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Ultrasound-guided peripheral nerve block in chronic pain management

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The use of ultrasound (US) for the guidance of peripheral nerve blocks allows the practitioner to visualize soft tissue structures and needle advancement in real time. These advantages make it potentially advantageous in the field of chronic pain management. The objective of this current review is to summarize the anatomy, existing techniques, and literature on a few selected peripheral nerve blocks published to date in chronic pain management.
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It is well established that the high failure rate of peripheral nerve blockade is often attributable to anatomical variation between individuals.[1,2] Given this, the reliance on various palpable anatomical landmarks for accurate needle placement, and therefore successful nerve block, is a dubious proposition. Ultrasound (US) has the advantage of visualizing the soft tissue structures and adjacent vessels around which the peripheral nerves are situated and, much of the time, the nerves themselves. Fluoroscopy allows identification of bony structures, which have less relevance in landmarking peripheral nerves than soft tissues. In addition, US is affordable, portable, and does not expose the patient or the anesthesiologist to radiation. It also permits real-time visualization of needle advancement and injectate spread in the area of interest, minimizing the potential for intravascular injection.

The objective of this current review is to summarize the anatomy, existing techniques, and literature on a few selected peripheral nerve blocks published to date in chronic pain management, namely stellate ganglion, suprascapular, lateral femoral cutaneous, and intercostal nerve.

Stellate ganglion block

Anatomy

The sympathetic fibers for the head, neck, and upper limbs ascend through the sympathetic chains, and synapse in the superior, middle, and inferior cervical ganglia. Formed by fusion of the inferior cervical and first thoracic ganglion, the stellate ganglion is located adjacent to the neck of the first rib, lateral to the longus colli muscle, and posterior to the vertebral artery (Figure 1A). From the stellate ganglion, postganglionic fibers are sent to the cervical nerves (C7-C8) and first thoracic nerve (T1) to supply sympathetic innervation to the upper limbs. Axons from preganglionic sympathetic fibers pass from their respective spinal nerve roots to join the upper cervical sympathetic ganglia.[3] When local anesthetic is injected around the area of the stellate ganglion, sympathetic outflow to the head and neck is interrupted either by inactivation of these pregan-

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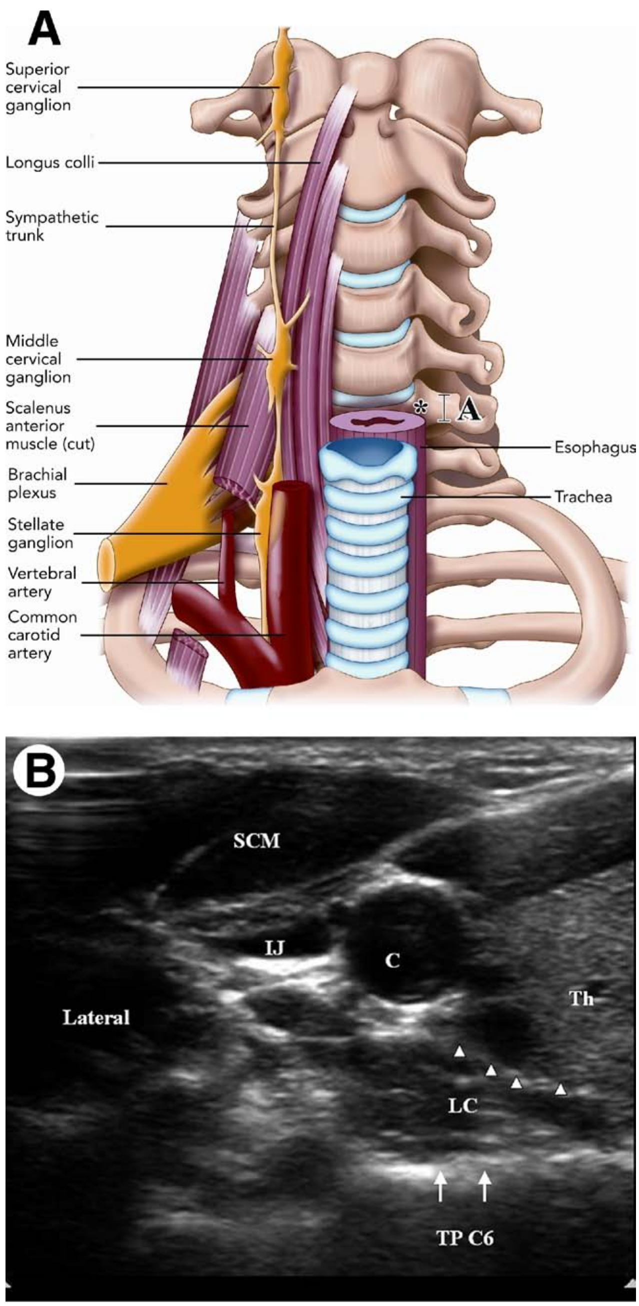

Figure 1 (A) Prevertebral region of the neck. The target site for needle insertion in classical approach is marked as *. The breadth of the transverse process is marked as A. (B) Ultrasonographic image of neck at C6. C, carotid artery; IJ, internal jugular vein (compressed by the probe); SCM, sternocleidomastoid muscle; Th, thyroid; LC, longus colli muscle; TP C6, transverse process of C6. The prevertebral fascia is marked by solid arrowhead. Images reproduced with permission from USRA (http://www.usra.ca). (Color version of figure is available online.)

glionic fibers or postganglionic fibers from the stellate ganglion itself, or both.[3]

Existing techniques

Although many approaches to the stellate ganglion have been described, the most popular is the classical technique using the anatomical landmark of the prominent anterior tubercle of C6 (Chassaignac's tubercle). This landmark only approximates the stellate ganglion, which actually lies at the level of the first rib. As a recent anatomical study of the sixth cervical vertebra demonstrates, there is large variability in the size and location of the landmarks used to localize Chassaignac's tubercle.[4] Furthermore, the narrow dimension (6 mm) of the transverse process in the cephalad-to-caudad direction increases the risk of a misguided needle to the vertebral artery or posterior tubercle, resulting in intravascular injection or nerve root block. The use of fluoroscopy would obviate this risk, especially with the oblique approach.[5] However, the location of the cervical sympathetic trunk is defined by the fascial plane of the prevertebral fascia, which cannot be revealed with fluoroscopy. Vascular structures (inferior thyroidal, vertebral, and carotid arteries) and soft tissues (thyroid and esophagus) are also not seen with fluoroscopy and are therefore at risk of puncture with the fluoroscopy-guided technique.[6]

Ultrasound-guided injection

The first report of US-guided stellate ganglion block (SGB) was described by Kapral and coworkers in 1995.[7] Twelve patients were given a SGB by the classic, blind technique followed by a SGB guided by US the next day. Three of the 12 patients who received the blind injection developed a local hematoma, which was not observed in the US-guided group.

After Kapral's study, a case series of 33 US-guided SGB in 11 patients[8] demonstrated a higher incidence of successful sympathetic block and lower incidence of hoarseness associated with subfascial injection of local anesthetic.

Scanning and injection technique

The patient is placed in the supine position with the neck in slight extension. A high-frequency linear transducer (6-13 mHz) is placed at the level of C6 to allow cross-sectional visualization of anatomic structures, including the transverse process and anterior tubercle of C6, longus colli muscle and prevertebral fascia, carotid artery, and thyroid gland (Figure 1B). A prescan is important in planning the path of needle insertion as the presence of the esophagus[6] and the inferior thyroidal artery[9] may obviate the needle insertion path between the carotid artery and trachea. In that situation, the needle may be inserted lateral to the carotid artery.

The tip of the needle is directed under the prevertebral fascia superficial to the longus colli (Figure 1B). There are a couple reasons for choosing this target. First, the suprafascial injection results in the spread of injectate around the carotid sheath with medial, posterior, or anterior extension, increasing the risk of hoarseness, probably secondary to contact of the solution with the recurrent laryngeal nerve medial to the carotid and lateral to the trachea.[10] Secondly,

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