Variable Osteology of the Sixth Cervical Vertebra in Relation to Stellate Ganglion Block

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Background and Objectives: Stellate ganglion block is often carried out using palpation of surface landmarks to guide needle placement. However, anatomic variation of the surface landmarks used is common and block failure has been reported in as many as 30% of patients, even when the surface landmarks that guide needle placement can be easily identified.

Methods: Computed tomography (CT) images of the cervical spine of 70 adult patients were examined to measure the distances in the coronal and sagittal planes between various points on the cricoid cartilage, anterior tubercle, posterior tubercle, and nadir of the vertebral gutter. The width of the tubercle in the caudal and cephalad plane was determined through multiplanar reformatted CT images in 6 randomly chosen patients.

Results: The mean distance from the lateral margin of the cricoid cartilage laterally to the anterior tubercle was 13 ± 5 mm (range 3-22 mm) in men and 12 ± 3 mm (range 6-22 mm) in women. The mean depth of the anterior tubercle as measured posteriorly from the midpoint of the trachea was 20 ± 4 (range 10-33 mm) in men and 19 ± 4 mm (range 9-33 mm) in women. The maximal and minimal cephalad-caudad dimensions of the transverse process of C6 were 9.3 ± 0.3 mm, and 6.7 ± 0.3 mm, respectively.

Conclusions: Large variability was observed in the size and location of the landmarks used for needle placement during stellate ganglion block. Placement of the needle medially where the transverse process joins the lateral margin of the vertebral body provides a larger bony target that may potentially provide a safer, more reliable block. *Reg Anesth Pain Med 2008;33:102-108.*

Key Words: Stellate ganglion, Complex regional pain syndrome, Anatomy, Computed tomography, Chassaignac's tubercle.

The sympathetic nervous system is thought to be involved in the pathophysiology that leads to a number of different chronic pain conditions, including complex regional pain syndrome (CRPS) and ischemic pain. These chronic pain states are included under the general heading of sympathetically maintained pain, because they share the characteristic of pain relief following blockade of the regional sympathetic ganglia. Block of the stellate ganglion using local anesthetic is an established method for the treatment of sympathetically maintained pain of the head, neck, and upper extremity.[1] The cervicothoracic (stellate) ganglion is the relay point for sympathetic fibers to and from the head, neck, and upper extremities.

While over 16 approaches to stellate ganglion block have been described,[2] the most common is based on the original technique of Leriche,[3] the anterior paratracheal approach at C6 using surface landmarks. Using this approach, anatomical landmarks palpable from the skin's surface are identified to guide placement of the block at the C6 vertebral level. The transverse process of C6 lies just lateral to the cricoid cartilage where the anterior tubercle of the transverse process of C6 (Chassaignac's tubercle) is readily palpable in most individuals. Chassaignac's tubercle is typically palpable in the groove between the trachea and the sternocleidomastoid muscle at the C6 level and has been estimated to be 1.5 cm lateral to midline.[4]

Despite the apparent ease in performing stellate ganglion block found in most descriptions, there is a significant failure rate. Variability in the stellate

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ganglion's relationship to the cervical vertebra and origin of the vertebral artery has been investigated by Katritsis et al.,[5] while Hogan and Erickson[6] have demonstrated its location using magnetic resonance imaging. More recently, the work of Cha et al.[7] has examined the use of the neck crease landmark in identifying the level of C6 in obese patients. Their results reveal an approximate 30% failure rate in correct identification of C6 in these obese patients. Similar failure rates are common, even in patients of average proportion.[8] Recent publications have anecdotally described more medially placed modified injection techniques and the resultant patterns of radiocontrast spread.[9,10] Trials designed to validate the usefulness of these new techniques have yet to determine their efficacy in providing upper extremity sympathetic blockade. However, radiocontrast clearly spreads to include the stellate ganglion as well as the T2 sympathetic ganglia, a structure that often contributes sympathetic innervation to the upper extremity.[10] Despite studies describing the great degree of anatomic variability and the frequent failure rate using the classic paratracheal approach to stellate ganglion block, none of these reports describe a means of modifying the technique to improve block success based on measurements of the anatomic variation in the general population.

The aim of this study is to determine the degree of anatomic variation in the dimensions of Chassaignac's tubercle. Based on this anatomic analysis, we propose use of a simple modification of the classic paratracheal approach that was first described by Moore in 1954.[11] The aim of this modification is to potentially improve the success rate and reduce the risk of complications associated with stellate ganglion injections.

Methods

Following University of Vermont College of Medicine Institutional Review Board approval, computed tomography (CT) images of the cervical spine that had previously been carried out at Fletcher Allen Health Care to rule out fracture in 70 adult patients (ages 18-65 years) who had sustained head and neck trauma were reviewed. Studies done in patients outside this age range were excluded; younger patients to eliminate size variation due to age, older patients to eliminate size variation due to spondylosis, which becomes nearly universal in the elderly. In each CT image, the sixth cervical vertebra was identified. Scans suggestive of fracture or poor quality such that the anterior tubercle of C6 could not readily be identified were excluded from further analysis. Transverse images at the level of C6 (bone windows) were downloaded digitally for further measurements. All measurements were carried out in Adobe Photoshop®, version 6.0 (Adobe Systems Inc., San Jose, CA) using a program designed to perform digital measurements: the UTHSCSA ImageTool program (developed at the University of Texas Health Science Center at San Antonio, TX and available on the Internet at http://ddsdx.uthscsa.edu/dig/). The cricoid cartilage was chosen as a readily palpable reference point that is often the first landmark located in performing the stellate ganglion block. The anatomic midpoint of the cricoid cartilage was used as an anterior and medial reference point for the depth measurements (Fig 1). Distances in the coronal (medial-lateral) and parasagittal (anterior-posterior) planes between the most lateral aspect of the cricoid cartilage and anterior tubercle, lateral cricoid cartilage and posterior tubercle, anterior tubercle and posterior tubercle, as well as lateral cricoid cartilage, and nadir of the vertebral gutter were measured in centimeters (Fig 1).

Conventional CT allowed for measurement in only 2 planes: anterior-posterior (depth of the tubercle), and medial-lateral (distance of the tubercle from the lateral margin of the trachea). To better define the width of the tubercle (superior-inferior dimension), we used multiplanar reformatted CT images of C6 bilaterally in 6 of the study patients; 3 males and 3 females, chosen at random. The reconstruction was carried out approximately 20 degrees from the frontal plane to correspond to the axis of the transverse process on each side (Fig 2). Measurements were carried out on digital images as described for the transverse images.

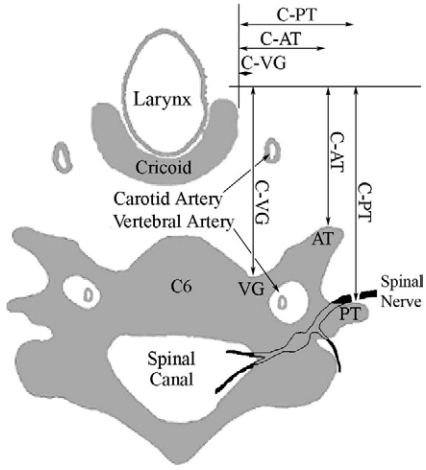

Fig 1. Diagram of the measurements taken from each computed tomography image to quantitate the position of Chassaignac's tubercle, the posterior tubercle (PT) and the vertebral gutter (VG) in relation to the cricoid cartilage. AT, anterior tubercle; C, lateral cricoid.