Internal Jugular Vein Cannulation: Time Required Under Ultrasonographic Guidance with a Valsalva Maneuver

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Time required for the cannulation of right internal jugular vein (IJV) under ultrasonographic guidance with a Valsalva maneuver was investigated in surgical patients. The degree of distension of the IJV and the changes in blood pressure (BP) during the maneuver were also examined. The required time for the cannulation was 11 ± 5 sec (mean ± SD, n = 21), and there was no failure in the cannulation. The mean BP decreased significantly during the maneuver, while the vessels enlarged approximately twofold, which facilitated the cannulation. The decrease in BP and the enlargement of the vessels during a Valsalva maneuver were confirmed in the left side, which indicated the feasibility of left IJV cannulation under ultrasonographic guidance. (Key words: internal jugular vein, ultrasonography, cannulation, time required, Valsalva maneuver)

(Miyake C, Arai T, Mori K: Internal jugular vein cannulation: Time required under ultrasonographic guidance with a valsalva maneuver. J Anesth 5: 68–72, 1991)

Internal jugular vein (IJV) cannulation is a commonly employed technique for central venous pressure monitoring and pulmonary artery catheterization. Recently, to facilitate the location of the IJV and following venipuncture, the real-time ultrasonographic guidance have been recommended[1,2]. The effects of a patient's position and a Valsalva maneuver on distension of the IJV were also examined with ultrasonographic scans[3,4]. However, no information is available about the required time for actual cannulation under ultrasonographic guidance with a Valsalva maneuver. The changes in blood pressure (BP) during the maneuver are not either reported.

In this study, to elucidate the above-mentioned problems, the required time for right IJV cannulation under ultrasonographic guidance with a Valsalva maneuver was investigated. The degree of distension of the IJV and the changes in BP during the maneuver were also examined. Further, the feasibility of left IJV cannulation was evaluated providing for the case that right IJV is not available.

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Patients and Methods

Subjects were 14 male and 7 female adult patients undergoing elective surgeries, i.e., 10 upper abdominal and 11 thoracic surgeries. Age ranged from 20 to 71 years; weight ranged between 42–65 kg. Informed consent was obtained from each patient. After the induction and intubation, the radial artery was cannulated for continuous BP monitoring. Then, the patient was placed in a 14-degrees head-down position and the head was rotated 30-degrees to the left. Under sterile precausions, the ultrasonographic image was obtained using an ultrasonographic

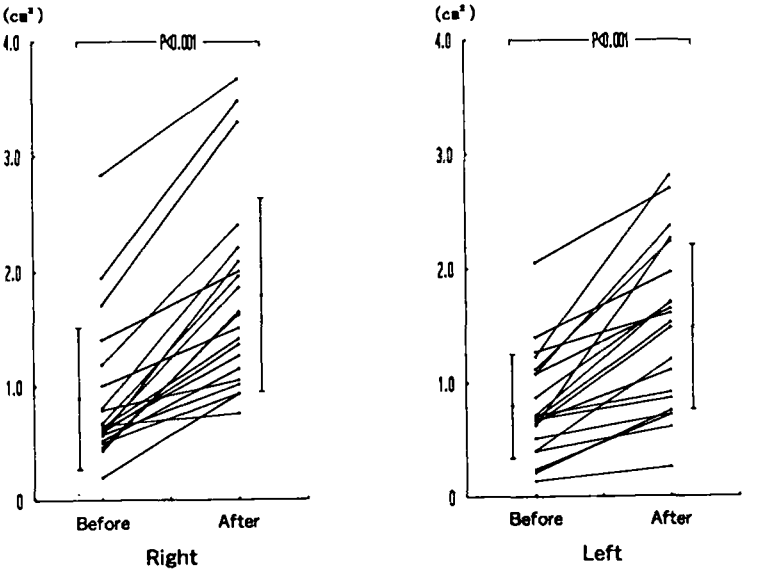

Fig. 1. The changes in the cross sectional area of right and left internal jugular veins during a Valsalva maneuver.

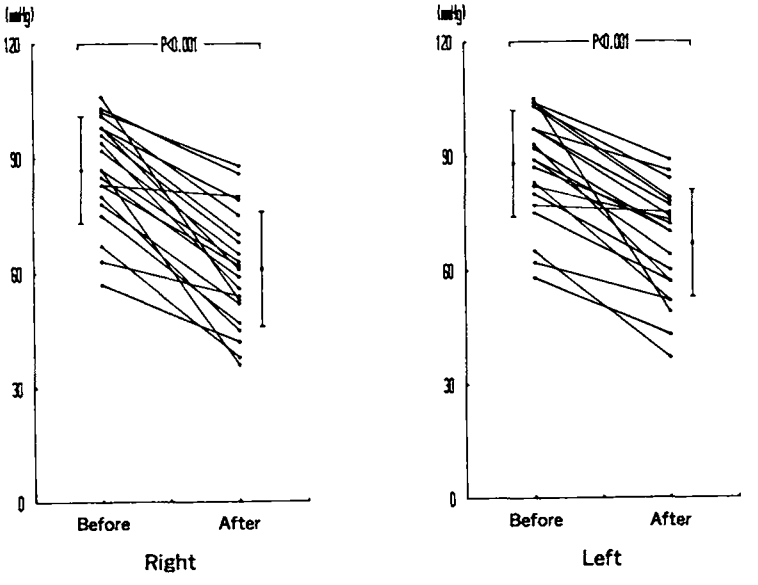

Fig. 2. The changes in mean blood pressure during a Valsalva maneuver performed in right and left sides.

scanner (Echo Camera, Model SSD-210 DX II, Aloka, Tokyo, Japan) equipped with a 7.5 MHz ultrasound transducer. A Valsalva maneuver was conducted by keeping the airway pressure more than 20 cmH_2O for 10 sec, and the scan results before and during the Valsalva maneuver were recorded on photographic film for later analysis. The continuous recording of BP was also done during the maneuver. Then, actual cannulation was performed under ultrasonographic guidance with a Valsalva maneuver, using a central vein catheterization kit (Arrow International Inc., Reading, PA). In this time, the required time for actual cannulation (from the introduction of the needle through the skin to the placement of the outer sheath of the needle into the vessel) was recorded. Next, the patient's head was rotated 30-degrees to the right, and ultrasonographic scanning and continuous recording of BP with a 10-sec Valsalva maneuver were conducted in

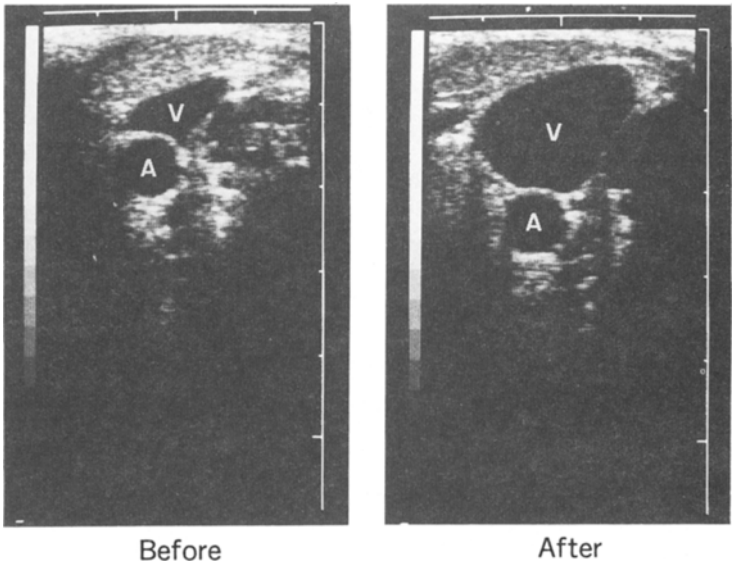

Fig. 3. A typical case which shows the changes in the area of right jugular vein.
V; right jugular vein: A; carotid artery.

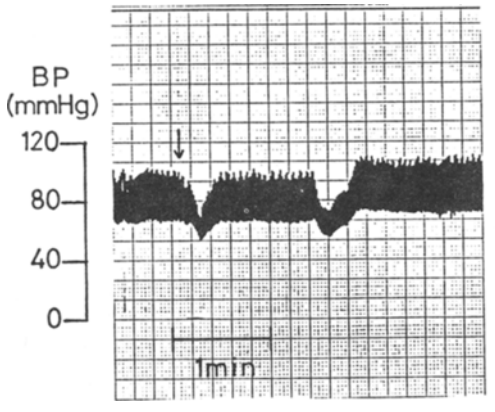

Fig. 4. Actual recording of blood pressure during a Valsalva maneuver.
Arrow shows the start of the maneuver for 10 sec. Actual cannulation was performed during the second time Valsalva maneuver.

the same way as described in right jugular cannulation. However, in the left, actual puncture was not performed.

The cross sectional area of the jugular vein was measured by the digitizer (MPC8501, NEC, Tokyo, Japan) on the photograph of the scanned IJV. Data were expressed as mean ± SD. The changes in the area of the vessel and BP during a Valsalva maneuver were analyzed with a paired t-test.

Results

The changes in the area of right and left jugular veins during a 10-sec Valsalva maneuver were shown in figure 1. The area of the IJV increased significantly from 0.89 ± 0.62 cm^2 to 1.79 ± 0.84 cm^2 in the right side and from 0.79 ± 0.46 cm^2 to 1.49 ± 0.73 cm^2 in the left side, respectively, during a Valsalva maneuver ($P < 0.001$, in both sides). The corresponding changes in mean BP were shown in figure 2. The mean BP decreased significantly from 87 ± 14 mmHg to 61 ± 15 mmHg in the right side and from 88 ± 14 mmHg to 67 ± 14 mmHg, in the left side respectively, during the maneuver ($P < 0.001$, in both sides). The required time measured in the actual cannulation of right jugular vein was 11 ± 5 sec. The shortest was 4.8 sec and the longest was 16.8 sec. There were neither failure in cannulation nor associated complications.

The typical photograph which shows the changes in the area of right jugular vein and the actual BP recording were shown in figure 3 and 4, respectively. In this case, the required time for cannulation was 10 sec.

Discussion

There have been various reports about the internal jugular cannulation employing

anatomical land marks. No less than 13 approaches to cannulation of the IJV have been described[5]. Metz et al. evaluated 15 techniques for localization of the IJV, and concluded that no technique proves best in successful IJV puncture[6]. However, since Bazaral et al. demonstrated the usefulness of ultrasonography for the localization of the IJV[3], the IJV puncture under ultrasonographic guidance have been widely used, and the difficulty of the localization has been overcome. In this study, there were failure neither in localization nor cannulation of the IJV. The failure in cannulation after successful localization and venipuncture of the IJV is reported to occur occasionally[7]. This may be due to dislocation of the needle tip from the lumen of the vein during detachment of a syringe from the needle. In this study, fortunately, such trouble did not occur, but it is possible trouble. However, this trouble may be also overcome by using a recently developed new device which unites a syringe and a wire-guide[8].

A short-term Valsalva maneuver for distension of the IJV was effective to facilitate the actual cannulation. Although significant decreases in BP were observed during the maneuver, severe hypotension can be avoided by limiting the time for the maneuver. As a matter of fact, the mean required time for the actual IJV cannulation was approximately 10 sec, which proved that a short-term Valsalva maneuver is sufficiently useful for the IJV cannulation under ultrasonographic guidance.

The required time for an actual IJV without ultrasonographic guidance was already reported by Escarpa et al.[7] According to their report, the mean required time from the needle induction to the completion of cannulation was approximately 28 sec, which was around 3 times longer than the required time in our method. Since, in their method, the required time includes the time for the localization of the IJV, this difference in the required time is reasonable. Our results proved that the required time for the IJV cannulation can be shorten by using the ultrasonography for localization.

Generally, the IJV cannulation is not conducted in the left side. The reason is partially due to the anatomical problems such as higher apex in the left lung than that in the right lung, but mainly due to the unfamiliarness of anesthesiolosists to anatomical landmarks in the left side. However, in this study, it was demonstrated that left IJV is located easily by the use of the ultrasonography and that a Valsalva maneuver is also effective for the enlargement of the vessel. Therefore, it is considered that left IJV cannulation can be performed safely under ultrasonographic guidance in the case that right IJV is not available for cannulation.

In conclusion, the IJV cannulation under ultrasonographic guidance with a short-term Valsalva maneuver increases the success rate and shortens the required time. Moreover, this method is considered to be useful in the left IJV cannulation.

A part of this work was presented at the 33rd Congress of Japan Society of Anesthesiologists held in Kyoto, April, 1986.

(Received Aug. 2, 1990, accepted for publication Aug. 28, 1990)

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