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Original Contribution

Confirmation of optimal guidewire length for central venous catheter placement using transesophageal echocardiography☆

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Abstract

Study objective: Several authors have reported rare, but severe, complications associated with the length of the intravascular guidewire during central venous catheter placement, as the wire tip can cause cardiac arrhythmia or perforation or become trapped within the vessel. Although one report investigated the optimal guidewire length using fluoroscopy, few reports have precisely measured guidewire position using transesophageal echocardiography (TEE). Here, we investigated the appropriate intravascular length of a guidewire for right internal jugular vein approach using TEE during cardiac surgery.

Design: A prospective observational study.

Setting: Operating room.

Patients: Fifty-two patients undergoing elective cardiac surgery.

Measurements: The intravascular guidewire distance from the insertion site to the superior vena cava–right atrium (SVC-RA) junction was measured by TEE. Demographic factors (height, weight, age, etc) were recorded.

Results: The mean distance from the access site to the SVC-RA junction was 17.8 ± 1.3 cm (maximum/minimum =20.0/15.0 cm). There was a greater correlation with height than with weight or age.

Conclusion: We confirmed the wire tips at all cases by ultrasonography. The distance using TEE was similar to that by fluoroscopy, but TEE was more precise. Guidewire length was weakly correlated to height. About 15 cm as minimum length should be considered the limit for guidewire length in an adult, in consideration of height, to ensure patient safety during central catheter placement for right internal jugular vein approach.

1. Introduction

Central venous catheters (CVCs) are placed for a number of clinical indications. Several authors have reported rare, but severe, complications associated with the intravascular guidewire during placement of a CVC, as the wire tip can cause

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cardiac arrhythmia or perforation [1] or become trapped within the vessel [2,3]. We previously reported a case in which the guidewire became trapped within the Chiari network [4]. There is one study that investigated the optimal length of a guidewire by fluoroscopy [5]. However, few studies have investigated precise guidewire positioning using transesophageal echocardiography (TEE). Therefore, the aim of this study was to determine the appropriate intravascular length of a guidewire using TEE during elective cardiac surgery.

2. Materials and methods

This prospective observational study was approved by the Institutional Review Board of Tokuyama Central Hospital, Yamaguchi, Japan (approval no. K170), and informed consent was obtained from all patients for publication of the presented data. A total of 52 patients who underwent elective cardiac surgery were enrolled during the study period. Obese patients (body mass index >35) were excluded. All patients received general anesthesia by induction with remifentanil (0.3-0.5 μg/[kg min]), fentanyl (50-100 μg), and sevoflurane (3%-5%). After intubation, TEE was performed using the PROSOUND SSD-4000 high-performance digital ultrasonography system (Hitachi-Aloka Medical, Ltd, Tokyo, Japan). A CVC was placed in the right internal jugular vein [6]. The head turned to the left and the table tilted head-down by 15°. The operator identified a triangle formed by the medial and lateral portions of the sternocleidomastoid muscle and the clavicle, which served as the base of the triangle. The internal jugular vein courses from the apex of the triangle toward the base, parallel to the long axis of the body. The apex of the triangle was punctured, and the guidewire was inserted (ARROW Multilumen Access Catheter; Teleflex Incorporated, Wayne, PA). The intravascular guidewire distance between the point of skin entry and the junction of the superior vena cava (SVC) and right atrium (RA) was recorded when we determined the wire tips attained at the SVC-RA junction by TEE (Fig. 1).

Preoperative demographic variables included patient age (years), sex, height (cm), and weight (kg). The primary outcome for this study was the intravascular guidewire distance. Plots of the distance against these variables were generated, and linear regression analysis was performed to calculate regression lines and equations. In addition, multiple regression analysis was performed to calculate coefficients of determination and 95% confidence intervals. Data are expressed as the mean ± standard deviation for continuous variables. Statistical analyses were performed using SPSS version 21 software for Windows (IBM-SPSS, Inc, Chicago, IL).

Using G*power (version 3.1, written by Franz Faul, Universitat Kiel, Germany) to calculate the sample size (α = .05; β = .15; effect size = 0.15; and number of predictors, 3) yields a total sample size of 50 cases.

3. Results

Patients' baseline characteristics are shown in Table 1. Among cardiac patients being operated, there were 21 coronary artery bypass grafting cases, 16 aortic valve replacements, 1 mitral valve replacement, 3 mitral valvuloplasties, 8 total arch replacements, 2 myxomas, and 1 atrial septal defect. There were no marfanoids among our samples. In addition, the maximum body mass index was 30.

The mean intravascular guidewire distance was 17.8 ± 1.3 cm (maximum/minimum =20.0/15.0 cm). There was a greater correlation with height (R = 0.55) than with weight (R = 0.42) or age (R = 0.064) (Fig. 2). As shown in Table 2, the multiple regression model of the distance based on patient height, weight, and age revealed that the most relevant factors associated with intravascular guidewire distance were patient height and age.

4. Discussion

This is the first investigation to confirm the optimal guidewire length from the right internal jugular vein access site to

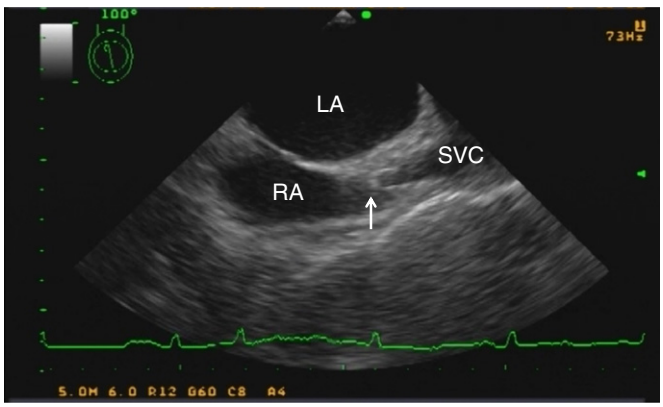

Fig. 1 Midesophageal bicaval view showing the guidewire (white arrow) passing through the SVC and the tips through the SVC-RA junction. RA, right atrium; LA, left atrium.