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Original article

Clinical observation on limb elevation for prevention of blood spills during withdrawal of trocar puncture core needles

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ABSTRACT

Objective: The study aimed to explore a lien secure trocar as an effective method to prevent blood spills.
Methods: This study included 1200 patients, who had a safety catheter from March to April in 2012, from the emergency department of the Shengjing Hospital of China Medical University. The patients were randomly divided into an experimental group and a control group. Using a conventional method, we compressed the vein at the tip of catheter to prevent blood spillage in the control group. We raised the patient's upper limb, while compressing the vein at the tip of catheter in the experimental group.
Results: The results showed that the experimental group was better than the control group not only in quantity but also in quality regarding blood pollution. The results reached a level of statistical significance ($P < 0.01$).
Conclusions: Raising the patient's upper limb and occluding the vein distal to the catheter can effectively interrupt blood spillage while withdrawing the steel needle (i.e., pulling out the trocar).

1. Introduction

In recent years, venous indwelling needles have been applied more and more frequently in clinical practice, especially to rescue critically ill patients, and they play an important role in stimulating development of drugs administered via intravenous infusion, parenteral nutrition, etc. Venous indwelling needles should not be affected by position and activity, and they can be used at any time according to need of treatment of the illnesses. There are many models and brands of trocars in clinical practice. We have used B. Braun Introcan Safety IV catheters in our hospital for 2 years. Following the manufacturer's instructions, we compressed the vein at the tip of the catheter to prevent blood spillage. Sometimes blood contamination occurred, which increased the nurses' workload and occupational risks[1] and the patients' psychological burden. This contamination possibly reduced the patients' confidence in the nurses as well. Therefore, we changed the way of handling the B. Braun Safety IV catheter to provide an effective and simple way for our counterparts to prevent blood contamination while withdrawing the steel needle from the patient's limb.

2. Materials and methods

2.1. General information

From March to April in 2012, a total of 1200 patients treated with a B. Braun Introcan Safety IV catheter in our emergency department were selected. Patients who had poor peripheral vascular circulation, or poor visibility of peripheral veins were not included in this study. The patients were divided randomly into two groups: experimental group and control group. The two groups had no significant difference in age, gender, variety of disease, and puncturing condition ($P > 0.05$) (Table 1).

2.2. Methods

2.2.1. Materials

In this study, Introcan Safety 22G (24G), B. Braun Medical Int' I Trading Co., Ltd., 3M Tegaderm Transparent Film Dressing was used.

2.2.2. Choice of puncture site

We chose the large blood vessels of the limbs with abundant blood flow without a venous valve and tried to avoid puncturing any part of the joint and injuring the skin.

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Table 1
The gender, age, and illness situation of the two groups of patients.

Items	Experimental group ($n = 600$)	Control group ($n = 600$)	t or χ^2	P
Gender (male)	302	305	1.632	>0.05
Average age (year)	48 ± 1.55	51 ± 0.78	0.624	>0.05
Circulatory system	156	165	0.833	>0.05
Respiratory system	136	145	1.145	>0.05
Nervous system	110	115	0.945	>0.05
Digestive system	106	95	1.433	>0.05
Multiple trauma	26	30	0.524	>0.05
Other	56	50	0.379	>0.05

2.2.3. Detailed puncturing method

After disinfection of the puncture site and removal of the protective cap, a suitable vein was punctured. The puncture site is typically cleaned using 0.5% of a compound iodine. The center of the sterilized puncture site should be no less than 8 cm × 8 cm.[2] The overtube is loosened by rotating, and the conglutination of the tube and the needle is released. The manipulator checks if there is a barb on the indwelling needle and if there is forking and damages on the edge of the overtube. The bevel of the needlepoint is adjusted. The manipulator fastens and tightens the vein with the left hand and punctures the vein straight with an angle of 20–25° with the right hand (similar to holding a pen) after affirming that the indwelling needle is in the blood vessel. The index finger of the right hand pushes the flexible tube of the overtube into a suitable place in the blood vessel, loosens the patient's fist and the tourniquet, and then fixes the flexible tube in a closed-type with 3M Tegaderm Transparent Film Dressing. At the center of the puncture site, the film dressing is pressed outward to stick tightly to the skin and avoid air residual. Then, the indwelling needle is fixed firmly. Before withdrawal of the steel needle, the patients from the control group adopted a V method, which is the left-hand finger pressing the trocar nipple and keeping still. Meanwhile, pressing the tube to the upper vein with the left-hand middle finger, the right hand is parallel to the skin to pull out the needle core. Paralleled the needle to the skin, at that time, the metal security clip is activated and locks down the needlepoint automatically. For the experimental group a “V” method was adopted to press the vein and withdraw the needle after raising distant part of limbs from the punctured site. Then, link the i.v. line, fix Kolafu joint and i.e. line with another adhesive tape, and finally write the date and time of puncture on the sticker.

2.2.4. Observation parameters

The degree and times of blood contamination during the application in the two groups were observed. The degrees of blood contamination were as follows: normal (no blood spillage), mild (blood overflow within the area of the joint, less than 0.5 cm^2), moderate (blood overflow within the area of the joint from 0.5 cm^2 to 1 cm^2), and severe (blood overflow area larger than 1 cm^2; dressing needs to be removed and puncture site needs to be sterilized and fixed again).

2.2.5. Statistical methods

All data were analyzed by SPSS 17.0. The measurement data were represented with x ± SD. The one-way ANOVA method was applied to analyze the significance difference between the groups, and the enumeration data were analyzed by a Chi-square test. The statistical significance was set at $P < 0.05$.

3. Results

The results showed that in 99.7% of the 600 patients, venipuncture was successful, and there were significant differences between the two groups. The experimental group showed a better result in both blood contamination times and degree than in the control group (Tables 2 and 3). All of the nurses in our emergency department prefer the new, compressed way to improve the success rate of punctures, operate more easily, and lower blood contamination.

Table 2
Times of blood contamination in two groups ($n = 600$).

Groups	Contamination	Uncontamination
Experimental Group	2	598
Control Group	56	544

Note: Comparison of the two groups ($\chi^2 = 52.829$, $P = 0.001$).

Table 3
Degree of blood contamination ($n = 600$).

Degree of blood contamination	Experimental group	Control group
Mild	2	24
Moderate	0	12
Severe	0	20
Total	2	56

Note: Comparison of the two groups ($\chi^2 = 2.549$, $P = 0.28$).

4. Discussion

4.1. The influences of gravity and posture on blood returning to the heart[3]

The main power of blood circulation is not the contraction of vessels but the pressure difference in vessels. There are many aspects that influence pressure differences in veins (e.g., the heart's contractility, gravity, posture, and respiration movement of muscle tissue around vessels). When a patient lies down, veins in the whole body and heart are at the same level; therefore, the hydrostatic pressure is about the same. When a person changes posture from lying to standing, the veins become dilated and expanded because of the influence of blood gravity in the blood vessels, as well as the small vein resistance to the bloodstream. Therefore, there is more blood contained, and the vein vasoconstriction above the heart facilitates the return of venous blood.[4,5] Consequently, when the distal limbs with the punctured site are higher than the heart, the vein vasoconstriction can increase the blood return. In this way, it can prevent blood contamination when the B. Braun Introcan Safety IV catheter is withdrawn.

4.2. B. Braun Introcan Safety IV catheter

Because of its needlepoint telescopic protecting system that boasts a design patent, the needle tip gets in the protective case automatically while withdrawing the core needle and cannot come back again. This leads to no remaining blood and prevents the nurses from contacting the blood directly during the entire operation.[6] Thus, this method can reduce the chances of nurses being punctured and blood contamination, which ensures the nurses' safety and reduces the nurses' professionally acquired infection rate.[7] However, at the beginning of using such a trocar, blood overflowed when pressing under the standard “V” method due to little clinical experience,