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Negative Correlation between Right and Left Internal Jugular Vein Lateral Diameter Sizes Measured by Ultrasound

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Summary : We retrospectively examined the relationship of right and left internal jugular vein (IJV) lateral diameters in 190 patients who underwent cardiovascular surgeries. The lateral diameters of bilateral IJVs were measured after induction of anesthesia. The following relationships between the left IJV lateral diameter (L) and the right IJV lateral diameter (R) were investigated: 1) statistical difference of the mean value of R and L, 2) correlation of R and ratio of L to R (L/R ratio), and 3) correlation of L and ratio of R to L (R/L ratio). The results found that the mean value of the right IJV (17.0 ± 4.1 mm) was significantly higher than that of the left (14.4 ± 4.1 mm). There were significant negative correlations between the R and L/R ratio, and between the L and R/L ratio. The results showed dominance of the right IJV in terms of size as has been previously reported. Our finding of a negative correlation between right and left IJV lateral diameter sizes indicates that we can expect a larger size of the contralateral IJV when one side is small. Our present study also indicates the importance of measuring bilateral IJV prior to IJV puncture.
Key words : internal jugular vein, ultrasound, diameter, catheterization

Introduction

Ultrasound guidance for internal jugular vein (IJV) catheterization has become a common practice as a safety measure for the procedure.[1] The right internal jugular vein (IJV) is commonly selected as the preferable side for catheterization.[2] One of the reasons for selecting the right IJV is that its diameter is usually larger than that of the left IJV.[3–6] However, there have been reports of many variations in the diameters of both sides in IJVs.[3,7–9] The left IJV is also a choice for insertion of the catheter in cases where the right IJV is small[8,10] or absent.[11] For proper selection of the insertion site, it is necessary to have knowledge about the sizes of both IJVs. In this study, we found a negative correlation for diameters between the left and right IJV.

Patients and Methods

After obtaining Institutional Research Ethics Committee approval for the study protocol, we studied the relationship between the right and left lateral diameter sizes of IJVs measured by ultrasound in 190 patients who underwent cardiovascular surgery. As our routine procedure, both IJV lateral diameters were measured after induction of anesthesia at a patient position of around 10 degrees head-down tilt with approximately 40 degrees rotation of the head to opposite of the observation side. A 12 MHz linear probe of an ultrasonic diagnostic apparatus (GE Co. Vivid *i*, USA) was used for the measurements. The maximum lateral diameters of the IJVs in the scanning range from the caudal edge of the mandible to the clavicle were measured and recorded. The following relationships between the left IJV lateral diameter (L) and the right IJV lateral diameter (R) were studied retrospectively: 1) statistical difference of the mean value of R and L, 2) correlation of R and the ratio of L to R (L/R ratio), and 3) correlation of L and ratio of R to L (R/L ratio). In this study, we used the ratio of bilateral sizes of the IJV in order to standardize the individual difference of the measurement. After confirming the normal distribution of the data by Shapiro-Wilk test, a statistical significance of difference between left and right IJV lateral diameters was investigated with a paired T-test. The correlation between left and right IJV lateral diameters was studied using linear regression analysis. All statistical analyses were performed using software JMP (SAS Institute Inc., Cary, NC). The statistical significance level was $p = 0.05$. Data were expressed as mean ± standard deviation.

Results

Patient characteristics are shown in Table 1. Patients with thrombotic occlusion or stenosis of the IJV were not

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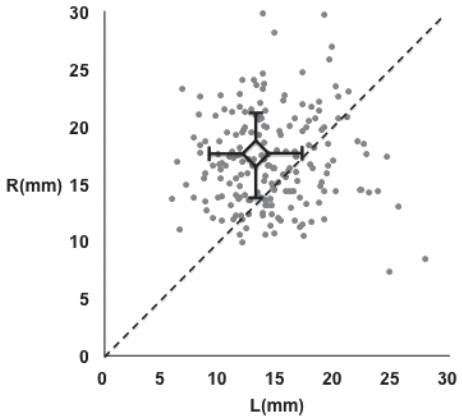
included. The mean values of the lateral diameters were 17.0 ± 4.1 mm for the right IJV and 14.4 ± 4.1 mm for the left IJV. The mean value of the right IJV was significantly higher than that of the left (Figure 1). There were significant negative correlations between the R and L/R ratio (Figure 2a), and between the L and R/L ratio (Figure 2b).

Table 1. Patient characteristics

Age (yr)	72 ± 9
Sex (M : F)	105 : 85
Height (cm)	157.5 ± 9.6
Weight (kg)	58.2 ± 12.1

(mean ± SD)

M: male, F: female.



The right and left lateral diameter sizes of IJVs

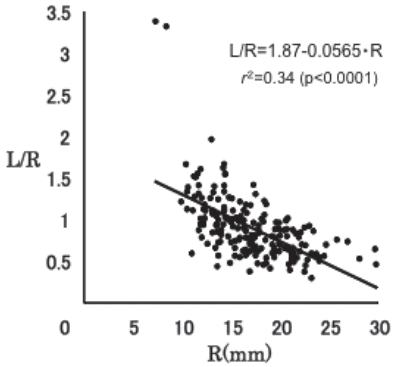
Figure 1. Scatter plot of the relation between the right and left lateral diameter sizes of IJVs. Dominance in the size of the right IJV was observed. IJV: internal jugular veins. R: diameter of right IJV. L: diameter of left IJV. Dotted line indicates R = L. The mean value of both R and L is shown as a diamond. Solid bars of the diamond are standard deviations of R and L.

Discussions

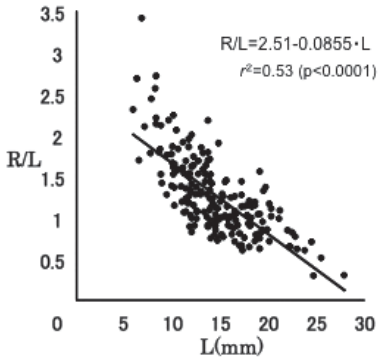
In the present study, the mean value of the lateral diameter of the right IJV was significantly higher than that of the left IJV. Such dominance in the size of the right IJV has been reported in past studies using ultrasound,[3,4] computed tomography (CT),[5] and also as autopsy observations.[6] Additionally, an osteologic study showed that the right-side size of the jugular foramen, where the IJV flows out, was significantly larger than the left side.[12] Our results supported previous observations regarding the dominance of the right IJV lateral diameter.

In addition, the results of our study also showed significant negative correlations between the R and L/R ratio (Figure 2a), as well as the L and R/L ratio (Figure 2b). These findings indicate that the size of the left IJV diameter tends to be large when that of the right IJV is small and vise versa. According to this negative correlation between the right and left IJVs, we can expect a larger left IJV when the right side IJV is small.

Catheter insertion of the IJV is sometimes difficult because of the small size of the vessels. It has been reported that catheter insertion became difficult when the IJV diameter was 7 mm or less, or the cross-sectional area was 0.4 cm^2 or less.[13] As mentioned above, we can expect a larger IJV of the contralateral side when the ipsilateral side of the IJV is small. Actually, two patients in our study had a more than three times larger size of the left IJV when the right IJV lateral diameter was 8 mm or less (Figure 2a). However, both sides of the IJV can also be small in size. Czyzewska et al. reported that the cross-sectional area of both sides of IJV measured by ultrasound was 0.4 cm^2 or less in 4.9% of 185 healthy adult subjects.[4] Their report suggests that the negative correlation between the right and left diameter of the IJV found in our present study



2a. Correlations between the R and L/R ratio



2b. Correlations between the L and R/L ratio

Figure 2. Significant negative correlations were found between the R and L/R ratio (2a), as well as the L and R/L ratio (2b). r^2 indicates coefficient of determination. Regression equations are shown in the figure.

is not applicable in certain patients. Therefore, as suggested by previous reports,[4,8–10] it is important to observe both sides of the internal jugular vein using ultrasound prior to the IJV puncture.

The IJV lateral diameter studied in this present report was obtained from patients who were under endotracheal general anesthesia for cardiovascular surgery. Further study is necessary to test whether such a negative correlation can be found in other patient groups. In addition, neither cross-sectional area, anteroposterior diameter of the IJV, nor external jugular vein diameter was studied in the present study. For external jugular vein diameter, there are previous reports suggesting that the size of the external jugular vein diameter has a close relationship with IJV diameter.[7,14] Stickle et al. reported that the IJV lateral diameter size was small when the external jugular vein diameter was large, and the external jugular vein diameter had a negative correlation with the IJV diameter.[14] Future research would be required to understand the relationships among the diameters of the left and right inter jugular and external jugular veins.

In conclusion, we examined the relationship of right and left IJV lateral diameters after induction of anesthesia in patients who underwent cardiovascular surgeries. Our results showed a negative correlation between right and left IJV lateral diameter sizes. Our present study also indicates the importance of measuring bilateral IJV prior to IJV puncture.

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Conflict of Interest Statement

Yukari Toyota has no conflict of interest.
Shigeaki Kurita has no conflict of interest.
Katsuyuki Moriwaki has no conflict of interest.

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