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More advantages of trocar compared than steel needle in deep venipuncture catheterization

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Abstract

Background: Deep venipuncture catheterization is widely used in clinical anesthesia. However, it is worth thinking about how to improve the rate of successful catheter insertion, and relieve patients' discomfort. This paper aimed to compare the clinical advantages between trocar and steel needle.

Methods: Total 503 adult patients were recruited and randomly assigned. The control group was punctured with steel needle, and the experimental group was punctured with trocar needle. Clinical and followed-up information was recorded. Pearson's chi-squared and spearman test were performed to analyze the correlation between intervention and relative parameters. Univariate logistic regression was performed to verify the odds ratio of trocar needle compared with steel needle.

Results: Pearson's chi-square test and Spearman's correlation test showed a significant correlation between puncture success, puncture comfort, successful catheter insertion, puncture time, thrombosis, catheter fever, bleeding, infection and interventions ($P < .05$). Univariate logistic regression showed that there existed better puncture comfort (odds ratio [OR] = 6.548, 95% confidence interval [CI]: 4.320–9.925, $P < .001$), higher successful catheter insertion (OR = 6.060, 95% CI: 3.278–11.204, $P < .001$), shorter puncture time (OR = 0.147, 95% CI: 0.093–0.233, $P < .001$), lesser thrombosis (OR = 0.194, 95% CI: 0.121–0.312, $P < .001$), lesser catheter fever (OR = 0.263, 95% CI: 0.158–0.438, $P < .001$), lesser bleeding (OR = 0.082, 95% CI: 0.045–0.150, $P < .001$) and lesser infection (OR = 0.340, 95% CI: 0.202–0.571, $P < .001$) in trocar group compared with steel needle group.

Conclusion: Trocar application in deep venipuncture catheterization can improve successful catheter insertion, relieve pain and discomfort of patients, reduce incidence of complications, and provide better security for patients.

Abbreviations: CI = confidence interval, OR = odds ratio.

Keywords: deep venipuncture catheterization, steel needle, trocar

1. Introduction

Deep venipuncture catheterization was initially an important means to establish a fast, safe and effective deep vein access to rescue critically ill patients. With the extensive development of individualized therapy, application of deep venipuncture catheterization was becoming more and more widespread.[1] At present, it has been extended to various fields.[2]

The types of deep venipuncture catheterization mainly include "PICC (Peripherally Inserted Central Catheter)" and "CVC (Central Venous Catheter)", PICC is more useful and has more advantages than "CVC". PICC catheter is a kind of catheter inserted into the superior vena cava through peripheral venous puncture, which can be indwelled in the body for up to 1 year. It is simple and quick to operate, with little risk of puncture and few complications.[3] PICC has a low risk of acute complications, a low risk of thrombosis and a low risk of bloodstream infection, and has developed into a convenient, effective and safe catheterization technology.[4] Deep venipuncture catheterization could be performed after general anesthesia.[5] However, it is worth thinking about how to improve the rate of successful catheter insertion, and relieve patients' discomfort.

When the needle moves slightly, the needle may puncture the blood vessel, resulting in a failed puncture. Therefore, how to improve the rate of successful catheter insertion have become the concerns of clinicians. Real-time guidance technology is widely used in clinical anesthesia, changing from blind exploration operation to precise puncture operation, which greatly improves the puncture success rate and reduces the incidence of complications.[6–8] Trocar, also known as intravenous indwelling needle, is composed of stainless steel needle core, plastic soft trocar and small plug.[9] It is sealed and packed for use after sterilization. Trocar puncture, as a new nursing technique, has been widely used in clinical practice, which overcomes many disadvantages

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

This study was approved by the Ethics Committee of the Cangzhou Central Hospital. Written informed consent was obtained from all patients.

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of conventional venipuncture. The study has shown that trocar can assist iris dialysis repair out of situ.[10] It has also been reported in the literature that trocar assisted scleral fixation is used for the treatment of incompletely dislocated intraocular lens.[11] In recent years, the use of trocar for venipuncture has achieved better results, the trocar needle is easier to operate, it can make the operator dexterous use.[12] The short soft cannula was indwelled in the deep vein through trocar puncture and then catheterized through soft cannula, which can greatly improve the success rate of puncture and reduce the discomfort of patients.[13]

Therefore, this research purposed to perform the prospective clinical trial to verify the clinical advantages of trocar compared than steel needle in deep venipuncture catheterization.

2. Methods

2.1. Sample size

The sample size was estimated based on the relevant research results in the literature and the preliminary clinical study analysis of the research group.

$$n = \pi 1 - \pi) * \frac{(U_{1-\alpha} + U_{1-\beta})^2}{\delta^2} * \frac{(1 + C)}{C}$$

$\alpha = 0.05$, $\beta = 0.20$, $U_{1-\alpha} = 1.64$, $U_{1-\beta} = 0.84$,n = 402. Considering the 20% loss rate, we expect to enroll 503 subjects.

2.2. Patients and ethics

A total of 503 adult patients were recruited at the Cangzhou Central Hospital, from March 2017 to June 2021.

Inclusion criteria: >18 years old; receive surgery requiring general anesthesia; normal cardiopulmonary function; normal clotting function.

Exclusion criteria: poor pulmonary, cardiac, and liver function; abnormal coagulation; patients and their families did not agree to participate in the trial.

This study was approved by the Ethics Committee of the Cangzhou Central Hospital. Written informed consent was obtained from all patients.

2.3. Parameters in the research

Patients requiring deep vein catheterization were randomly selected in clinical trial. One group received puncture and catheterization with steel needle (n = 251), and the other group received puncture and catheterization with trocar needle (n = 252). The clinical characteristics and the complications in the two groups were recorded, such as sex (Male/Female), age (<60/≥60), puncture success (No/Yes), puncture comfort (Discomfort: Visual analog scoring >5/Comfort: Visual analog scoring <5), successful catheter insertion (Unsuccessful/Successful), puncture time (Short/ Long), thrombosis (No/Yes), catheter fever (No: temperature <38°C/ Yes: temperature >38°C), bleeding (No/Yes), and infection (No/Yes).

2.4. Statistical methods

The data was expressed as percentage of total and percentage. By using the Pearson's chi-squared test, associations between the clinical parameters and intervention were analyzed. The Spearman-rho test was made to compare clinical data and different needle for the correlation analysis. Univariate logistic regression analysis was used to calculate the odds ratio (OR) of trocar needle compared with the steel needle. All statistical analyses were conducted using SPSS software, version 21.0 (IBM Corp., Armonk, NY). A P value < .05 was considered statistically significant.

3. Results

3.1. Relationship between relevant factors and interventions based on χ^2 test

In clinical samples, puncture success (P < .001), puncture comfort (P < .001), successful catheter insertion (Unsuccessful/Successful) (P < .001), puncture time (P < .001), thrombosis (P < .001), catheter fever (P < .001), bleeding (P < .001), and infection (P < .001) were markedly related to the interventions. However, no significant associations were found between sex (P = .485), age (P = .516) and intervening measure (Table 1).

3.2. Spearman's correlation test was used to further identify associations between potential factors and interventions

Spearman's correlation coefficient displayed that different needle interventions were significantly correlated with the puncture success ($\rho = 0.173$, P < .001), puncture comfort ($\rho = 0.415$, P < .001), successful catheter insertion ($\rho = 0.281$, P < .001), puncture time ($\rho = -0.390$, P < .001), thrombosis ($\rho = -0.320$, P < .001), catheter fever ($\rho = -0.239$, P < .001), bleeding ($\rho = -0.423$, P < .001), and infection ($\rho = 0.173$, P < .001). However, there was no significant correlation between sex ($\rho = 0.031$, P = .486), age ($\rho = -0.029$, P = .517) and interventions (Table 2).

3.3. Univariate logistic regression analysis of odds ratios between interventions and correlative factors

Table 3 describes the ORs and 95% confidence interval (CI) of the study subjects at the univariate level using univariate logistic regression and concludes that there existed better puncture comfort (OR = 6.548, 95% CI: 4.320–9.925, P < .001), higher successful catheter insertion (OR = 6.060, 95% CI: 3.278–11.204, P < .001), shorter puncture time (OR = 0.147, 95% CI: 0.093–0.233, P < .001), lesser thrombosis (OR = 0.194, 95% CI: 0.121–0.312, P < .001), lesser catheter fever (OR = 0.263, 95% CI: 0.158–0.438, P < .001), lesser bleeding (OR = 0.082, 95% CI: 0.045–0.150, P < .001) and lesser infection (OR = 0.340, 95% CI: 0.202–0.571, P < .001) in the trocar group compared with the steel needle group. However, there was no significant correlation between sex (OR = 1.133, 95% CI: 0.798–1.609, P = .485), age (OR = 0.889, 95% CI: 0.624–1.268, P = .516), puncture success (OR = 1.756, 95% CI: 0.789–3.908, P = .168) and interventions (Table 3).

4. Discussion

The patient's pain was obvious when the steel needle was punctured. In addition, improper puncture Angle is easy to cause difficulty in catheterization.[14] Through >10 years of clinical exploration, a large number of clinical cases have been accumulated, and the standard routine of trocar needles has been summarized.[15] By indwelling a trocar in the deep vein and then placing the guide wire through the hose, the success rate of puncture can be improved. The trocar guided deep vein puncture and catheterization has less damage and less pain than the steel needle puncture. The success rate can be improved by using the trocar needle.[16,17]

The fluctuation of patients' vital signs in the process of surgery is also regulated by intravenous medication. Therefore, whether the venous access is unobstructed is the key to ensure the success of surgery. For patients undergoing surgery, the venous access can achieve the purpose of intravenous medication and rapid infusion to expand blood volume, which is also the key to ensure the success of surgery. Trocar is widely used in clinic. After puncture with trocar, the needle core is

Table 1

Clinical characteristics between patients using original steel needle and trocar.

Characteristics		Groups		P
		Steel needle group (%)	Trocargroup (%)	
Sex				.485
Male	242	116 (23.1%)	126 (25.0%)	
Female	261	117 (23.3%)	114 (28.6%)	
Age				.516
<60	215	96 (19.1%)	119 (23.7%)	
≥60	288	137 (27.2%)	151 (30.0%)	
Puncture success				<.001*
No	48	35 (7.0%)	13 (2.6%)	
Yes	455	198 (39.4%)	257 (51.1%)	
Puncture comfort				<.001*
Discomfort	172	129 (25.6%)	43 (8.5%)	
Comfort	331	104 (20.7%)	227 (45.1%)	
Successful catheter insertion placement				<.001*
Unsuccessful	72	58 (11.5%)	14 (2.8%)	
Successful	431	175 (34.8%)	256 (50.9%)	
Puncture time				<.001*
Short	366	126 (25.0%)	240 (47.7%)	
Long	137	107 (21.3%)	30 (6.0%)	
Thrombosis				<.001*
No	388	146 (29.0%)	242 (48.1%)	
Yes	115	87 (17.3%)	28 (5.6%)	
Catheter fever				<.001*
No	416	170 (25.0%)	246 (48.9%)	
Yes	87	63 (21.3%)	24 (4.8%)	
Bleeding				<.001*
No	396	140 (27.8%)	256 (50.9%)	
Yes	107	93 (18.5%)	14 (2.8%)	
Infection				<.001*
No	427	181 (36.0%)	246 (48.9%)	
Yes	76	52 (10.3%)	24 (4.8%)	

Pearson's chi-squared test was used.

*$P < .05$.

Table 2

The relationship between characteristics of patients and different groups.

Characteristics	Groups	
	ρ	P
Sex	0.031	.486
Age	−0.029	.517
Puncture success	0.173	<.001*
Puncture comfort	0.415	<.001*
Successful catheter insertion placement	0.281	<.001*
Puncture time	−0.390	<.001*
Thrombosis	−0.320	<.001*
Catheter fever	−0.239	<.001*
Bleeding	−0.423	<.001*
Infection	−0.187	<.001*

Spearman correlation test was used.

*$P < .05$.

removed and only the outer trocar is kept in the blood vessel. Because the material used in the outer trocar has the characteristics of good flexibility and little irritation to the blood vessel, it can be indwelled in the blood vessel for a long time. The use of trocar makes the patient feel comfortable in the whole transfusion process, and can maintain the continuous patency of the venous pipeline, which is convenient for rescue, and reduces the pain caused by repeated puncture of the common scalp needle and the damage to the superficial vein. Trocar insertion is faster, less painful, less fluid leakage during use, and less vascular irritation, thereby protecting blood vessels.[18,19] Reduce the pain and fear caused by repeated puncture, each use can be retained for 2 to 4 days, no need to use again, directly connect the indwelling cannula, reduce the damage to the vein. And trocar small, no extension tube, fixed, firm and secure. Catheter in the blood vessels will not puncture the blood vessels, not easy to swelling, and avoid subcutaneous tissue necrosis and phlebitis, feel more comfortable, improve patient satisfaction and nursing quality.[20] It can also improve the work efficiency of nurses, rational drug use, avoid intermittent infusion many times a day, reduce puncture and not on time medication, avoid reaction between drugs to reduce costs, reduce the cost of scalp needle puncture caused by exudation treatment.

The steel needle tip without security protection, prone to blood-borne infectious diseases caused by needle stick injuries of infection, steel tube cavity, and vascular biocompatibility is bad, don't feel comfortable, easy to produce phlebitis, steel needle tip sharp, easy to broken blood vessels, causing leakage of liquids, which affect the occurrence of phlebitis, and short retention time (2–4 hours), can increase the number of puncture. Causing pain and damage to blood vessels. Therefore, trocar is superior to steel needle in clinical application. Application in deep vein puncture trocar tube insertion.

5. Conclusions

In summary, application of trocar in deep venipuncture catheterization could improve the successful catheter insertion, relieve the pain and discomfort of patients, reduce the incidence of complications, and provide better security for patients.

Table 3

Characteristics of patients of the impact on intervening measure by logistic regression analysis.

Parameters		Intervening measure		
		OR	95% CI	*P*
Sex	Male	1		.485
	Female	1.133	0.798–1.609	
Age	<60	1		.516
	≥60	0.889	0.624–1.268	
Puncture success	No	1		.168
	Yes	1.756	0.789–3.908	
Puncture comfort	Discomfort	1		<.001*
	Comfort	6.548	4.320–9.925	
Successful catheter insertion placement	Unsuccessful	1		<.001*
	Successful	6.060	3.278–11.204	
Puncture time	Short	1		<.001*
	Long	0.147	0.093–0.233	
Thrombosis	No	1		<.001*
	Yes	0.194	0.121–0.312	
Catheter fever	No	1		<.001*
	Yes	0.263	0.158–0.438	
Bleeding	No	1		<.001*
	Yes	0.082	0.045–0.150	
Infection	No	1		<.001*
	Yes	0.340	0.202–0.571	

95%CI = 95% confidence interval, OR = odds ratio.

*$P < .05$.

Author contributions

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