# 3 Cervical Sympathetic Trunk

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## Introduction

The stellate ganglion block (SGB) is the most common sympathetic block performed today. The sympathetic nervous system plays a prominent role in neuropathic, visceral, and vascular pain. As a result, the SGB can be helpful for a variety of painful and non-painful medical conditions. A temporary blockage of the sympathetic nervous system can help differentiate sympathetically maintained pain (SMP) from sympathetically independent pain (SIP) for conditions of the head, neck, or upper extremity.

Sympathetic fibers supplying the head, neck, and upper limbs arise from the first few thoracic segments and ascend through the sympathetic chains to synapse in the superior, middle, and inferior cervical ganglia, which together form the cervical sympathetic chain (Fig. 3.1). The stellate ganglion (also known as the cervicothoracic ganglion) is formed on each side of the neck by the fusion of the inferior cervical ganglion with the first thoracic ganglion. It lies deep to the prevertebral fascia and medial and posterior to the carotid artery. The ganglion is 1–2.5 cm long and approximately 1 cm wide and may be fusiform, triangular, or oval in shape. At the level of the sixth cervical vertebra (C6), the transverse process has a bony process (termed the "Chassaignac tubercle"), which may be palpated with deep pressure by retracting the carotid artery laterally.

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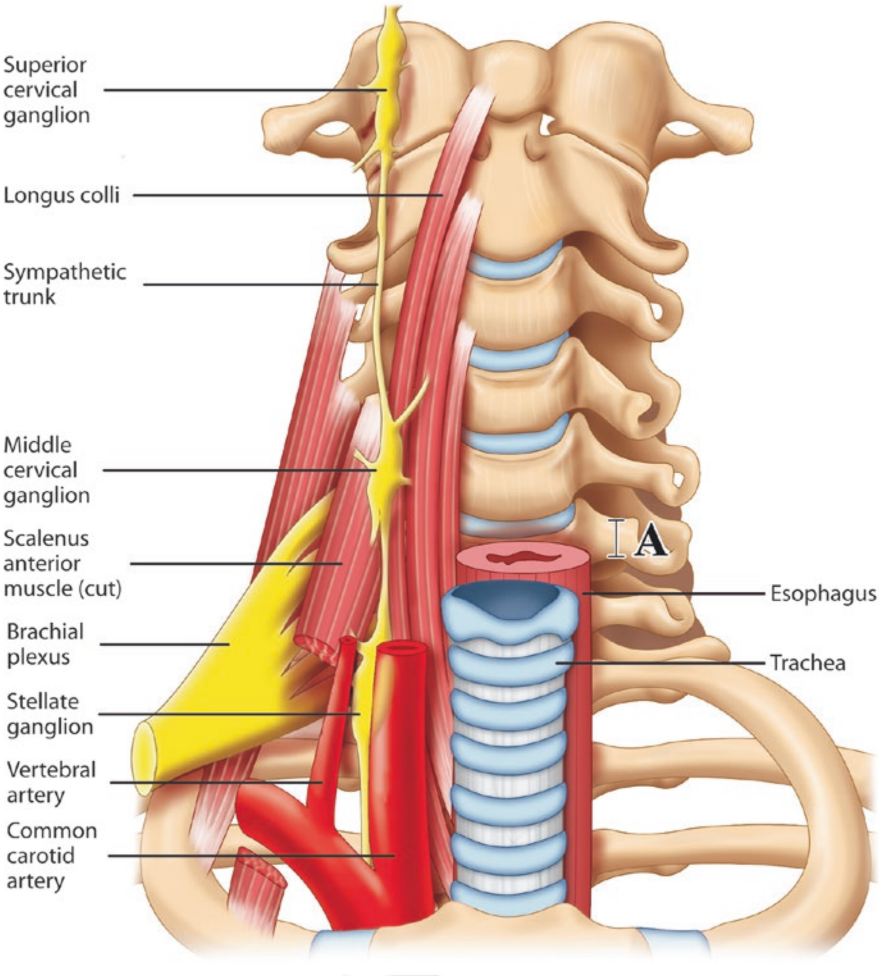


**Fig. 3.1** Anatomy of cervical sympathetic chain. (Reprint with permission from Philip Peng Educational Series)

The preganglionic fibers of the head and neck region continue to travel cephalad to the superior and middle cervical ganglion through the cervical sympathetic trunk. Injection of local anesthetic around the stellate ganglion interrupts the sympathetic outflow to the head, neck, and upper limbs through inactivation of both preganglionic and postganglionic fibers (Fig. 3.2). The stellate ganglion is located in close proximity to the pleural and vertebral artery. As a result, the SGB is performed at a more cephalad location, in proximity to the middle cervical ganglion.

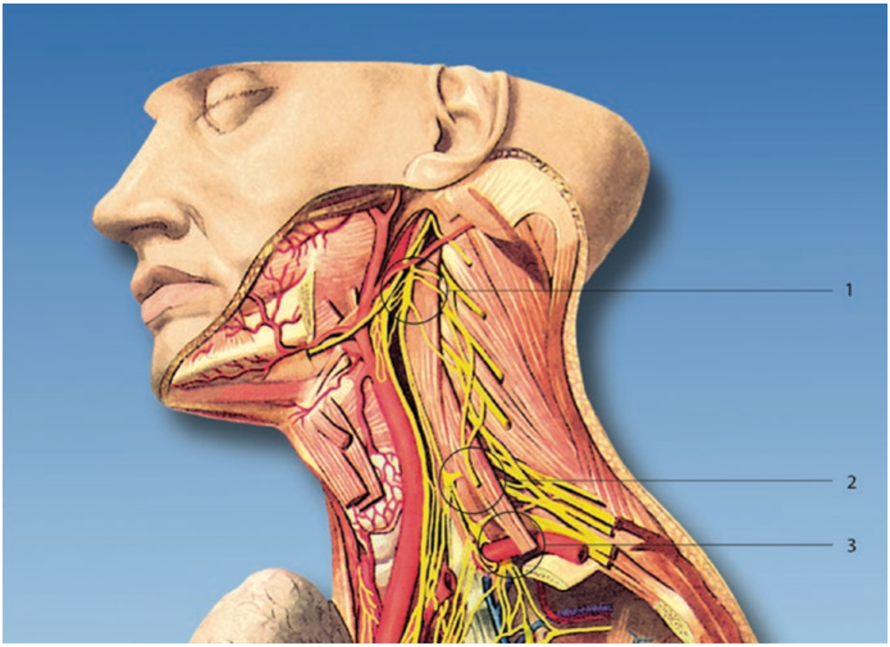


**Fig. 3.2** The cervical ganglion trunk: (1) superior cervical ganglion, (2) middle cervical ganglion, and (3) cervicothoracic ganglion. (Reprinted with permission from Danilo Jankovic)

## Patient Selection

Stellate ganglion blocks are used for a variety of painful conditions, most notably for sympathetically mediated pain in the context of complex regional pain syndrome. However, the technique is not limited to painful conditions. There is growing evidence for its use in treating numerous non-painful medical conditions.

| Indications |
|---|
| *Painful medication conditions:* |
| Sympathetically mediated pain of the upper extremity, head, or neck |
| Acute herpes zoster or postherpetic neuralgia of the head, neck, or upper thorax |
| Phantom limb pain |
| Cluster headache or atypical vascular headache |
| Intractable angina pectoris |
| *Non-painful medication conditions:* |
| Raynaud disease |
| Obliterative vascular disease |
| Vasospasm |
| Hyperhidrosis |
| Lymphedema |
| Refractory ventricular arrhythmia |
| Post-traumatic stress disorders |

| Contraindications |
|---|
| Anticoagulated patient or coagulopathy |
| Preexisting contralateral phrenic nerve palsy |
| Recent myocardial infarction |
| Cardiac conduction block |
| Only unilateral blocks should be performed to avoid bilateral recurrent laryngeal nerve block and resulting stridor. |

## Ultrasound Scanning

- Position: Semi-lateral decubitus position, with the neck turned contralateral
- Probe: Linear 6–13 MHz

- Scan 1: Place the probe at the C6 level (Figs. 3.3 and 3.4). Identify the key landmarks, including the longus colli muscle (LC), longus capitis muscle (LCa), prevertebral fascia (arrows), cervical nerve root (N), carotid artery (C), and internal jugular vein (∗∗). At this level, the transverse process has a prominent anterior tubercle (AT).
- Scan 2: To confirm the level, scan the probe caudally to the C7 level. The transverse process is the key landmark to identify at this level (Fig. 3.5). At this level, the transverse process has a prominent posterior tubercle and vestigial anterior tubercle. Use color Doppler to identify the vertebral artery.

  Note that at the C6 level, the vertebral artery most commonly enters the foramen transversarium. In up to 10% of patients, the vertebral artery travels outside the foramen transversarium at the C6 or even C5 level. The figure showed the presence of vertebral artery anterior to the anterior tubercle at C5 level (Fig. 3.6).

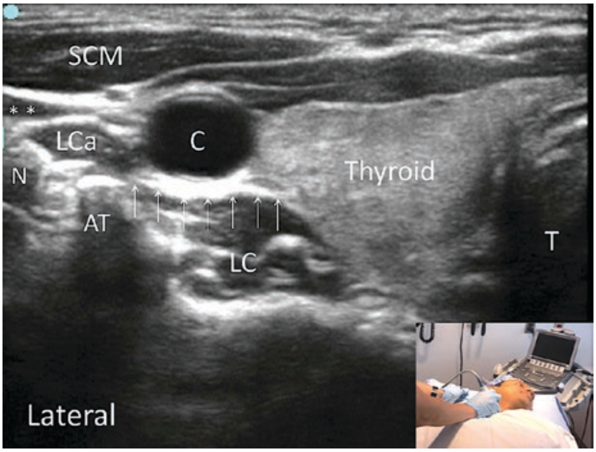


**Fig. 3.3** Sonoanatomy at C6. The right lower corner showed the position of the patient. Longus colli muscle (LC), longus capitis muscle (LCa), prevertebral fascia (arrows), cervical nerve root (N), carotid artery (C), and internal jugular vein (∗∗). At this level, the transverse process has a prominent anterior tubercle (AT). (Reprinted with permission from Philip Peng Educational Series)

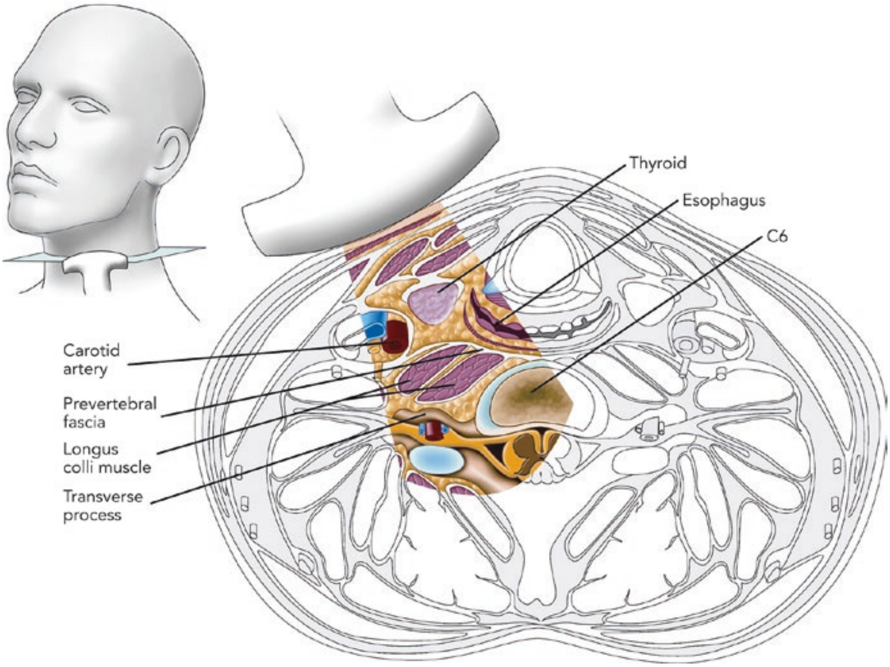


**Fig. 3.4** The corresponding anatomic structures revealed at C6. (Reprinted with permission from Philip Peng Educational Series)

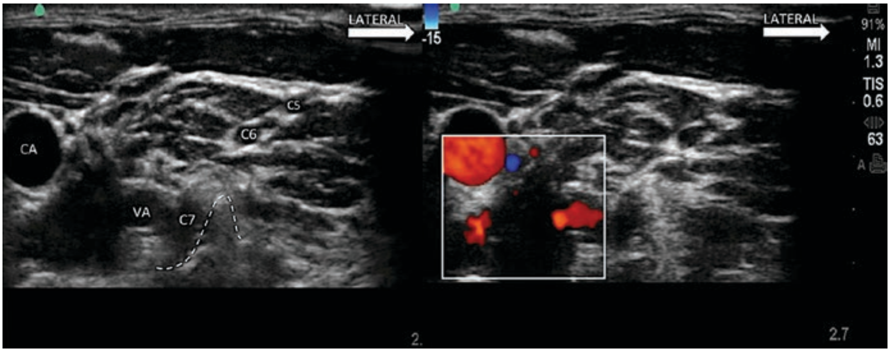


**Fig. 3.5** Sonography at C7. VA, vertebral artery; CA, carotid artery. (Reprinted with permission from Philip Peng Educational Series)

- Scan 3: At the C6 level, perform a pre-scan with and without color Doppler (Fig. 3.7). Identifying aberrant vessels and structures such as the esophagus will help plan for the safest approach, which may change in location on swallowing (Fig. 3.7). The location of the esophagus and the vessel may discourage a practitioner from performing a medial or lateral approach (see procedure below).

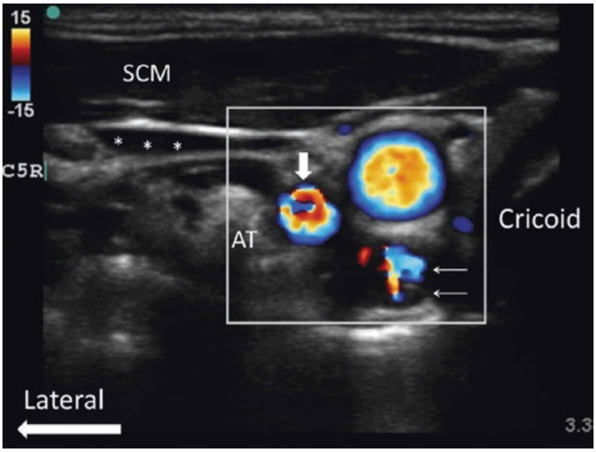


**Fig. 3.6** Vertebral artery anterior to the anterior tubercle (AT) at C5. Vertebral artery indicated by bold arrow. The other artery medial to the vertebral artery is the carotid artery with a reflection artifact (arrows). SCM, sternocleidomastoid muscle; ∗jugular vein. (Reprinted with permission from Philip Peng Educational Series)

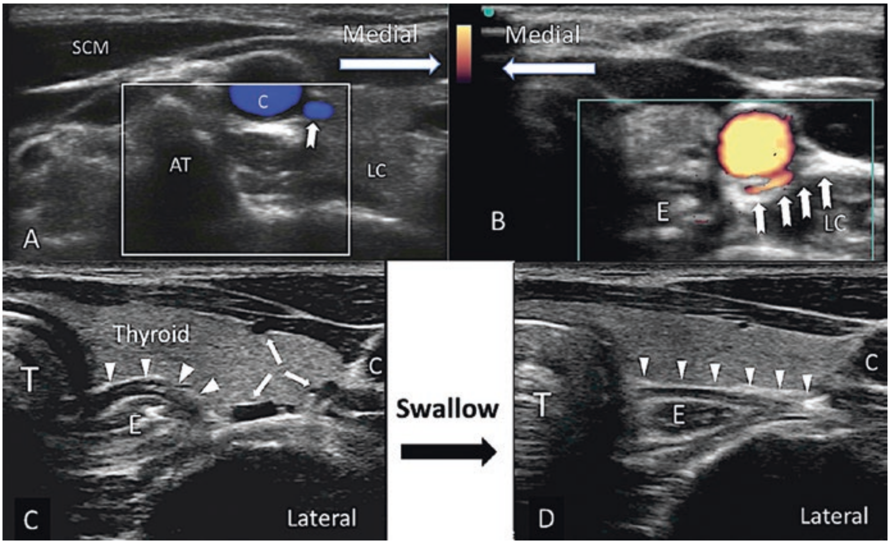


**Fig. 3.7** Panels (**a**)–(**c**) showed different aberrant vessels in short axis and long axis (bold arrows). Panels (**b**)–(**d**) showed the presence of the esophagus (E) outlined by arrowheads. (Reprinted with permission from Philip Peng Educational Series)

## Procedure

### Equipment and Drugs

- Needle: 25G 1.5 inch or 22G 3.5 inch needle
- Drugs: 3–5 mL of local anesthetic (0.25–0.5% bupivacaine)

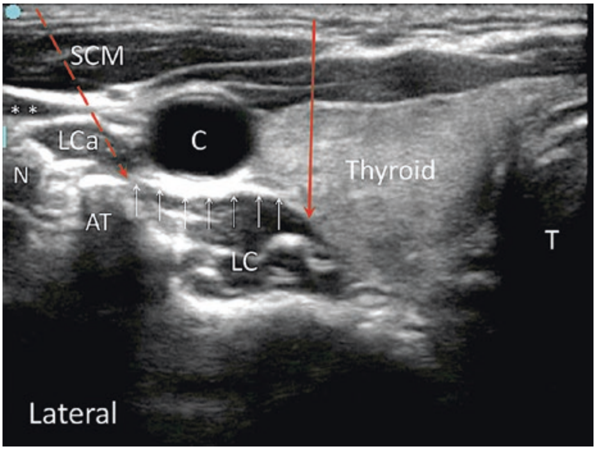


**Fig. 3.8** Figure showing the medial (out-of-plane) approach or lateral in-plane approach. The target is the prevertebral fascia (arrows). SCM, sternocleidomastoid muscle; LCa, longus capitis muscle; LC, longus colli muscle; AT, anterior tubercle; T, trachea; solid line, medial out-of-plane approach, dotted line, lateral in-plane approach. *Internal jugular vein (collapsed) (Reprinted with permission from Philip Peng Educational Series)

Both medial and lateral approaches can be utilized for this technique (Fig. 3.8). With both techniques, the needle tip is directed between the prevertebral fascia between the longus colli and capitis muscles. The target is the soft tissue plane between these two layers of prevertebral fascia. The medial approach involves placing the needle medial to the carotid artery, and the needle is advanced toward the target using an out-of-plane technique. The lateral approach involves placing the needle in-plane and lateral to the carotid artery, with the needle tip advanced to the target. Typically, a lateral approach is recommended because of the frequent presence of the esophagus and aberrant vessel medial to the carotid artery.

Care needs to be taken to avoid cervical nerve roots, major blood vessels, and non-vascular structures such as the esophagus and thyroid gland. Continued visualization of the needle tip throughout the technique, coupled with the use of hydrodissection and visualization of local anesthetic spread, will help ensure safe needle placement.

## Clinical Pearls

1. When confirming cervical levels, make sure to scan in a caudal and cephalad direction to identify both C6 and C7 levels.
2. In 7–10% of patients, the vertebral artery will be exposed outside of the foramen transversarium at the C6 level.
3. Place a normal saline bag underneath the ipsilateral shoulder to allow more space for the hand holding the needle for the in-plane technique.
4. Always turn the hand to the contralateral side to “move” the carotid artery further away from the anterior or carotid tubercle of C6.
5. Always use color Doppler to assess for the location of the vertebral artery and other major vessels that may lie in the path of the needle.

6. Hydrodissection with normal saline will help minimize the risk of unintended intravascular injection with local anesthetic. Due to the proximity of the central nervous system, small amounts of local anesthetic injected intravascularly can quickly lead complications, such as seizures.
7. Perform only unilateral injections to avoid risk of respiratory complications associated with bilateral injections, such as phrenic nerve palsy and swallowing difficulties.
8. Patients should be made aware of what can be expected postinjection, including but not limited to Horner's syndrome, facial and conjunctival flushing, upper extremity numbness or weakness, hoarseness, and dysphagia. Horner's syndrome following the procedure can be used as a confirmatory sign of successful blockade.

## Literature Review

The stellate ganglion block can be useful for both painful and non-painful conditions of the upper extremity, head, neck, and upper thorax. The target is the cervicothoracic ganglion, which is approached by targeting the plane within the prevertebral fascia. This procedure has commonly been performed by using either a landmark-based approach or fluoroscopic-guided approach. These techniques do not allow for identification of the target fascial plane, nor do they help to visualize important vascular structures in the region. Ultrasonography has emerged as a more accurate and potentially safer imaging option for performing an SGB.

Typically, the SGB procedure has involved the injection of local anesthetic for a single sympathetic block; however, other modalities have been used in an attempt to provide a longer duration of blockade. This includes the use of both chemical and thermal neurolysis. Chemical neurolysis for SGB, with the use of phenol, for example, is associated with the risk of serious complications, due to unintended spread to adjacent nerve and vascular structures. Conventional thermal radiofrequency ablation carries the risk of long-term nerve injury due to neural destruction. Pulsed radiofrequency, a variation of thermal radiofrequency that results in less thermal damage, has emerged as a potential treatment for various chronic pain syndromes, including SGB. Evidence is limited, and further research is needed to support its application for the SGB.

## Suggested Reading

Abdi S, Zhou Y, Patel N, Saini B, Nelson J. A new and easy technique to block the stellate ganglion. Pain Physician. 2004;7(3):327–31.

Atez Y, Asik I, Ozgencil E, et al. Evaluation of the longus colli muscle in relation to stellate ganglion block. Reg Anesth Pain Med. 2009;34:219–23.

Bhatia A, Peng P. Stellate ganglion block. In: Regional nerve blocks in anesthesia and pain therapy. 4th ed. Cham: Spring Publishing; 2015.

Bhatia A, Flamer D, Peng PW. Evaluation of sonoanatomy relevant to performing stellate ganglion blocks using anterior and lateral simulated approaches: an observational study. Can J Anaesth. 2012;59:1040–7.

Drummond PD, Finch PM, Skipworth S, Blockey P. Pain increases during sympathetic arousal in patients with complex regional pain syndrome. Neurology. 2001;57:1296–303.

Flamer D, Seib R, Peng P. Complications of regional anesthesia in chronic pain therapy. Complications of regional anesthesia. Cham: Spring Publishing; 2017.

Gofeld M, Shankar H, Benzon H. Fluoroscopy and ultrasound-guided sympathetic blocks: stellate ganglion, lumbar sympathetic blocks, and visceral sympathetic blocks. In: Essentials of pain medicine. 4th ed. Philadelphia: Elsevier Publishing; 2016.

Huntoon MA. The vertebral artery is unlikely to be the sole source of vascular complications occurring during stellate ganglion block. Pain Pract. 2010;10:25–30.

Kim ED, Yoo WJ, Kim YN, Park HJ. Ultrasound-guided pulsed radiofrequency treatment of the cervical sympathetic chain for complex regional pain syndrome: a retrospective observational study. Medicine (Baltimore). 2017;96:e5856.

Makharita MY, Amr YM, El-Bayoumy Y. Effect of early stellate ganglion blockade for facial pain from acute herpes zoster and incidence of postherpetic neuralgia. Pain Physician. 2012;15(6):467–74.

Peng P. Peripheral applications of ultrasound for chronic pain. In: Benzon HT, Huntoon MA, Narouze S, editors. Spinal injections and peripheral nerve blocks: interventional and neuromodulatory techniques for pain management. 1st ed. Philadelphia: Elsevier; 2011.

Peng P. Ultrasound for pain medicine intervention: a practical guide. Philip Peng Education Series. 2013. iBooks. https://itunes.apple.com/ca/book/ultrasound-for-pain-medicine-intervention-practical/id643092938?mt=11

Soneji N, Peng P. Ultrasound-guided pain interventions – a review of techniques for peripheral nerves. Korean J Pain. 2013;26(2):111–24.