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Visibility of Prevertebral Soft Tissues in the Neck Using Ultrasonography: A Feasibility Study

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ABSTRACT

Objective: To aid emergent diagnosis of postoperative retropharyngeal hematoma in anterior cervical spine surgery patients, this study investigates ultrasonography's potential role by evaluating the visibility of retropharyngeal and prevertebral soft tissues in the neck using ultrasound and potential correlations with body habitus.

Methods: The visibility of the anterior vertebral bodies and the prevertebral soft tissues in both sides of the neck was recorded and analyzed with 95% CI using the Wilson method. Body mass index, neck circumference, and neck length were measured. A point-biserial correlation was performed to compare body habitus with visibility of vertebrae and prevertebral tissues.

Results: Longus colli muscle and C3 to C6 were successfully visualized in all 10 (100%) cases on both sides. C2 was only visible in 6 (60%) on both sides. C7 was visible in 9 (90%) on the right and 7 (70%) on the left. The esophagus was visible in 7 (70%) on the right and 10 (100%) on the left. There was a significant negative correlation with neck circumference and C2 visibility on the right side, $r(8) = -0.76$, $P = 0.011$.

Conclusions: Ultrasonography was successful in visualizing prevertebral tissues, with a trend of obstructed visibility with wider and longer necks.

Clinical Relevance: Ultrasonography has potential to aid early detection of postoperative retropharyngeal hematoma after cervical spine surgery.

Level of Evidence: 4.

Novel Techniques & Technology

Keywords: retropharyngeal, prevertebral tissues, ultrasound, imaging, anterior cervical spine surgery

INTRODUCTION

A postoperative retropharyngeal hematoma may lead to airway compromise, a rare but life-threatening complication in patients who have undergone procedures such as anterior cervical discectomy and fusion.[1–3] However, imaging screening protocols for postoperative retropharyngeal hematoma are poorly defined.[4] This potentially life-threatening condition can be difficult to diagnose clinically and by computed tomography (CT), and although magnetic resonance imaging (MRI) can depict the extent of retropharyngeal lesions, it requires more patient cooperation, making it difficult to perform in acutely ill patients who may not have stable airways.[5] Sonography may potentially fill that role in cervical patients, given its portability and high-resolution imaging capabilities. This is a feasibility study with the purpose of evaluating the visibility of retropharyngeal and prevertebral soft tissues in the neck using ultrasonography (US) and determining the potential correlations with the body habitus.

METHODS

This prospective feasibility study was approved by the institutional review board and compliant with the Health Insurance Portability and Accountability Act. It was conducted between 8 August 2020 and 13 April 2021. Healthy adult volunteers aged 18 years or older were recruited from our institution and underwent US of the neck. All participants provided informed consent. All US examinations were performed and interpreted by a single fellowship-trained musculoskeletal radiologist. Visibility of the anterior vertebral bodies and the prevertebral soft tissues in the neck (esophagus and longus colli muscle [LCM]; Figure) was recorded and analyzed with 95% CIs using the Wilson method. Body mass index, neck circumference, and length were measured in all participants. A point-biserial correlation was performed to compare body habitus measurements (neck circumference and length, LCM thickness and cross-sectional area, and body mass index) with visibility of retropharyngeal and prevertebral tissues in the neck (C2, C3, C4, C5, C6, C7, esophagus, and LCM).

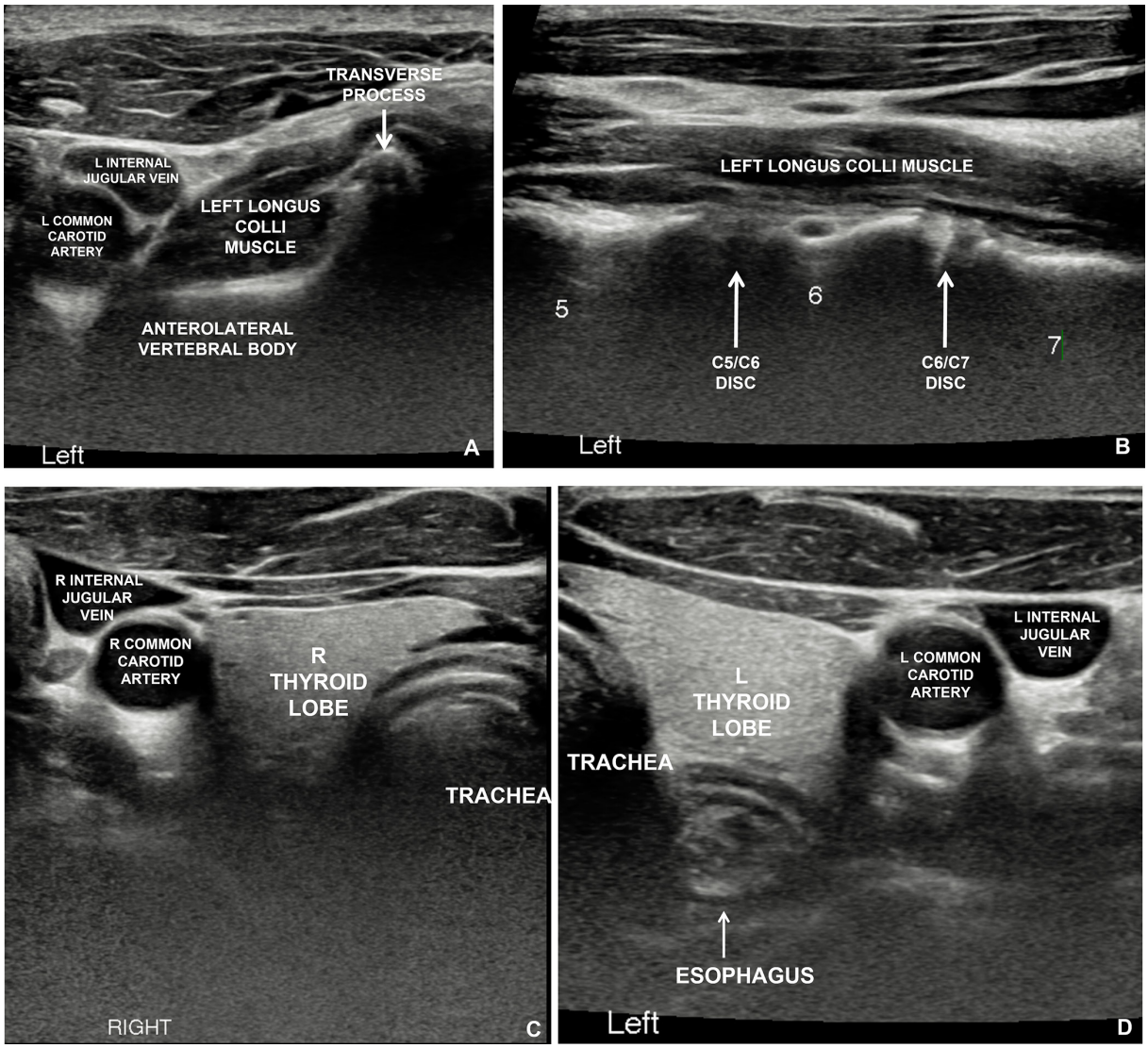

Figure. Sonography of the prevertebral soft tissues in the neck. Transverse (A) and longitudinal (B) images of the prevertebral tissues in the cervical spine from the left. The longus colli muscle overlies the anterior/anterolateral vertebral bodies. (C and D) Transverse sonographic images from the right and left of the neck demonstrating visualization of the esophagus only from the left. Abbreviations: L, left; R, right.

The analysis was stratified into right- and left-sided visibility.

RESULTS

Ten volunteers, 4 men and 6 women, were enrolled. Participants' mean age was 41 years (range 31–65). The mean neck length and circumference were 15.25 cm (SD = 2.4) and 37.55 cm (SD = 2.0), respectively. LCM and C3 to C6 of the anterior cervical vertebral body were successfully visualized in all 10 (100%) cases on both sides. C2 was only visible in 60% of the cases on both sides. C7 was visible in 90% on the right and 70% on the left. The esophagus was visible 100% of the time on the left but only 70% on the right (Table; Figure). There was a significant negative correlation with neck circumference and C2 visibility on the right side, $r(8) = -0.76$, $P = 0.011$. Visibility of left and right C2, right esophagus, and right C7 displayed similar negative correlations with neck circumference and length but were not significant. Because LCM, C3 to C6, and the esophagus (on the left) were visible in all cases, correlations could not be completed due to the constancy of the variable.

DISCUSSION

In this feasibility study, US was successful in the visualization of anterior vertebral bodies and prevertebral soft tissues in the neck in most cases. There was a trend of obstructed visibility with wider and longer necks, but only C2 level visibility was significantly decreased

Table. Visualization of soft tissues in neck with ultrasound imaging.

	Cases Visualized on Ultrasonography		Proportion (95% CI)[a]	
Soft Tissue	**Right**	**Left**	**Right**	**Left**
Esophagus	7/10	10/10	70% (40%–89%)	100% (72%–100%)
Longus colli muscle	10/10	10/10	100% (72%–100%)	100% (72%–100%)
C2	6/10	6/10	60% (31%–83%)	60% (31%–83%)
C3	10/10	10/10	100% (72%–100%)	100% (72%–100%)
C4	10/10	10/10	100% (72%–100%)	100% (72%–100%)
C5	10/10	10/10	100% (72%–100%)	100% (72%–100%)
C6	10/10	10/10	100% (72%–100%)	100% (72%–100%)
C7	9/10	7/10	90% (60%–98%)	70% (40%–89%)

[a]The proportion (Wilson 95% CI) of cases with successful visualization of the target structure.

in participants with wider necks. Decreased rates of esophageal visualization on the right makes anatomical sense, given its leftward location in the neck. Although visibility for the cervical prevertebral soft tissues using US may not be as good as on MRI or CT, the portability of US allows it to be applied at the bedside. This portability would allow for early diagnosis of complications such as prevertebral hematoma; such early diagnosis would be particularly useful in critically ill patients who are not stable enough to undergo MRI or CT.

After anterior cervical spine surgery, dysphagia is the most common complication.[2,3] However, airway compromise is of the most critical adverse events, caused by retropharyngeal edema or hematoma. Emergent treatment of airway compromise requires stabilization of the airway and identification of the cause of obstruction. Angioedema is the earliest cause of airway compromise, seen within 6 to 12 hours. Retropharyngeal hematoma typically occurs between 6 and 24 hours postoperatively[3] while the patient is in postoperative recovery and usually before the patient is discharged from the hospital. Bedside US evaluation for the presence, size, and location of hematoma could be beneficial in this period, guiding the need for surgical reintervention in real time.

There is a fairly long literature history documenting the use of US in the spine,[6,7] with studies using US to characterize intramedullary lesions[8,9] and studies evaluating sonography to confirm successful cervical spinal decompression.[10,11] Several reports have demonstrated the benefits of US-guided intervention of the cervical spine and nerves.[12,13] The previously published findings and the current study showing feasible sonographic visibility of the prevertebral soft tissues of the neck suggest the potential of US in the diagnosis of postoperative anterior cervical hematoma.

Some limitations of our study are our small sample size and the use of healthy volunteers as study subjects. Future studies should focus on assessing the efficacy of cervical prevertebral US in the acute postoperative period. A musculoskeletal radiologist performed and interpreted the US examinations in this study, an unlikely scenario in an emergent moment of need. However, there is routine and successful application of emergency US evaluation by nonradiologists in clinical practice among emergency department practitioners.[14–17] Thus, providers on the inpatient wards (eg, spine surgeons and critical care clinicians) can be taught to successfully use the appropriate US techniques.

CONCLUSION

This feasibility study establishes the viability of US as an imaging modality to visualize soft tissue structures in the anterior neck. The portability and ability of bedside application of US makes it particularly useful for critically ill patients who are not stable enough to undergo MRI or CT. This suggests the use of US in the early detection and intervention of complicated postoperative issues such as retropharyngeal hematoma following anterior cervical spine surgery.

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