Technical Report

# Ultrasound-guided Stellate Ganglion Block Successfully Prevented Esophageal Puncture

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Stellate ganglion block is utilized in the diagnosis and management of various vascular disorders and sympathetically mediated pain in the upper extremity, head and neck. The cervical sympathetic chain is composed of superior, middle, intermediate, and inferior cervical ganglia. However, in approximately 80% of the population, the inferior cervical ganglion is fused with the first thoracic ganglion, forming the stellate ganglion also known as cervicothoracic ganglion.

The stellate ganglion lies medial to the scalene muscles, lateral to the longus coli muscle, esophagus and trachea along with the recurrent laryngeal nerve, anterior to the transverse processes and prevertebral fascia, superior to the subclavian artery and the posterior aspect of the plura, and posterior to the vertebral vessels at C7 level. Consequently, inadvertent placement of the needle into the vertebral artery, thyroid, neural tissues, or esophagus can occur with the fluoroscopic or blind approach. While fluoroscopy is a reliable method for identifying boney structures, ultrasound may identify the vertebral vessels, thyroid gland and vessels, longus coli muscles, nerve roots and the esophagus. Thus, ultrasound may prevent inadvertent placement of the needle into these structures as might happen with either the blind technique or fluoroscopic technique.

A patient with complex regional pain syndrome type I of the left upper extremity was scheduled for left stellate ganglion block with the anterior paratracheal approach under fluoroscopy. Real-time ultrasound imaging prevented inadvertent injury to the esophagus as well as the thyroid gland and vessels.

Ultrasound-guided block may improve patient safety by avoiding the soft tissue structures in the needle path that can't be readily seen by fluoroscopy. This may be particularly useful in the patient with asymptomatic pharyngoesophageal diverticulum (Zenker diverticulum).

**Key words:** Esophageal injury, stellate ganglion block, ultrasound-guided stellate ganglion block, Zenker diverticulum

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Stellate ganglion block is utilized in the diagnosis and management of various vascular disorders and sympathetically mediated pain in the upper extremity, head, and neck.

Many techniques have been used to block the lower cervical sympathetic chain. The 2 most common techniques are at the C6 transverse process (1-3) and the anterior paratracheal approach at C7 (4) with or without fluoroscopy.

This case report illustrates the clinical use of ultrasound in performing stellate ganglion blockade as it may detect and prevent many of the complications reported to be associated with its blockade.

## Case Report

We report on a 25-year-old female with a history of left upper extremity complex regional pain syndrome type I (CRPS I) for the last 6 months. She was scheduled for a left stellate ganglion block. We planned to do the procedure under fluoroscopy (our routine practice) using the classic anterior paratracheal approach and to verify needle placement with ultrasound for teaching purposes. After obtaining an informed consent and applying standard ASA monitors, the patient was positioned in the supine position with the neck extended by placing a pillow under her shoulder in order to stretch the esophagus and makes it move medially under the trachea. With fluoroscopic guidance the bony target was identified at the junction of the anterolateral vertebral body with the transverse process at C6 level in the anteroposterior view and the skin was marked. With complete aseptic technique, a 22-gauge blunt needle was used aiming towards the identified bony target under fluoroscopy guidance (Fig. 1). After passing through the skin and subcutaneous tissue and stabilizing the needle, a 3-12 MHz linear array probe (HD11-XL, Philips, Bothell, WA) was used to verify the position of the needle. The needle was shown to be aiming towards the thyroid tissue anteriorly and then the esophagus posteriorly. At this point the needle was withdrawn and it was reinserted obliquely and it was advanced with real-time ultrasound sonography so that the needle tip will lie anterior to the longus coli muscle (anterior to C6 transverse process) (Figs. 2,3). After negative aspiration, 1 mL of contrast agent was injected which showed good spread without vascular escape (Fig. 4). Then 5 mL of bupivacaine 0.25% were injected in divided doses with real-time ultrasound imaging which showed nice spread of the local anesthetic agent at the area of the lower cervical sympathetic chain with both cephalad and caudad spread (approximately 2 segments each). Five minutes later the patient developed left sided Horner's syndrome as well as vasodilation of the left upper extremity. The temperature at the left middle finger, measured by contact thermography, rose from 28°C to 35°C (7


Fig.1. *AP view showing the needle in target view with the anterior paratracheal approach at C6 aiming towards the junction between the transverse process and the vertebral body at C6.*

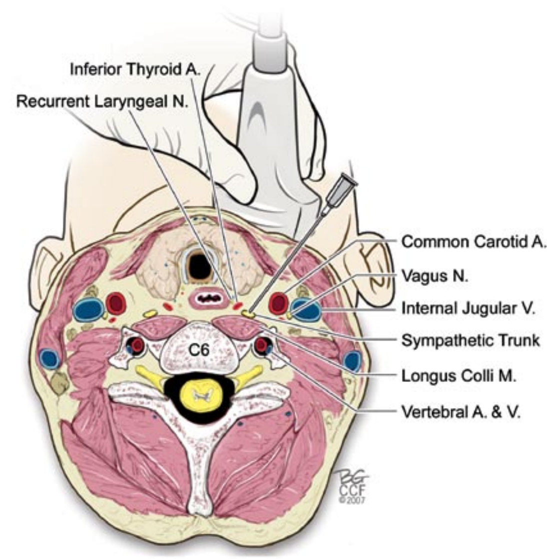


Fig. 2. *Illustration showing the position of the ultrasound probe and the needle in the oblique path. Reprinted with permission from the Cleveland Clinic Foundation.*

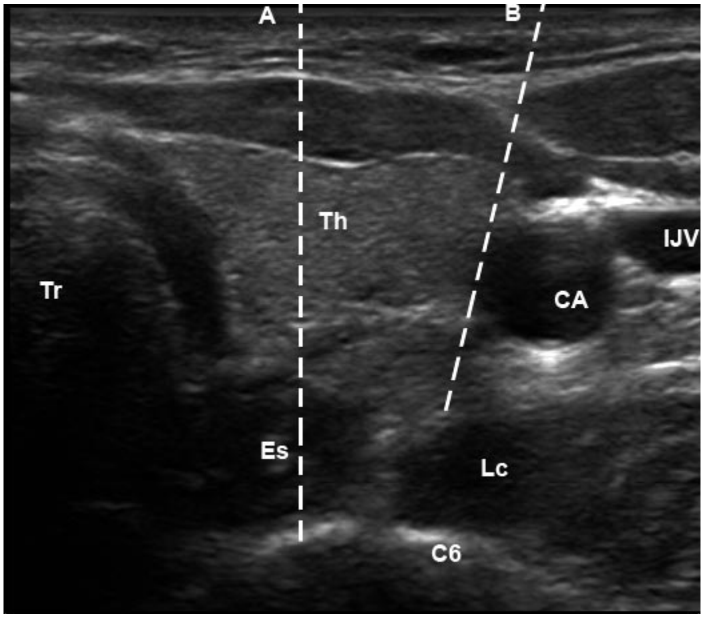


Fig. 3. *Ultrasound imaging of the left stellate ganglion. A: the needle path with the anterior paratracheal approach. B: the needle path with ultrasound guidance. Tr: trachea, Es: esophagus, Th: thyroid, Lc: longus coli muscle, CA: carotid artery, IJV: internal jugular vein. Reprinted with permission from the Cleveland Clinic Foundation.*

degrees), while it rose only 0.5 degree on the right. The patient was monitored in the recovery room for another 30 minutes. She didn't develop recurrent laryngeal nerve palsy, her pain score was dropped from 8 to 2 on a visual analog scale of 0–10, and subsequently she was discharged home in a stable condition.

## Discussion

The cervical sympathetic chain is composed of superior, middle, intermediate, and inferior cervical ganglia. In 80% of the population the inferior cervical ganglion is fused with the first thoracic ganglion, forming the stellate ganglion (cervicothoracic ganglion), which measures approximately 2.5 cm long, 1 cm wide, and 0.5 cm thick (anteroposterior diameter). It is usually located posteriorly in the chest in front of the neck of the first rib and may extend to the seventh cervical (C7) vertebral bodies (5-7). If the inferior cervical ganglion and first thoracic ganglion are not fused, the inferior cervical ganglion lies in front of the C7 tubercle, and the first thoracic ganglion rests over the neck of the first rib (5-7). Accordingly, by using the blind technique at C6 the ganglion primarily blocked is the middle cervical ganglion, and the cervicothorac-


Fig. 4. *AP view showing the spread of the contrast agent.*

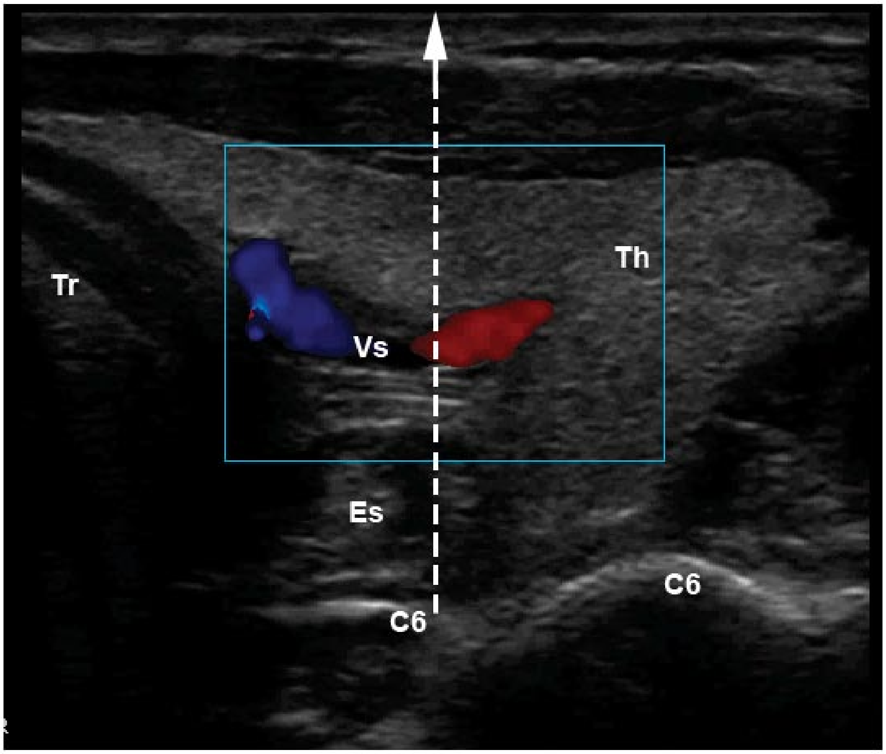


Fig. 5. *Ultrasound imaging showing that with the anterior paratracheal approach the needle may inadvertently injure the thyroid vessels with the potential for hematoma formation. Tr: trachea, Es: esophagus, Th: thyroid, Vs: thyroid vessels. Reprinted with permission from the Cleveland Clinic Foundation.*

ic ganglion is blocked if the injectate spreads down to T1 level.

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The anatomy of the stellate ganglion being in close proximity to various critical structures, results in a number of complications potentially associated with its blockade, some of which life are threatening (9). Accordingly, techniques of blockade have evolved and varied from the use of the standard blind technique to the use of computerized tomography (CT) (10), magnetic resonance imaging (MRI) (7,11), and radionuclide tracers (12).

However these techniques may not be practical in clinical practice as they are time consuming, cost ineffective, and involve radiation exposure.

Fluoroscopy has been suggested as a safer and more effective way to perform stellate ganglion block than the traditional blind approach (13,14). Abdi et al (14) described an oblique fluoroscopic approach targeting the junction between the uncinate process and the vertebral body at the C7 level.

Inadvertent placement of the needle into the vertebral artery, thyroid, neural tissues, or esophagus can occur with the fluoroscopic approach. Fluoroscopy is a reliable method for identifying bony structures; however the adjacent anatomical structures can't be identified. On the contrary ultrasound can identify the vertebral vessels, thyroid gland and vessels, longus coli muscle, nerve roots, and the esophagus and accordingly can prevent inadvertent placement of the needle into these structures as might happen with either the classical blind technique or the more widely used fluoroscopic technique (15).

Kapral et al (16) first described ultrasound imaging (US) for stellate ganglion block. They showed that the blind technique resulted in hematoma formation in 3 out of 12 patients (asymptomatic), with no hematoma occurring during US technique. They attributed this to injury to the thyroid gland or the vertebral artery.

The frequency of retropharyngeal hematoma after stellate ganglion block was reported to be 1 in 100,000 cases with resulting airway compromise and obstruction (9). However Kapral et al (16) reported a much higher incidence of asymptomatic hematoma with the blind technique.

The vertebral artery runs anteriorly to the SG at the C7 level before it enters the foramen of C6 transverse process in about 90% of cases. However it enters at C5 or higher in the remaining cases (17). This makes it vulnerable to injury during lower cervical sympathetic block, not only at the C7 level but at C6 as well, a possibility that can be easily avoided by ultrasound imaging.

Also the inferior thyroid vessels run ventrally at the C6 and C7 level, these together with the thyroid gland itself were reported to be a source of retropharyngeal hematoma with stellate ganglion block (9). With the blind technique and even with fluoroscopic guidance the thyroid gland and vessels can be easily injured in the path of the needle, and again this can be prevented with ultrasound (Fig. 5).

Ultrasound imaging can easily identify the esophagus especially on the left, and our case showed that this is a very important tool as it avoided esophageal penetration and prevented the potential development of mediastinal infection and/or mediastinal emphysema. The procedure was repeated safely as the esophagus was visualized and avoided (which is unique to ultrasound compared to fluoroscopy, unless it is performed after a barium swallow study). It showed that the esophagus has an outpouching that clearly occupies the area that would have been traversed by the needle using the classical anterior paratracheal approach.

The esophagus can be identified by the change in shape and shadowing during swallowing and the presence of a peripheral arc-shaped echogenic line or a boundary hypoechoic zone, which is suggestive of the striatal structure of the digestive tract (18,19).

This may be even more important in patients with pharyngoesophageal diverticulum (Zenker diverticulum), with reported prevalence of 0.01–0.11%, as they are usually asymptomatic and detected incidentally by neck sonography (18,19).

Hardy and Wells (20) showed that cervicothoracic sympathetic block was only achieved by using 20 mL local anesthetic. However placing the needle by ultrasound closer to the target will minimize the amount of local anesthetic and hence improve the patient's safety as Wulf et al (21) reported toxic plasma levels in 30% of patients undergoing stellate ganglion block using 10 mL bupivacaine 0.5%.

Another common side effect of stellate ganglion block is recurrent laryngeal nerve (RLN) block, which is the main reason behind the common practice of avoiding bilateral stellate ganglion block . Hardy and Wells (20) reported an incidence of 10% with 10 mL local anesthetic LA solution and up to 80% with 20 mL solution. Kapral et al (16) reported RLN palsy in only one patient (N=12) where the US showed the spread of the LA between the carotid sheath, thyroid gland, and the esophagus (the anatomic site of the RLN). Ultrasound may predict and/or avoid such complications by repositioning the needle and monitoring the spread of the LA, and if the spread of the LA is away from the site of the RLN, then bilateral stellate ganglion block may be performed safely.

Ultrasound-guided stellate ganglion block may improve the safety of the procedure by direct visualization of the related anatomical structures and accordingly the risk of thyroid gland and vessels, vertebral artery, or esophagus injury may be minimized. Also ultrasound guidance will allow direct monitoring of the spread of the LA and hence complications like RLN palsy, intrathecal, epidural, or intravascular spread may be minimized as well.

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