Stellate Ganglion Block

56

Ioannis M. Skaribas, Aanchal Sharma,
and Elena E. Skaribas

Introduction

Stellate ganglion block was first described in the 1930s by Fontaine and Leriche as a method to relieve reflex sympathetic dystrophy symptoms of the upper limbs. Since then it has been used for diagnosis and treatment of many sympathetically mediated pain states of the head, neck, and upper extremities such as CRPS-I (RSD) and CRPS-II (causalgia), postherpetic neuralgia, and vasospastic disorders. In addition to neuropathic pain, an increase in stellate ganglion activity has also been postulated to cause many ventricular arrhythmias including congenital QT prolongation, ventricular tachycardia, and ventricular fibrillation. The block has been used to treat life-threatening ventricular arrhythmia and congenital long QT syndrome. So far various techniques have been employed to successfully block the stellate ganglion including anatomical landmarks, fluoroscopic guidance, CT guidance, and most recently ultrasound guidance. As all the sympathetic supply of head and neck and most of the sympathetic supply of upper extremity either synapse or pass through stellate ganglion, this is considered as a complete sympathetic block.

In this chapter, we intend to discuss the anatomy of stellate ganglion, the technique of the ganglion block, its indications, its contraindications, and the complications associated with the block.

I. M. Skaribas (✉) · A. Sharma
Expert Pain P.A., Department of Anesthesiology,
McGovern Medical School, The University of Texas Health
Science Center at Houston, Houston, TX, USA
e-mail: skaribasmd@expertpaincare.com;
aanchal.sharma@uth.tmc.edu

E. E. Skaribas
Southern Methodist University, Dallas, TX, USA
e-mail: eskaribas@smu.edu

Anatomy

Sympathetic supply to the head, neck, and upper extremity is derived from the preganglionic fibers arising from the cell bodies located in the anterolateral horn of T1 and T2 segments of the spinal cord. Some sympathetic innervation to the upper extremities originates from T2 to T3 via anatomically distinct nerves (Kuntz's nerves). Preganglionic fibers leave the spinal cord and enter their respective spinal nerves. They then pass through the white rami communicantes to enter the cervical sympathetic ganglia. The cervical sympathetic ganglia are located along the prevertebral fascia behind the cervical neurovascular bundle extending from the level of the transverse process of the second cervical vertebrae to the first rib where they transition to the thoracic sympathetic chain. They are divided to superior, middle, and inferior cervical sympathetic ganglia. In 80% of the population, the inferior cervical ganglion and the first thoracic ganglion are fused to create the cervicothoracic or stellate ganglion. In the remaining 20% of individuals, the first thoracic vertebral ganglion is called stellate ganglion. The postganglionic fibers from the stellate ganglion either pass upward to supply the head or join the gray rami communicantes to supply the neck and upper extremity. All the sympathetic supply to the head and neck and most of the upper extremity passes through the stellate ganglion. The stellate ganglion is oval or star shaped and measures approximately 2.5 cm in length and 1 cm in width and is 0.5 cm in thickness. Understanding its anatomy is important for an effective blockade and to avoid unnecessary complications. When fused, the ganglion lies against the C7 transverse process and the neck of the first rib. Anterior to the ganglion lies the subclavian and vertebral artery; posteromedial the longus colli muscle; laterally the carotid sheath, scalene muscles, and the brachial plexus; and medially the trachea, esophagus, and recurrent laryngeal nerve. Inferior to the ganglion is the pleura and the dome of the lung (Fig. 56.1).

T. R. Deer et al. (eds.), *Deer's Treatment of Pain*, https://doi.org/10.1007/978-3-030-12281-2_56

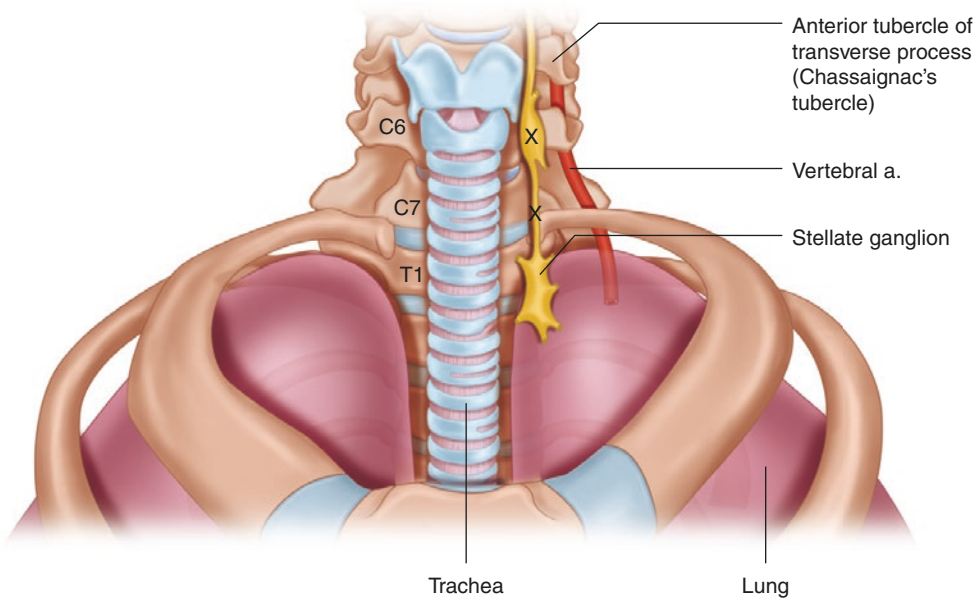

Fig. 56.1 Anatomy of the stellate ganglion. The location of the star(stellate) ganglion is appreciated on the left. The location of relevant adjacent anatomical structures is seen including the anterior tubercle of the C6 transverse process where the stellate ganglion block is performed, as well as the location of the first rib, cupola of the lung, and vertebral artery

Indications

The stellate ganglion has been successfully used in various pain syndromes as well as other conditions, including:

1. Complex regional pain syndrome type I (reflex sympathetic dystrophy/RSD) of the head and upper extremities
2. Complex regional pain syndrome type II (causalgia) of the head and upper extremities
3. Phantom limb pain
4. Postherpetic neuralgia
5. Orofacial pain syndromes including trigeminal neuralgia and orofacial neuropathic pain
6. Sympathetically maintained headaches, cluster headaches
7. Neuropathic cancer pain
8. Postradiation neuropathic pain
9. Postmastectomy pain
10. Vascular insufficiency
11. Raynaud's disease
12. Acute vasospasm following intra-arterial injection
13. Refractory anginal cardiac pain

In addition to the conditions outlined above, stellate ganglion blocks have been used successfully in the treatment of non-painful conditions such as cardiac arrhythmias, hyperhidrosis, and post-traumatic stress disorder (PTSD).

Contraindications

1. Patient refusal
2. Infection at the site of the needle insertion
3. Bilateral stellate ganglion blocks
4. Bleeding disorders
5. Patient on anticoagulation therapy
6. Unilateral recurrent laryngeal nerve palsy or phrenic nerve palsy
7. Pregnancy (fluoroscopy)

Fluoroscopic Technique

The most common approach to the stellate ganglion is the anterior paratracheal approach at the C6 transverse process level (Chassaignac's tubercle) where anatomical landmarks are easily palpable and identifiable by imaging. This approach significantly reduces the risk of pneumothorax and intravascular injection. Most stellate ganglion blocks in chronic pain medicine are performed with fluoroscopic guidance, although an ultrasound-guided technique has been developed.

After informed consent is obtained, the patient is taken to the operating room where he/she is positioned supine with a pillow under the shoulders to hyperextend the neck. This hyperextension serves two purposes: to stretch the esophagus away from the transverse process and to facilitate clarity of the osseous anatomical landmarks. Although this procedure can be performed with only local anesthesia, most physicians prefer to use mild sedation for patient comfort. The neck is prepped and draped in a sterile manner. A sterile draped C-arm is introduced and positioned over the cervical spine in a posterior-anterior orientation without oblique or cephalocaudal angulation to identify the vertebral bodies of the sixth and seventh cervical vertebral body (C6, C7). The stellate ganglion block is preferably performed at a C6 level. Macroscopically, this corresponds to the level of the cricoid

cartilage. The transverse process of C6 is identified as well as the anterior tubercle of the transverse process (Chassaignac's tubercle), which is important if the procedure is to be performed blindly as it is an easily identifiable anatomical landmark by palpation. Fluoroscopic land marking for needle placement is the junction of the transverse process to the base of the corresponding uncinated process. The superimposed skin is infiltrated with 3–5 cc of 1% lidocaine. The patient is asked to refrain from talking or swallowing. A 22 gauge 3 ½ inch needle is inserted through the skin, and under fluoroscopic guidance utilizing a coaxial technique is advanced until periosteum is contacted at the previously mentioned anatomical target. Once in its final position, the needle should be situated firmly into the tissue layers. The depth from the skin to target varies between patients. After negative aspiration is performed for blood or cerebrospinal fluid (CSF), 1–2 ml of radiographic contrast dye (iohexol 180 or 240 mg/ml) is injected under real-time, continuous fluoroscopy to rule out any intravascular or intrathecal spread and to verify accurate cephalocaudal spread of the contrast material along the anterolateral surfaces of the corresponding vertebrae (Figs. 56.2 and 56.3). Both posterior-anterior (PA) and lateral fluoroscopic views are utilized for verification. This fluoroscopic confirmation illustrates the spread of the injectate in the prevertebral fascia where the stellate ganglion is located. A negative aspiration cannot exclude possible intravascular or intrathecal administration, so a high level of awareness is required when performing this procedure. A commonly used therapeutic injectate consists of a 10 ml mixture of 0.25% ropivacaine with 40–80 mg of triamcinolone (Kenalog). A test dose of 1 ml is initially injected while observing for signs and symptoms of intravascular or intrathecal injection. If no abnormalities are noted, the test dose is followed by a slow injection of the remaining volume under intermittent or continuous fluoroscopy. If a C7 approach is desired, the anatomical considerations are important. At C7 level there is no anterior tubercle, and often there is no transverse foramen to protect the vertebral artery that is located anterior to the lateral C7 transverse process. Therefore, it is imperative to be constantly aware of the needle trajectory and to keep the needle at/or medial to a line connecting the uncinated processes to avoid accidental vertebral artery puncture and inadvertent intra-articular injection. At the end of the procedure, the patient is transferred to the recovery room and is observed for signs of a successful sympathetic block and for possible complications before discharged.

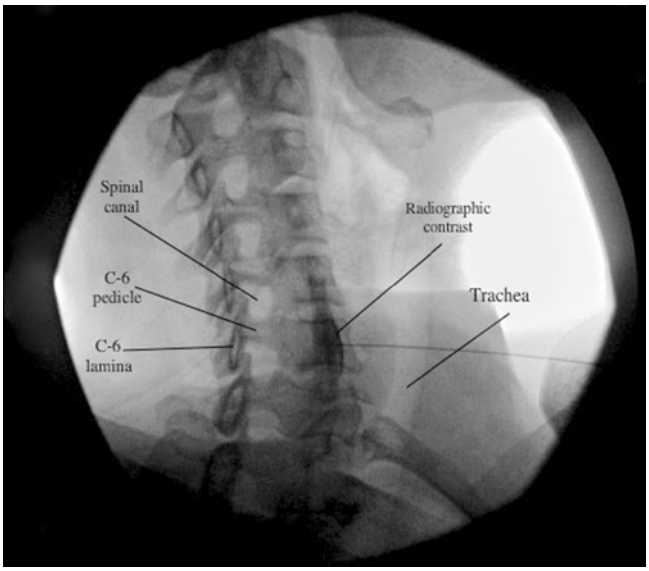

Fig. 56.3 This is a lateral fluoroscopic view of a C6 stellate ganglion block at C6 level. The spread of the contrast is appreciated at the anterolateral surface of C6

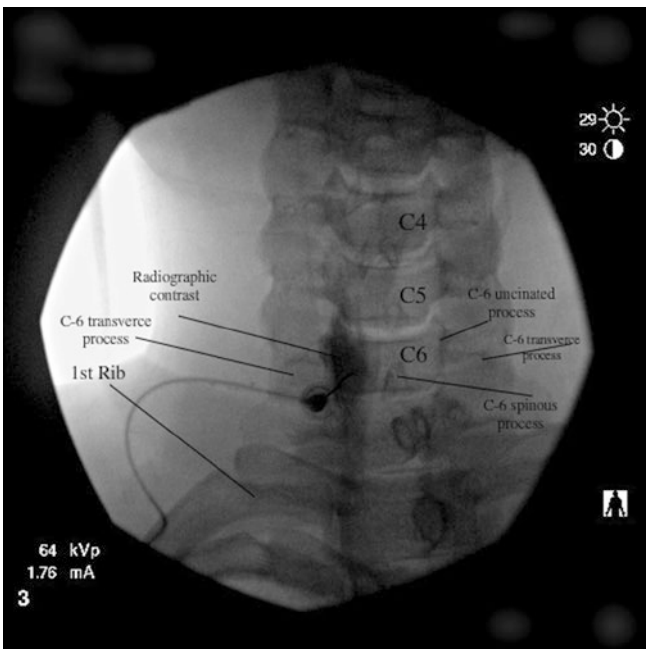

Fig. 56.2 Posterior-anterior fluoroscopic view depicts placement of the needle for the performance of fluoroscopy-guided right stellate ganglion block at C6 level. The needle is identified under fluoroscopy with the tip placed at the junction of the right C6 uncinated and transverse process. The contrast is identified spreading both cephalad and caudad

Ultrasound Technique

In the last 10 years, the utilization of ultrasound for regional anesthesia and analgesia has transferred over to the field of pain medicine. Stellate ganglion block is one of the procedures where ultrasound guidance is frequently performed. There are obvious advantages to the usage of ultrasound for stellate ganglion blockade including the real-time visualization of all anatomical structures and real-time advancement of the needle accounting for improved safety and avoidance of radiation exposure for both physician and patient alike. The utilization of ultrasound has confirmed the significant variability of the anatomical structures surrounding the stellate ganglion and the cervicothoracic sympathetic chain in

general. Esophageal deviation from the midline is very common, and accidental penetration can result to severe complications such as mediastinitis. Vascular anatomical variations of the inferior thyroidal artery and other vessels can result in inadvertent vascular penetration with secondary formation of a hematoma.

Like with the fluoroscopic technique, the patient is placed in a supine position and with a pillow under the shoulders to hyperextend the neck. After the neck is prepared and draped sterilely, a linear ultrasound transducer (6–13 MHz) is introduced under sterile conditions. The transducer is positioned to contact skin in a transverse orientation to the axis of the neck and to the right or left of midline at the level of the cricoid cartilage, which corresponds to the level of C6. A cross-sectional scan is obtained, and all the anatomic structures are sonographically identified before the needle insertion (Fig. 56.4). Color Doppler can be utilized to further facilitate the identification of vessels such as the carotid artery or the inferior thyroid artery. Both an in-plane and an out-of-plane technique can be utilized (Fig. 56.5a, b). The in-plane technique is favored since it provides real-time "step-by-step" visualization of the needle tip as it travels through the different fascial planes. After the skin is infiltrated with 3–5 ml of 1% lidocaine, a 22 gauge 3.5 inch spinal needle or an echogenically insulated 22 gauge 80 mm regional block needle is inserted through the skin and advanced under real-time

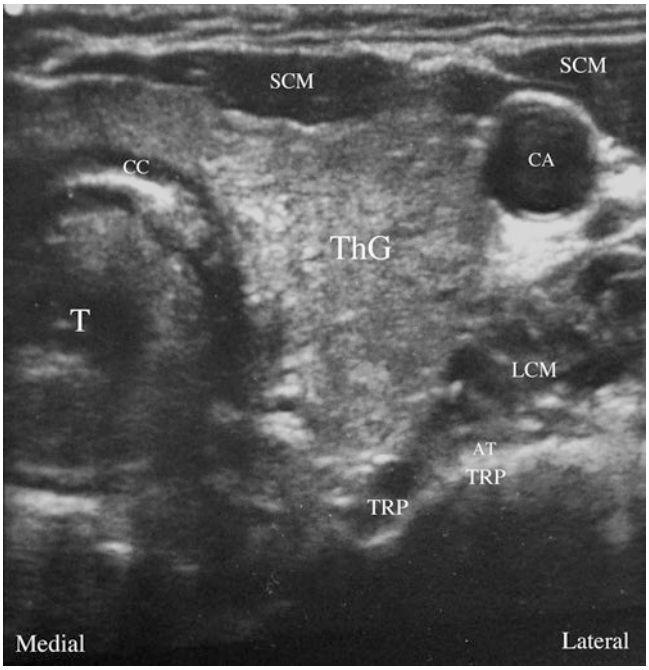

Fig. 56.4 Sonographic image of a cross-sectional scan at right C6 level. The relevant anatomical structures are clearly seen. From medial to lateral: T (trachea), CC (cricoid cartilage), SCM (sternocleidomastoid muscle), ThG (thyroid gland), TRP (transverse process of C6), AT TRP (anterior tubercle of C6 transverse process/Chassaignac's), LCM (longus coli muscle), CA (carotid artery)

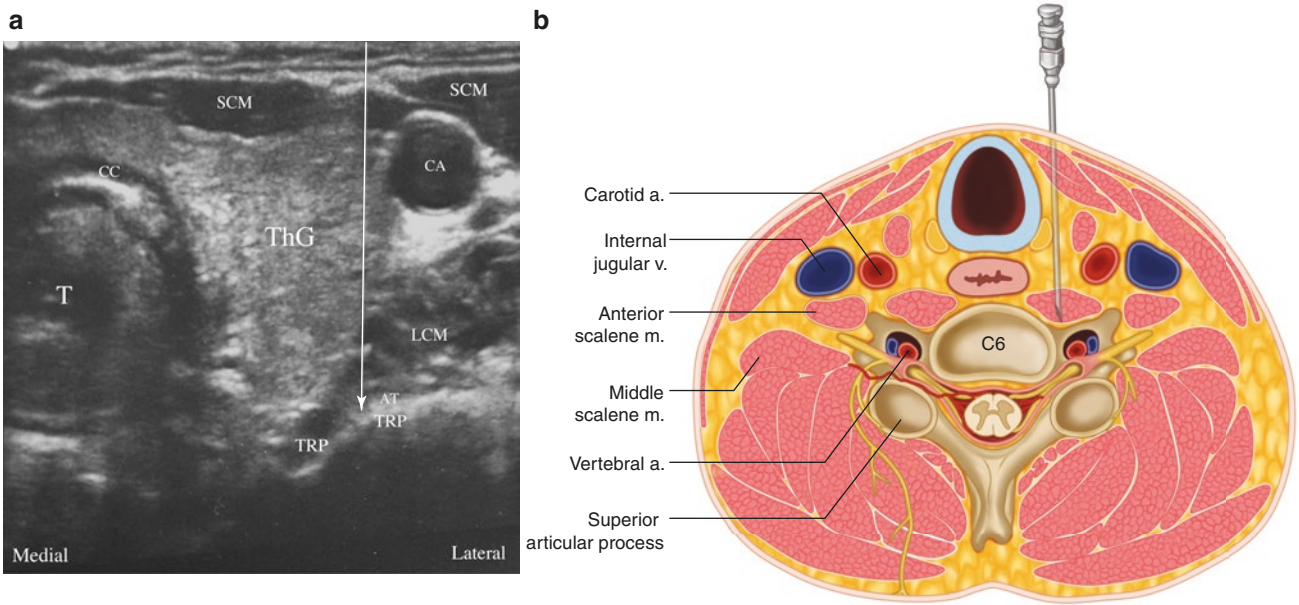

Fig. 56.5 (**a**) Sonographic depiction of an out-of-plane needle insertion for purposes of a right C6 stellate ganglion block. This sonographic image depicts the classic trajectory of the needle during fluoroscopy-guided stellate ganglion blocks and its relationship to the adjacent anatomical structures. The tip of the needle is located at Chassaignac's tubercle near the prevertebral fascia and the longus coli muscle. One can appreciate the location of both the carotid artery and the thyroid gland and their proximity to the needle. (**b**) Cross-sectional illustration of a right stellate ganglion block at C6 level. The vascular and muscular relevant anatomy is depicted as the needle advances toward Chassaignac's tubercle

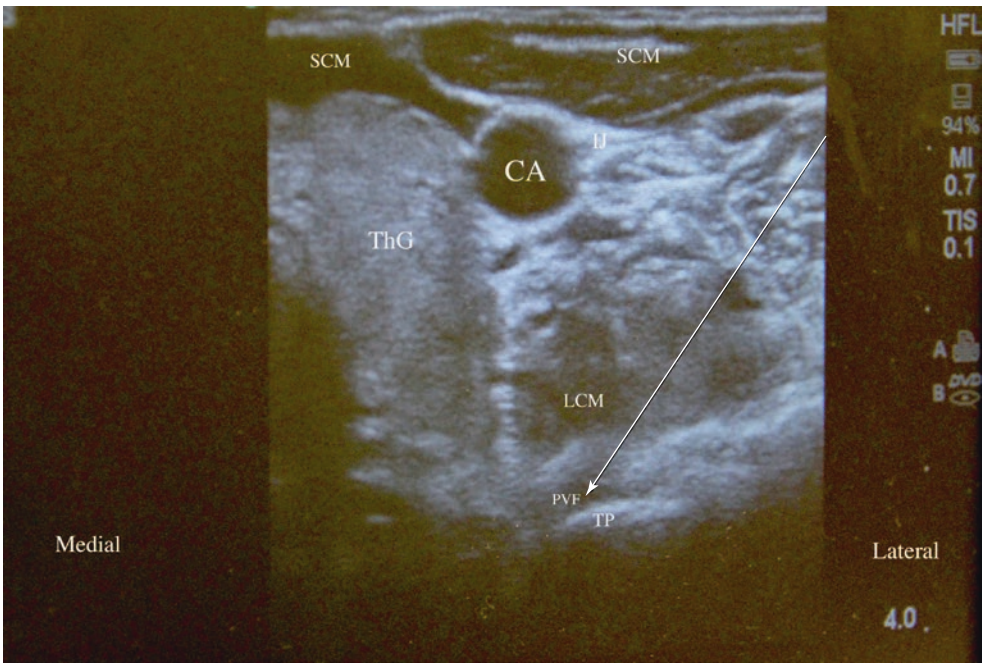

Fig. 56.6 Sonographic depiction of a right C6 ultrasound-guided stellate ganglion block using an in-plane technique. The needle is inserted through the skin and advanced under real-time ultrasound guidance in a latero-medial direction toward the prevertebral fascia and longus colli muscle traveling between the anterior tubercle and the carotid artery

ultrasound guidance in a latero-medial direction toward the prevertebral fascia and longus coli muscle traveling between the anterior tubercle and the carotid artery (Fig. 56.6). Once in position and after negative aspiration for blood or CSF is performed, a test dose of 1 ml is given sonographically observing spread in the prevertebral fascia. Lastly, the rest of the 5–10 ml volume is injected slowly under ultrasound.

Signs of Successful Stellate Ganglion Block

1. Horner's syndrome (ptosis, myosis, anhidrosis, enophthalmos, nasal congestion)
2. Ipsilateral conjunctival injection
3. Vasodilation of the ipsilateral upper extremity
4. Temperature elevation of the ipsilateral upper extremity by 1–3 °C

Complications

1. Related to the technique
   - (i) Injury to surrounding vascular structures (carotid artery, subclavian artery, vertebral artery, internal jugular vein).
   - (ii) Hematoma formation especially in patients on anticoagulants.
   - (iii) Intravascular injection.
   - (iv) Intrathecal injection.
   - (v) Cardiovascular collapse.
   - (vi) Injury to pleura leading to pneumothorax, esophageal perforation, and injury to thoracic duct leading to chylothorax.
   - (vii) Stellate ganglion block due to inhibition of sympathetic fibers can lead to profound bradycardia and even heart block.
   - (viii) Vasovagal attack.
2. Infection
   - (i) Cellulitis
   - (ii) Soft tissue infection
   - (iii) Osteitis of vertebral body and transverse process
   - (iv) Meningitis
3. Related to local anesthetic medication injected
   - (i) Spread of local anesthesia to recurrent laryngeal nerve and phrenic nerve
   - (ii) Hoarseness
   - (iii) Dyspnea
   - (iv) Intra-arterial injection of local anesthetic
   - (v) Seizures
   - (vi) Local anesthetic systemic toxicity
   - (vii) Neuro-blockade of the brachial plexus

Recommended Reading

1. Bonica JJ. Sympathetic nerve blocks for pain diagnosis and therapy. Technical considerations Vol. II. Block of stellate ganglion and cervicothoracic and thoracic chains. Winthrop. 1984; p. 61–77.
2. Deer TR. Treatment of chronic pain by interventional approaches: the American Academy of pain medicine textbook on patient management. New York: Springer; 2015.

3. Elias M. Cervical sympathetic and stellate ganglion blocks. Pain Physician. 2000;3(3):294–304.
4. Lofstrom B, Cousins M. Sympathetic neural blockade of the upper and lower extremity. In: Cousins M, Bridenbaugh PO, editors. Neural blockade in clinical anesthesia and management of pain, second edition. London: J.P. Lippincot; 1988.
5. Peng P, Narouze S. Ultrasound-guided interventional procedures in pain medicine: a review of anatomy, sonoanatomy, and procedures: part I: nonaxial structures. Reg Anesth Pain Med. 2009;34(5):458–74.
6. Rathmell JP. Atlas of image-guided intervention in regional anesthesia and pain medicine. 1st ed. Philadelphia, USA: Lippincott, Williams and Wilkins; 2011.