pugh score	6 (5-7)	6 (5-7)	0.445
MELD score	8 (6-11)	8 (6-14)	0.792
WBC (per mm^3)	2,050 (930-3,470)	2,450 (1,520-3,870)	0.090
Platelets (per mm^3)	55,000 (20,300-96,300)	55,00 (21,600-155,300)	0.832
Prothrombin activity (%)	73 (51.4-102.0)	73 (46-98)	0.060
INR	1.1 (0.9-1.2)	1.1 (0.9-1.5)	0.540
Operative duration (min)	240 (180-405)	270 (210-405)	0.060
Blood loss (ml)	350 (100-1500)	500 (150-1000)	0.101
total volume of intraoperative intravenous infusion (ml)	3500 (3000-4100)	3600 (2800-3900)	0.055
Intraoperative blood transfusion (yes/no)	8/28	14/20	0.123
Postoperative hospital stay (day)	20 (10-64)	21 (12-47)	0.423

MELD: Model for end-stage liver disease score.
WBC: White blood cell counts.
INR: International normalised ratio.

Table-2: Catheter complications of the two groups.

Complications	Group A (n=36)		Group B (n=34)		P value
	Number	Events/1000 catheter days	Number	Events/1000 catheter days)	
Minor haemorrhage	4	5.9	8	18.7	0.213
Minor oozing	4	5.9	6	14.0	0.508
Mild haematoma	0	0	2	4.7	0.232
Infection complications	3	4.4	5	11.7	0.472
Probable CRBSI	2	2.9	2	4.7	1.000
Entry-site infection	1	1.5	3	7.0	0.350
Other complications	9	13.2	3	7.0	0.112
Phlebitis	5	7.3	0	0	0.054
Accidental dislodgement	0	0	1	2.3	0.486
Migration catheter tip	1	1.5	0	0	1.000
Catheter occlusion	3	4.4	2	4.7	1.000

CRBSI: Catheter-related bloodstream infections.

ultrasonography (Group B). The primary endpoints were the number of attempts at venipuncture, the success rate of venous catheterisation, and the indwelling catheter times. Secondary endpoints were catheter-related complications.

Statistical analyses were performed using SPSS version 21. A Chi-square test or Fisher's exact test was used to compare dichotomous variables and a Mann-Whitney test was used to compare continuous variables. Multiple logistic regression using the stepwise method was used to determine independent risk factors related to catheter-related complications. P<0.05 was considered statistically significant.

Of the total, 36(51.4%) patients underwent placement of PICC (Group A), while 34(48.6%) underwent had CVC (Group B) (Table-1). There were no technology-related complications. In Group A, a total of 48 venipunctures were needed and the total number of days of venous catheterization inclusive of all patients was 683 days. The corresponding numbers in Group B were 46 and 428 respectively.

The median number of vascular puncture time was not statistically different from Group B (p=0.86). The rates of successful venous catheterization on the first attempt were 24(67%) in Group A and 24(71%) in Group B (p=0.74). The median duration of IV catheterisation per patient was 17 days (interquartile range [IQR] 8-61 days) in Group A and 12 days (IQR: 5-23 days) in Group B (p=0.002).

Catheter-related complications were observed in 11(31%) patients in Group A and in 14(41%) patients in Group B (p=0.46). Phlebitis was the most common complication in Group A, but did not occur in Group B (Table-2). In both groups, there were 2(2.8%) cases of probable catheter-related bloodstream infections (CRBSI).

At the time of removal of the Power PICC or CVC, IV infusion was no longer required for 28(78%) patients in Group A and 13(38%) in Group B (p=0.001). There were no significant differences between groups in the catheter-related complications requiring removal of the Power PICC or the CVCs (p>0.05). In Group A, No patients felt discomfort about the Power PICC and no catheters had to be removed, while in Group B, 6(17.6%) patients requested early removal of the CVC due to discomfort (p=0.01).

Logistic regression analysis of potential risk factors for catheter-related complications suggested that the platelet count (PLT) and prothrombin activity (PTA) were independent risk factures for puncture-site bleeding (p=0.013 and p=0.019 respectively) and that only the white blood cell (WBC) count was an independent risk factor for catheter-related infections (p=0.034).

Conclusion

In our study, the Power PICC and the CVC were both placed under ultrasonographic guidance. Placements of the IV catheters were successful in all cases with no technology-associated complications. Moreover, there were no significant differences in vascular puncture times and the success rates of venous cannulation on the first attempt. Our studies support the literature[5,6] suggesting that central venous catheterisation is best performed under ultrasonographic guidance.

Use of a Power PICC for the IV infusion of fluids worked well to deliver a median volume of 3,500ml during the operation. Although when compared to the CVC, the diameter of the PICC catheter is smaller and its tip is longer, but the Power PICC can be pressurised properly to

deliver an intraoperative rapid IV infusion because of its high injection pressure.

In Group A, the catheter indwelling times were significantly greater than Group B, but there was no significant difference in the incidence of catheter-related complications, suggesting that a PICC is safer than a CVC for patients. None of the Power PICCs needed to be removed because of discomfort, but 6 CVCs had to be removed, suggesting that the PICC catheter was better tolerated by patients.

The 4 cases of puncture-site bleeding in Group A were minor oozing, whereas 2 of the 8 cases of puncture-site bleeding in Group B resulted in a mild hematoma. One possible explanation for this difference is that the greater size of the CVC might have led to increased mechanical vascular injury. The preoperative PLT count and the PTA were independent risk factors for puncture-site bleeding. Platelet and fresh frozen plasma infusion prior to venous cannula might have decreased the risk of bleeding at the puncture site of patients with low PLT counts or decreased PTA.

There were no significant differences between the two groups regarding the incidence of infectious complications, in spite of the fact that the indwelling catheter times of Group A were significantly greater than that of Group B. Only the preoperative WBC was an independent risk factor for catheter-related infections. Our data suggests that special precautions should be taken for patients with suppressed WBCs possibly by using catheters containing antibacterial and antibiotic components.[7]

Phlebitis was the most common complication in Group A (7.3/1,000 catheter days). One of the 5 cases of phlebitis required the catheter to be removed because of peripheral venous malformations and venous thrombosis. The other 4 cases occurred within 24 hours of venous catheterisation with symptoms of a swollen arm and puncture-site oedema; these symptoms resolved quickly with topical cold ice treatment and did not require removal of the catheter nor affected its ultimate use.

In this study, the catheters of 28 patients in Group A were removed after termination of the IV infusion therapy. In Group B, the CVCs were removed in 13 patients after the termination of IV infusion, 10 of the remaining 21 patients required PICCs (instead of another CVC) for medical needs of continued IV therapy. Because the PICC can be kept indwelling for a longer time than the CVC, and almost one-third of the Group B patients required further IV therapy after removal of the CVC, the use of a PICC was more cost-effective than a CVC.

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