

Comparison of the scan-as-you-go technique with the short-axis out-of-plane technique on the incidence of posterior venous wall puncture in ultrasound-guided internal jugular vein cannulation - A randomised controlled trial

INTRODUCTION

Internal jugular vein (IJV) cannulation is done by the short-axis out-of-plane (SAOP) or long-axis in-plane approach. The long-axis technique reduces the risk of posterior vessel wall puncture (PVWP).^[1] Overshooting the needle without seeing the tip can cause a posterior venous wall puncture in the SAOP technique.^[2] In some patients, the carotid artery can be posterior to the IJV, with the possibility of carotid puncture if the needle is overshot.^[2] The scan-as-you-go (SAYGO) combines the techniques of dynamic needle tip visualisation in the SAOP and long axis in-plane while entering the anterior venous wall to reduce the incidence of PVWP. We hypothesised that SAYGO is superior to SAOP in reducing the incidence of PVWP in ultrasound-guided IJV cannulation.

METHODS

After approval by the institute's ethics committee (vide approval number JIP/IEC/2020/022, dated 7 July 2020) and Clinical Trials Registry-India registration (vide registration number CTRI/2020/08/027387; <https://ctri.nic.in/Clinicaltrials/pubview.php>), the study was started. The study was carried out according to the principles of the Declaration of Helsinki (2013) and good clinical practice. This was a randomised, single-blinded clinical study. Written informed consent was obtained for participation in the study and use of the patient data for research and educational purposes. We included adults undergoing elective or emergency surgery requiring IJV cannulation. We excluded patients with deformed neck, short neck, or coagulation abnormalities. The required sample was recruited by a convenient sampling technique. Block randomisation with varying block sizes generated

through a computer was used to randomise the patients. Allocation concealment was not done as it was a single-blinded study.

In Group 1, the SAYGO technique was followed [Figures 1 and 2]. At the level of the cricoid cartilage, the probe was kept perpendicular to the skin to view the IJV on a short axis. The midpoint of the IJV was marked at intervals of 0.5 cm from the cricoid up to the clavicle. In Group 2, the SAOP technique was followed wherein a short-axis image of the IJV was obtained at the cricoid level. In both groups, the needle was inserted at an angle of 45° to the skin and advanced towards the vein with gentle aspiration. The needle's entry to the vein was confirmed by blood aspiration. After confirming the needle tip in the vein by ultrasound, the guidewire was inserted, and the catheter was secured. Initially, if no blood appeared in the syringe even after the needle passed beyond the anterior vessel wall, the needle was withdrawn slowly. If the blood was aspirated during withdrawal, it was confirmed that overshooting of the needle happened with PVWP.

Anaesthesia residents did the procedure with more than ten cannulations in each technique. The primary objective was to compare the incidence of PVWP between the two groups. The secondary objective was to compare the time for successful central venous cannulation. The time for successful cannulation was between the skin puncture and the placement of a triple-lumen catheter. If unsuccessful, the needle was taken out and re-inserted. The time for successful cannulation at the second attempt included the time for both attempts. If the second attempt was unsuccessful, it was considered a failure and left to the discretion of the attending anaesthesiologist.

The sample size of 75 in each group was based on the 21% incidence of PVWP in the study by Srinivasan *et al.*^[3] The sample size was estimated using the formula of comparison of two proportions. Considering the anticipated difference between the two proportions as 0.15, at a 5% level of significance and 80% power, the sample size was estimated to be 75 in each group. The sample was recruited by convenient sampling. The statistical analysis was done using Statistical Package for the Social Sciences (SPSS) version 18 software (International Business Machines Corporation, Armonk, New York, United States). The categorical variables were expressed as frequency and proportion. The continuous variables were expressed as

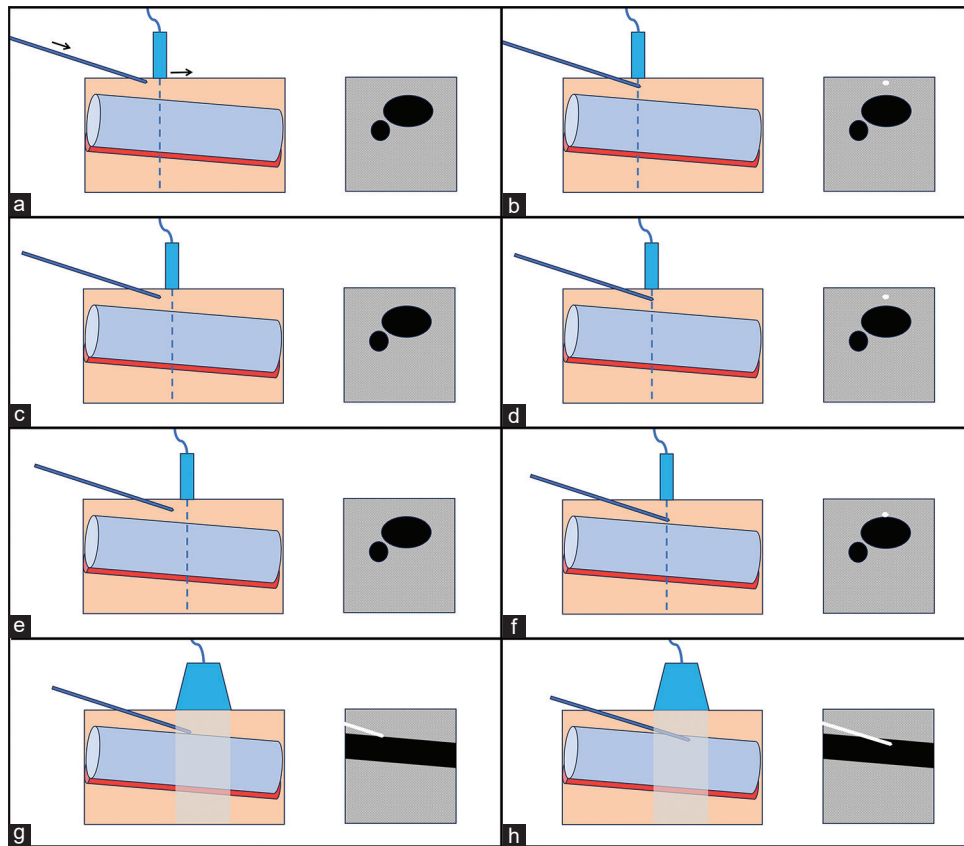


Figure 1: Pictorial representation of the scan-as-you-go (SAYGO) technique: (a) The needle was introduced into the skin through the pre-puncture marking and advanced. (b) The needle appeared as a hyperechoic dot on the screen. (c) The probe was slid down until the hyperechoic dot disappeared (d) The needle was advanced until the hyperechoic dot reappeared. (e,f) The process was repeated until the needle reached the anterior wall of IJV. (g) The probe was changed to a long-axis view, and the entire needle was visualised. (h) The needle angle was reduced, and the anterior wall of IJV was pierced in the long axis

mean [standard deviation (SD)] or median [interquartile range (IQR)] according to the distribution.

RESULTS

In total, 178 patients were enrolled, and after applying exclusion criteria, 156 patients underwent randomisation. Six patients refused to participate after randomisation. There was a 100% success rate in both groups. The PVWP was significantly higher in group 2 [26.7% versus 8%, RR: 3.3 (95% confidence interval 1.41,7.83), $P = 0.003$; Table 1]. The mean number of attempts was similar in both groups. The time taken for successful cannulation was significantly longer in group 1 compared to group 2 (285 s versus 204 s, $P = 0.001$). The time taken for free aspiration of blood from needle insertion was significantly longer in the SAYGO technique (122 s versus 65 s, $P = 0.001$). There was no significant difference in time taken for guide wire placement in both groups ($P = 0.45$). The number of changes in needle direction was comparable between the groups ($P = 0.146$).

DISCUSSION

The SAYGO had a significantly lower PVWP than the SAOP technique. The time taken for successful cannulation was significantly longer in the SAYGO compared to the SAOP technique. The time taken for free aspiration of blood from needle insertion was significantly longer in the SAYGO technique.

PVWP may occur because a fixed image perpendicular to the vessel is displayed, making it difficult to distinguish the needle shaft from the needle tip in the SAOP technique.^[4,5] The long-axis in-plane technique has a lower risk of PVWP because it allows simultaneous visualisation of the needle shaft and the tip.^[4-6] If the true centre of the vessel is not identified, it may cause inadvertent injury to the adjacent structures. Hence, in our SAYGO technique, we traced the needle tip stepwise in the short axis, and before piercing the anterior wall of the vessel, the probe was changed to the long axis, and the needle angle was reduced. This method provides the advantage of both techniques.

| Table 1: Outcome measures | | | |
|--|--------------------------------|---------------------------------|-------|
| Outcomes | Group 1 (n=75) | Group 2 (n=75) | P |
| Posterior venous wall puncture Attempts (1 st /2 nd) | 6 (8%) | 20 (26.7%) | 0.003 |
| Time taken from needle insertion to free aspiration of blood (s) Median (IQR) (95% CI) | 122 (105–130) (110.07, 126.76) | 65 (50–76) (63.03, 78.150) | 0.001 |
| Time taken for successful guide wire placement (s) Mean (SD) (95% CI) | 34.72 (16.38) (30.95, 38.49) | 32.07 (16.59) (28.25, 35.88) | 0.45 |
| Time taken for successful cannulation (s) Median (IQR) (95% CI) | 285 (250–310) (270.69, 298.16) | 204 (189–227) (201.40, 224.550) | 0.001 |

Data expressed as median (interquartile range), mean (standard deviation) or numbers. CI=confidence interval, SD=standard deviation, IQR=interquartile range, n=number of patients

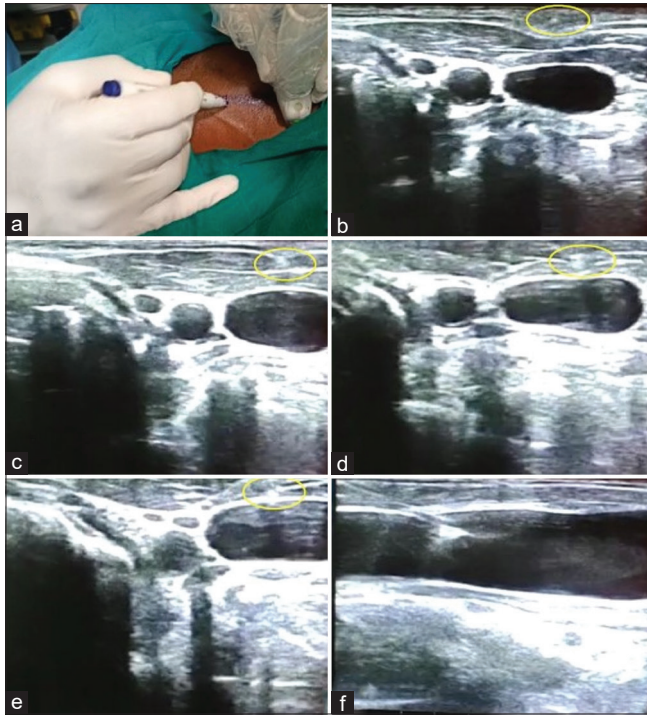


Figure 2: The scan-as-you-go (SAYGO) technique in a patient: (a) Pre-puncture marking. (b–f) serial ultrasound images of the SAYGO technique. The yellow circle denotes the hyperechoic tip of the needle

In a mannequin study by Blaivas *et al.*,^[7] the incidence of PVWP was 64% and 15% in the SAOP and long-axis in-plane techniques, respectively. Kumar *et al.*,^[8] found that the incidence of PVWP was 40% and 17.5% in the SAOP and long-axis in-plane groups, respectively, and was statistically significant ($P = 0.026$). Watanabe *et al.*,^[9] found that reducing the needle angle from 60° to 30° reduces the incidence of PVWP. In our study, the initial skin insertion was done at an angle of 45°. The needle angle was further reduced once the needle reached the vein's anterior wall.

In dynamic needle tip study by Seohee Lee *et al.*,^[10] the time from skin puncture to wire insertion was significantly higher than that of the long-axis technique (46.5 s versus 39.8 s, $P = 0.069$).

CONCLUSION

In ultrasound-guided IJV cannulation, the SAYGO significantly reduced the incidence of PVWP compared to the conventional SOAP technique. It takes a longer time compared to the conventional SOAP technique. Hence, we recommend employing the SAYGO technique for real-time ultrasound-guided IJV cannulation.

Study data availability

De-identified data may be requested with reasonable justification from the authors (email to the corresponding author) and shall be shared after approval as per the authors' institution policy.

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Nil.

Conflicts of interest

There are no conflicts of interest.

ORCID

Sathesh K. Periyasamy: <https://orcid.org/0009-0000-3312-0867>

Chitra Rajeswari Thangaswamy: <https://orcid.org/0000-0002-4036-1527>

Satyen Parida: <https://orcid.org/0000-0003-4752-3653>

Pankaj Kundra: <https://orcid.org/0000-0002-5670-7932>

**Sathesh K. Periyasamy, Chitra R. Thangaswamy¹,
Satyen Parida¹, Pankaj Kundra¹**

Department of Cardiothoracic and Vascular Anesthesia, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, Kerala, ¹Department of Anesthesiology and Critical Care, JIPMER, Puducherry, India

Address for correspondence:

Dr. Chitra R. Thangaswamy,
Department of Anesthesiology and Critical Care, JIPMER,
Puducherry - 605 006, India.
E-mail: dr.chitrarajeswari@gmail.com

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