Thoracic paravertebral and erector spinae plane block: A cadaveric study demonstrating different site of injections and similar destinations

Sir,

Erector spinae plane (ESP) block was described by Forero et al. as an ultrasound (US)-guided interfacial plane block and was used successfully for managing chronic neuropathic pain. ESP block is a novel technique for pain management. The exact mechanism of action of is not yet established. However, the anatomy, method of injection and extent of drug spread, doses and volume of local anesthetic needed are not very clear. Hence, this cadaveric study was planned to examine the mechanism of action and drug spread after a thoracic ESP block using methylene blue dye.

Hospital Ethics Committee approval was obtained for conduction this cadaveric study. In five unembalmed cadavers, US-guided left sided thoracic paravertebral (PV) and right-sided ESP injections were performed. Instead of dissection we planned for a transverse section on the following day. In five formalin-based prone cadavers a left-sided ESP block was performed with 20 ml injectate [0.1 ml methylene blue dye (1 ml = 10 mg methylene blue) and 19.9 ml normal saline] under US guidance. A total of 20 ml volume is required for injectate to spread to four to five levels. Using similar volumes right sided thoracic PV injections were also administered under US guidance in all five cadavers. Thus, in total there were ten injections made: five ESP block on left side and five PV injections of right. With the help of US and transducer placed parasagitally in craniocaudal orientation, needle tip was positioned under ESM at T4-T5 costotransverse junction. The needle tip was directed cephalad in ESP and injections were made at a moderate pressure (20 ml deposited over 40 s). After 24 h, transverse section of the cadavers was performed at 5 cm intervals at T4–T5 levels. Figure 1 is a representative figure of the cadaveric section at the level of T4. After performing sections, spread of dye was looked for from the point of injection.

In all five cadavers there was bilateral medial retrolaminar spread, bilateral PV spread and bilateral epidural spread. All ESP injections were performed on left side after identifying the tip of needle below erector spinae muscle. All PV...
injections were performed on the right side after confirming the needle tip in the PV space. Dye spread on injection was checked using US and later by analysis of cadaveric sections. The dye spread could be seen medially over the retrolaminar area which travelled along the laminae up to the spinous process but did not cross the midline. After spreading laterally on both the sides across the costotransverse foramen, the dye seeped into the PV space. It engulfed the thoracic nerve root, reached intervertebral foramen, and was seen spreading across the entire epidural space (lateral, dorsal and ventral). Laterally, the dye spread was observed across the intercostal space soaking the intercostal nerve. A similar dye spread occurred retrograde from the thoracic PV space into ESP posteriorly, intervertebral foramen, and epidural space medially. In two specimens the dye encroached as far as the prevertebral area on either side. The endothoracic fascia was sharply delineated, without any spillage into the thoracic cavity.

Ivanusic study concluded that there was no spread of dye anteriorly to the paravertebral space to involve origins of the ventral and dorsal branches of the thoracic spinal nerves. Dorsal ramus involvement was posterior to the costotransverse foramen.[2] The reason for this could be the presence of complex ligamentous attachment that possibly prevents the anterior spread of injectate. Yang et al. compared retrolaminar and ESP spread in unembalmed cadavers.[3] US-guided injections were performed in prone position using green colored ink, latex solution, and distilled water (total volume: 20 ml). The dye injections revealed posterior spread of dye to back muscles, PV spread beyond the superior costotransverse ligament, and thoracic spinal nerves after ESP block. Adhikary et al. had observed epidural and neuroforaminal spread of radiocontrast after US-guided ESP and retrolaminar blocks in cadavers which was confirmed by anatomic dissection and radiological findings.[4] However, they were not sure as to which of the either interventions lead to the spread as at each level, both ESP and retrolaminar blocks were performed at same level in the cadavers.

Based on US-guided dye injections in formalin-based cadavers we postulate that the probable mechanism of action of thoracic erector spinae blockade at the level of T4–T5 is through paravertebral and epidural blockade. We were not sure how much volume of one injection has encroached upon the contralateral intervertebral foramina and epidural spaces. This can be explained by using dye of different colors (e.g., methylene blue on one side and crimson red on another side).

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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How to cite this article: Diwan S, Garud R, Nair A. Thoracic paravertebral and erector spinae plane block: A cadaveric study demonstrating different site of injections and similar destinations. Saudi J Anaesth 2019;13:399-401.

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