

Short communications

Use of a wire-guided cannula for radial arterial cannulation

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Abstract

We compared the success rates of arterial cannulation with a wire-guided cannula (WGC) and the direct technique with a conventional non-wire-guided cannula (non-WGC). A total of 100 adult patients requiring an arterial line in the operating room were assigned randomly to undergo radial arterial cannulation either with the WGC or with the non-WGC. No significant difference in success rates and insertion times could be demonstrated between the WGC and the non-WGC (78.4% vs 67.3% and 22.6 ± 13.2 s vs 23.0 ± 19.3 s, respectively). Among the less experienced operators, insertion time was shorter with the WGC than with the non-WGC (27.7 ± 11.9 s vs 39.8 ± 20.4 s; $P < 0.05$), although the success rate was similar for the two types of cannula. Patient characteristics did not affect either the success rates or the insertion times for the two types of cannula. In conclusion, we have confirmed that the success rates of radial arterial cannulation for patients whose physical status is relatively good were similar with the use of the WGC and the non-WGC.

Key words Arterial cannulation · Modified Seldinger technique

Recently, a new, improved wire-guided cannula (WGC) that can be used for arterial cannulation has become available. In this study, we attempted to demonstrate the advantages of using the WGC over the conventional non-wire-guided cannula (non-WGC) for radial artery cannulation.

After obtaining local ethics committee approval and written informed consent from the patients, we studied 100 patients (American Society of Anesthesiologists

[ASA] physical status I–III) who were scheduled for elective surgery and in whom radial artery cannulation had been indicated. Two different cannulas were used in this study. One was a wire-guided cannula (Insyte-A; BD Medical Systems, Franklin Lakes, NJ, USA), and the other was a conventional intravenous cannula (Insyte; BD Medical Systems). For both types of cannulas, a 20-gauge cannula was used in male patients and a 22-gauge cannula was used in female patients. Six operators participated in this study; three staff anesthesiologists, who had each performed arterial cannulation in more than 100 patients, and three residents, who had each performed arterial cannulation in fewer than 10 patients. The study patients were randomly assigned to one of two groups: cannulated with the WGC ($n = 51$) or the non-WGC ($n = 49$). Operators were assigned to use the WGC and the non-WGC alternately in the individual patients. After general anesthesia was induced, the two types of cannulas were similarly inserted at an angle of approximately 30° . When less experienced residents performed the arterial cannulation, they were always supervised by a staff anesthesiologist and were provided with advice if needed. The insertion time (defined as the time from the initial puncture of the skin to the successful arterial threading of the cannula) was recorded. If the insertion time was greater than 180 s, the cannulation was regarded as a failure. Categorical data were analyzed using the X^2 test. Mean values were compared using Student's t -test. A value of $P < 0.05$ was considered to be significant. In a preliminary test, one of the operators generated success rates, at first attempt, of 80% with the WGC and 50% with the non-WGC during ten trials with each cannula. Assuming that a 30% difference in success rates is clinically important, we calculated that 44 patients would be required for each group. This would give the study an 80% power at a significance level of 5%. We expected some exclusions and thus increased the number in each group to 50.

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Table 1. Characteristics of patients

	Non-wire-guided (<i>n</i> = 49)	Wire guided (<i>n</i> = 51)
Age (years)	62.6 ± 13.5	63.9 ± 13.6
Weight (kg)	56.3 ± 10.7	58.7 ± 10.5
Height (cm)	158.6 ± 8.6	157.8 ± 10.4
Sex (M/F)	24/25	26/25
ASA Physical status		
I	17	14
II	27	28
III	5	9
Systolic blood pressure (mmHg)	104.8 ± 21.6	103.8 ± 18.8
Diastolic blood pressure (mmHg)	65.9 ± 12.8	63.0 ± 11.0
Pulse quality (bounding/thready)	44/5	43/8

Data values are presented as means (SD) or numbers of patients

Table 2. Success rate comparisons by arterial line experience, clinical characteristics, and sex

Parameter	Non-wire-guided	Wire-guided
	Success/Failure (%) Mean insertion time (s)	Success/Failure (%) Mean insertion time (s)
Overall	33/16 (67%) 23.0 ± 19.3	40/11 (78%) 22.6 ± 13.2
Operators		
Cannulation experience >100 (staff anesthesiologists)	20/5 (80%) 12.2 ± 6.8	20/5 (80%) 17.5 ± 12.6
Cannulation experience <10 (residents)	13/11 (54%) 39.8 ± 20.4	20/6 (77%) 27.7 ± 11.9*
Patients		
Hypertension (+)	9/8 (53%) 24.2 ± 17.6	14/4 (78%) 25.5 ± 12.9
Hypertension (-)	24/8 (75%) 21.9 ± 15.2	26/7 (78%) 21.0 ± 13.3
Male	17/7 (71%) 19.4 ± 15.2	20/6 (77%) 20.7 ± 13.2
Female	15/10 (60%) 23.5 ± 14.2	20/5 (80%) 25.4 ± 12.9

**P* < 0.05 vs non-wire-guided group

The study included 50 female and 50 male patients, ranging in age from 25 to 88 years (mean 63.2 ± 13.5 years). No differences were found between the WGC and non-WGC groups with respect to demographic data, baseline blood pressure, or the incidence of poorly palpable arteries (Table 1). Overall, no significant difference in success rates or insertion times could be demonstrated between the WGC and the non-WGC groups (Table 2). When the operator's experience was considered, less experienced operators demonstrated significantly shorter mean insertion times with the WGC than with the non-WGC (27.7 ± 11.9s vs 39.8 ± 20.4s; *P* < 0.05; Table 2). Among experienced operators, no significant cannula-related differences were observed for either the success rate or the mean insertion time. Among patients with hypertension, no significant difference in success rates was observed between the

WGC and non-WGC groups (Table 2). Also, when success rates were evaluated by patient sex, no significant difference was observed between the WGC and non-WGC groups (Table 2).

Our results demonstrated no overall differences between the WGC and non-WGC in success rates or in mean cannulation insertion times. When the operator's experience was considered, less experienced operators inserted the cannula faster with the WGC than with the non-WGC.

Three other studies comparing the direct technique with the wire-guided technique for arterial cannulation have shown greater success rates with the wire-guided technique when experienced operators performed cannulation [1–3]. Contrary to these studies, our results demonstrated no cannula-related difference in the success rates. One possible reason for this is that the arter-

ies of the patients in our study may have been easily accessible. The patients in our study were in better physical condition than those in the three studies noted above [1–3] and almost all our patients had a bounding pulse; hence, it is possible that the difference between the two cannulas affected the cannulation performance to only a very small extent.

The time to successful cannulation required by the less experienced operators appears to depend on the guidewire used. When using the WGC, operators are not required to change either the angle or the depth of the needle; they only thread the guidewire after confirmation of blood flashback. This minimizes the tendency to transfix the artery. Moreover, the guidewire is more advantageous for less experienced operators because it maintains the intravascular position of the cannula once the vessel is located. The faster insertion time with the WGC among the less experienced operators probably reflects this advantage.

Our results demonstrated no sex-related differences in success rates or in insertion times. Mangar et al. [1] reported that the success rate of arterial cannulation in female patients was significantly higher when the guidewire was used (86% vs 43%). In their study, the same gauge cannula (20-gauge) was used in both male and female patients. In our study, however, we used a 22-gauge cannula for female patients to prevent the likelihood of thrombosis. The diameters of radial arteries in females have been reported to be smaller than those in males [4]. Occlusion of the radial artery increases linearly as more of the arterial lumen is occupied by a cannula [5]. Indeed, after arterial cannulation, females tended to develop thrombosis more frequently [5–7]. Our choice of a small-gauge cannula for female patients may have led to our higher success rate of cannulation than that shown by Mangar et al. [1].

When data were analyzed only for patients with hypertension, the success rate tended to be higher with the WGC than with the non-WGC, but the difference did not reach statistical significance. It is not clear whether patients with hypertension have more difficult arteries, such as tortuous arteries arteriosclerosis, or barely palpable arteries. In addition, in this study, the incidence of patients who had a thready pulse was low. Therefore, apparent advantages of the WGC for patients with hypertension could not be determined.

Our study had several limitations. First, all operators had little prior experience in using the WGC before the study began. After more frequent training sessions, they could achieve a higher success rate with the WGC than that demonstrated in the present study. Second, the less experienced operators may have learnt the process of

arterial cannulation during the study period. Konrad et al. [8] reported that experience with more than 20 cases was required to achieve a success rate of over 80% in radial arterial cannulation. In our study, each operator performed approximately eight cannulations each with the WGC and the non-WGC. If the less experienced operators had had experience with more than 20 cases, they might have achieved a faster insertion time with the non-WGC, equivalent to that achieved with the WGC.

A major drawback of the WGC is its cost, which is up to ten times greater than that of the non-WGC. Our findings suggest that the routine use of the WGC for patients whose arteries are easily accessible may offer little advantage. Further studies to examine the efficacy of the WGC in critical situations, such as a barely palpable artery, secondary to arterial spasm, or in a tortuous artery such as the superficial temporal artery, may be useful.

In conclusion, the WGC yielded a shorter insertion time for arterial cannulation for less experienced operators. However, the operator's experience did not affect the success rates of arterial cannulation when a non-WGC was used. Therefore, routine use of the WGC for patients whose physical status is relatively good seems to have little benefit.

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