

Absence of efficacy of ultrasonic two-way Doppler flow detector in routine percutaneous arterial cannulation

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Several reports have demonstrated the usefulness of the ultrasound technique in assisting venous and arterial cannulation and decreasing the incidence of complications [1,2]. In a recent case report, we also reported the effectiveness of the ultrasonic two-way Doppler flow detector, incorporated with a minute probe tip with a diameter of 2 mm, as an aid to detect the arterial pulse during radial arterial cannulation in patients with hemorrhagic shock [3]. We evaluated whether this method would also be useful in routine surgical cases.

Among the patients who underwent general anesthesia between April 1999 and March 2002, 166 patients were randomly assigned to two study groups: 72 patients monitored by an ultrasonic two-way flow detector (group D) and 94 patients monitored by the conventional arterial palpitation method (group C). In both groups, arterial cannulation was performed uniformly, according to the respective cannulation method, by one board-certified anesthesiologist who had been trained in the ultrasound technique in 20 patients prior to the current study. “Success” was defined as access to the artery at the first puncture. “Failure” was defined as access to the artery after two or more punctures. An ultrasonic two-way Doppler flow detector (HD-307, Nihon Koden, Tokyo, Japan) was used.

The arterial puncture procedures in group D were as follows. As with conventional arterial puncture, a pillow was placed under the dorsum of the hand and the wrist was extended. The arterial pulse was identified using the probe tip. An office clip was used to mark the position of the strongest pulse sound. A pen was used to

mark a point distal and a point proximal to the above marking along the course of the artery. The puncture site was disinfected with alcohol. Puncture was performed relying on the markings, without palpating the artery.

Logistic regression analysis was used for statistical analysis. The dependent variables were “success” and “failure.” The independent variables were using or not using the ultrasonic two-way flow detector, sex, age, body mass index (BMI), systolic blood pressure (SBP), and hemoglobin (Hb). The significance level was 5%.

The mean age of the patients was 62.2 ± 11.8 (SD) years in group D and 64.1 ± 11.9 years in group C. The male-to-female ratio was 43:29 in group D and 59:35 in group C. The BMI was 22.7 ± 3.6 in group D and 23.0 ± 3.6 in group C. The SBP was 104 ± 14 mmHg in group D and 105 ± 18 mmHg in group C. The Hb level was 12.4 ± 1.6 g·dl⁻¹ in group D and 12.6 ± 1.8 g·dl⁻¹ in group C. In one patient each in groups C and D, the radial artery could not be accessed, even after multiple punctures (classified as “discontinued” in Table 1, but included as “failure” for statistical analysis). Irrespective of whether or not the flow detector was used, the first puncture was successful in over 80% of the patients. Access to the artery was obtained by two or more punctures in approximately 98% of the patients (Table 1). Sex was the only factor significantly influencing “success” (Table 2).

We used logistic regression analysis, a multivariate analysis, in the present study because we had great doubts about the conclusion reached from simple regression analysis of only two groups “using” or “not

Table 1. Results of access to the artery in groups C and D

Result	Group C (n = 94)	Group D (n = 72)
Success	77 (81.9%)	60 (83.3%)
Failure	16 (17.0%)	11 (15.3%)
Discontinuation	1 (1.1%)	1 (1.4%)

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Table 2. Predictive factors from the logistic regression analysis

Variable	Regression coefficient	<i>P</i> value	Odds ratio	95% confidence interval
Doppler flow detector	0.184	0.6776	1.202	0.505–2.863
Sex (male)	1.513	0.0018	4.542	1.752–11.773
Age	0.024	0.157	1.025	0.991–1.060
Body mass index	0.003	0.9598	1.003	0.887–1.135
Systolic blood pressure	0.002	0.8991	1.002	0.975–1.029
Hemoglobin	0.153	0.3092	1.166	0.868–1.566

using” the flow detector. Even if the outcome of puncture (“success” or “failure”) is simple, the result should be considered as the outcome of the coincidental overlap of many factors. Although it is impossible to include all the factors involved in the analysis, we selected using or not using the flow detector, sex, age, BMI, SBP, and Hb as independent variables, based on clinical judgment.

Since the flow detector facilitated successful arterial cannulation under shock conditions, we expected that the equipment would improve the efficiency of arterial cannulation when used in routine surgeries. Contrary to our expectation, the results showed that the flow detector did not provide additional benefit in patients in whom the radial pulse could be palpated.

In the multivariate analysis to identify factors that influence cannulation, using or not using the flow detector, age, BMI, SBP, and Hb were not significantly related to the outcome of cannulation. Sex was the only factor significantly influencing the success of cannulation. The relative risk (odds ratio) is approximately 4.5-fold (95% confidence interval, 1.75 to 11.77) for males compared with females. This result shows that radial

arterial cannulation is easier in males, which is probably related to the difference in arterial diameter.

According to the above results, in cases in which the radial arterial pulse is palpable, the ultrasonic two-way flow detector offers no additional benefit to gain access to the artery. However, in a case with a hardly palpable arterial pulse due to hematoma or arterial spasm after multiple unsuccessful punctures with the use of the conventional arterial palpitation method, such an auxiliary device may facilitate success in arterial cannulation.

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