

Teaching ultrasonographic identification of the cricothyroid membrane (CTM): a prospective cross-over cohort study

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Background

Accurate identification of the cricothyroid membrane is a crucial skill in acute care medicine, as it determines the success of potentially lifesaving cricothyroidotomy. However, palpation of the cricothyroid membrane (CTM) has been shown to be unreliable, even under elective conditions.

Airway ultrasound has been shown to:

- Increase success rates in both cadaveric and living transplants
- Decrease procedure times
- Decrease complication rates when compared to palpation alone

There is lack of structured teaching in airway ultrasound to anaesthesia trainees in Singapore, hence we set out to **evaluate the impact of a one-day training programme on improving the proficiency** of airway ultrasound identification of CTM amongst trainees.

Methodology

Ethics approval for the study was obtained from the National Healthcare Group Domain Specific Review Board.

We hypothesized that a 20% improvement in time taken to identify the CTM during the last scan from the first scan would be clinically meaningful. This required us to recruit 19 participants to estimate this improvement with 5% precision at 95% confidence level. We aimed to recruit 20 participants to account for possible dropouts.

The participants underwent a 1-hour systematic training for ultrasound identification of the CTM. This included didactic teaching and demonstration, followed by hands on practice on a healthy volunteer.

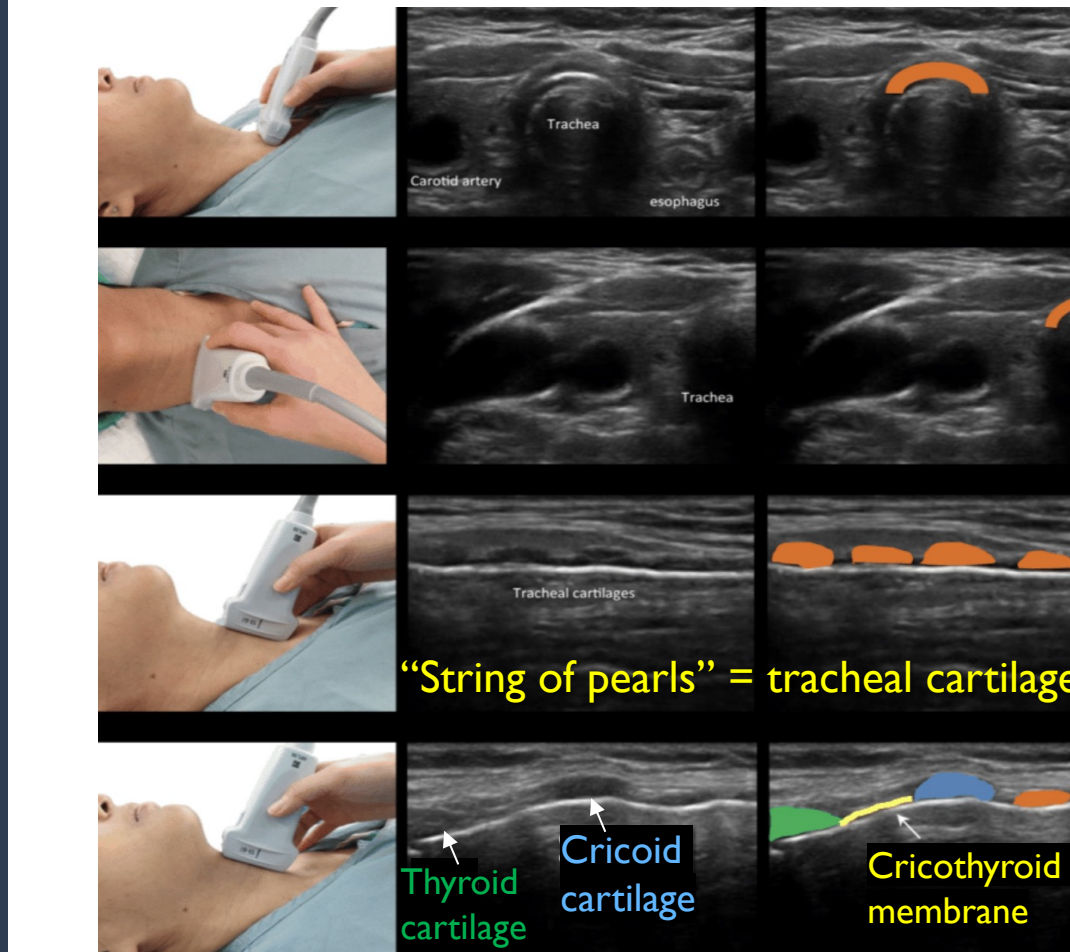
Assessment of the participants skills was carried out on the same day, by means of timed ultrasound scans on 8 healthy volunteers.

- Success was defined as correct identification of the CTM within 120 seconds
- Both SOP and TACA techniques were independently used to scan each volunteer.
- Participants were timed separately for each attempt. Timings and success rates were recorded.
- Video footage of the participants 1st and 8th attempts was obtained for technical quality scoring to be performed post-hoc by 2 independent airway specialists.
- Follow up assessment was performed at the 3 month mark on one healthy volunteer using both the SOP and TACA technique as well.

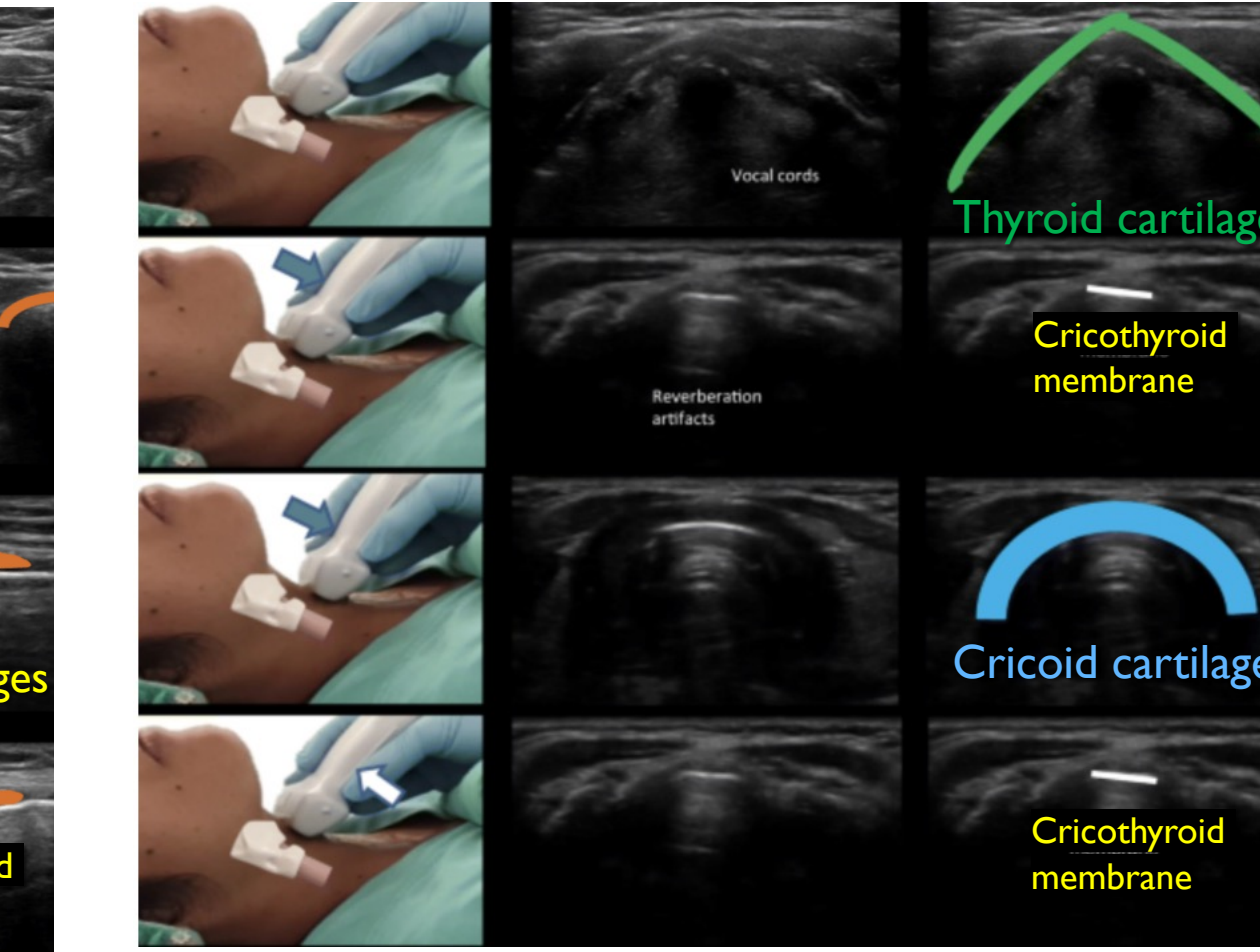
Techniques

There are 2 widely accepted techniques in ultrasound-guided identification of the CTM

1. Longitudinal = **SOP** (string of pearls) technique



2. Transverse = **TACA** (transverse- airline-cartilage- airline) technique



Outcomes

The **primary outcome** measured was the time taken for correct identification of the CTM.

Secondary outcomes included

- Success rates of identification of the CTM within 120 seconds. ,
- Technical skills scores – using assessment checklist (AC) and Global Rating Score (GRS)
- Skills retention rate at 3 months post-training

Demographics

Volunteer demographics

- 10 volunteers (2 male, 8 female)
- Median Age: 29.5 years old, Median BMI: 23.2 kgm⁻².
- 3 assessed to have difficult neck landmarks to identify on palpation
- 7 assessed to be moderately difficult

Participant demographics

20 participants were recruited for the study, with 1 drop-out, leaving a total of 19 participants

- 7 junior residents
- 11 medical officers
- 2 clinical associates
- No prior experience or clinical training in airway ultrasound

Years of experience in anaesthesia	Number
<1 year	5
1-3 years	10
4-5 years	2
>5 years	2

Results

Quantitative results

Longitudinal “SOP” technique

- Mean time taken for CTM identification was **67.0s** for the 1st scan which improved to **45.3s** on the 8th scan
- Mean time difference **-21.1s** (95% CI -36.1, -6.2), $p=0.005$

Transverse “TACA” technique

- Mean time taken for CTM identification was **64.8s** for the 1st scan which improved to **35.8s** for the 8th scan.
- Mean time difference **-28.1s** (95% CI -44.6, -11.6), $p=0.001$

There was no statistically significant difference in the time taken between the two ultrasound techniques.



Figure 1. Line plot of **mean time taken** for CTM identification across all 8 attempts using (A) SOP and (B) TACA technique; **percentage success** in CTM identification across all 8 attempts using (C) SOP and (D) TACA technique.

At 3-month follow-up, **82.7% (TACA)** and **52.9% (SOP)** accurately identified the CTM.

Technical scoring

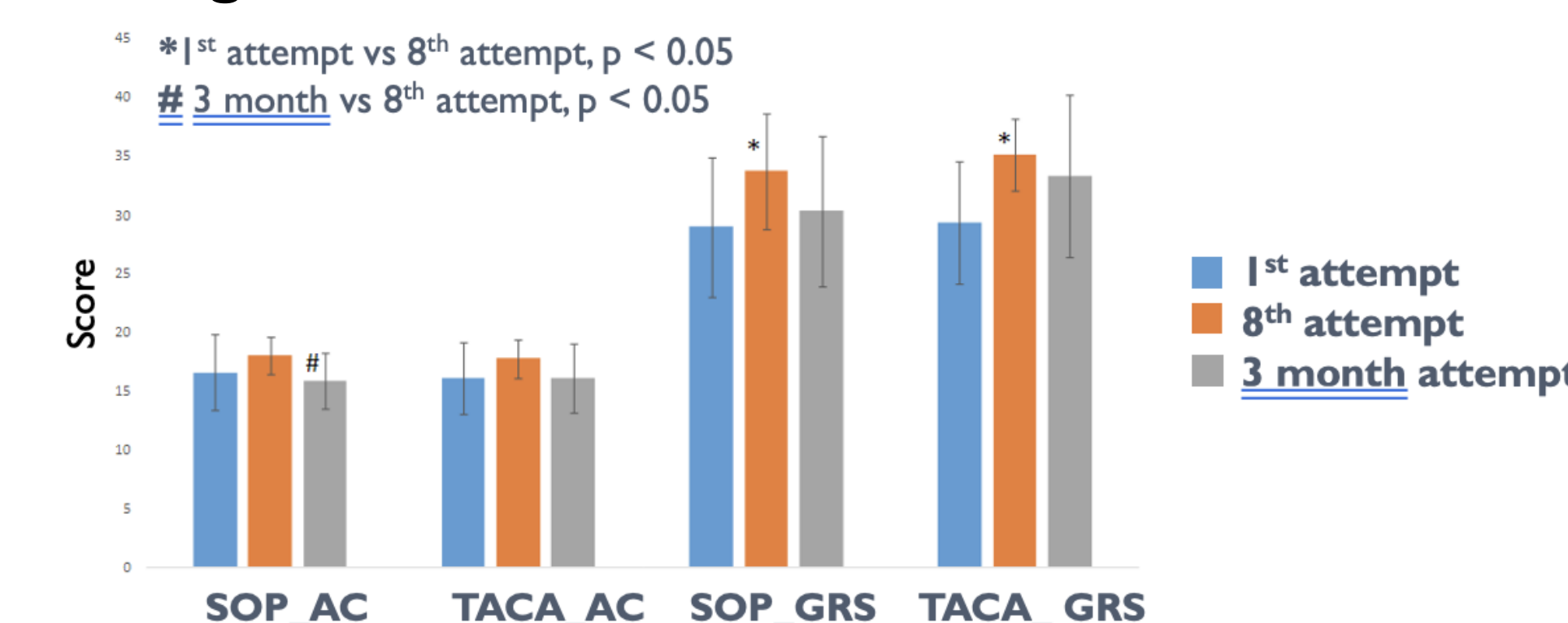


Figure 2. Bar chart showing AC and GRS scores for the 1st, 8th and 3-month scans

Results (continued)

There was significant improvement in GRS scores for both techniques. However, there was a significant decrease in AC score in the 3-month attempt as compared to the 8th attempt when using the SOP technique.

Discussion

We adopted a structured stepwise program in teaching airway ultrasound skills in our study. After the 1-day training program which comprised a total of 4 hours of interactive teaching, the participants achieved

- Significant improvement in **time-to-CTM identification** using both SOP and TACA techniques
- Improvement in **success rates and GRS technical skill scores** - with an overall success rate of more than 90% with the TACA technique and 89.5% with the SOP technique by the end of the program
- **Accurate identification of the CTM using at least one of the two techniques**, with **neither technique showing a statistically significant difference in time taken** to accurately identify the CTM. This underscores the importance of learning both techniques.

Overall, the above findings suggest that the training program was reasonably successful in improving success rates and mean time taken to identify the CTM.

Participants retained a high success rate for TACA technique 3 months after the training programme, however poor retention of SOP skill was observed. This suggests that **more needs to be done to improve skill retention for both techniques**, which could include supervised practice, logging of a pre-determined number of clinical cases within a stipulated period and review of their logged cases with an identified airway ultrasound mentor.

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