ANATOMICAL VARIATION IN THE POSITION OF THE PROXIMAL INTERCOSTAL NERVE

P. A. J. HARDY

Intercostal nerve block with local anaesthetic provides good analgesia which may be extended by the use of intercostal catheters or alternative techniques such as cryoanalgesia. The classical anatomical description is of a segmental nerve lying in the subcostal groove on the lower border of the corresponding segmental rib, adjacent to the intercostal artery and vein [1]. The method of nerve block depends on walking a needle off the lower border of the rib to enter the subcostal groove. Using this technique with percutaneous cryoanalgesia Conacher [2] obtained poor results and suggested that this may have resulted from incomplete contact between the tip of the probe and the nerve.

A major requirement for successful cryoanalgesia is accurate location of the nerve. This study was performed to assess the position of the proximal intercostal nerve in cadavers.

METHODS AND RESULTS

Thirty cadavers were studied in the Medical Dissecting Room in the Department of Anatomy in Liverpool. Thoracic evisceration had been completed, leaving the posterior mediastinum and chest wall complete. The 2nd to 11th intercostal nerves were dissected and followed from the intervertebral foramen to approximately 3–5 cm lateral to the angle of the rib on both sides of the chest wall. After identification of the nerve, the borders of adjacent ribs were located using a blunt probe in order to assess relative position.

From the paravertebral space to the angle of the rib, the nerve lies just below the parietal pleura. From the angle of the rib laterally the internal intercostal muscle lies internal to the intercostal nerve. This muscle was removed to allow the nerve to be followed laterally. The first major division of the nerve starts at about the angle of the rib.

Three forms of intercostal nerve were identified.

SUMMARY

Anatomical study of the proximal intercostal nerve in cadavers revealed three nerve forms, depending on the relation between the nerve and adjacent ribs. This was found in the classical subcostal position in 16.6%, in the midzone in 73% and in the inferior supracostal position in 10%.


Address for correspondence: Whiston Hospital, Dragon Lane, Prescot, Merseyside.

FIG. 1. Diagrams of the observed relations of the intercostal nerve. This shows the nerves (n), ribs (r) and paravertebral spaces (p). 1 = Subcostal relation; 2 = midzone position; 3 = supracostal relation.
according to the relative position of the nerve and adjacent ribs. The particular form adopted was present in all nerves on both sides in each cadaver. The three identified forms were classical subcostal, midzone and inferior supracostal (fig. 1). As the individual nerve arises from the intervertebral foramen, its position is relatively closer to the inferior rib than to the segmental but superior rib. The adoption of the particular nerve form occurred within the paravertebral space. The frequency of the individual forms was classical subcostal 16.6% (n = 5), midzone 73% (n = 22) and inferior supracostal 10% (n = 3).

**COMMENT**

The normal technique of intercostal nerve injection is to insert a needle to produce contact with the appropriate rib and then "walk" the needle off the lower border of the rib. The needle enters the subcostal groove adjacent to the segmental artery and vein. From a single needle insertion the superior intercostal space may be entered also by "walking" the needle off the superior border of the rib.

Injection studies in man have demonstrated that extensive spread of local anaesthetic solution occurs into adjacent intercostal spaces [3, 4] and medially into the paravertebral space [5]. Accurate location of the nerve is not essential with such wide spread of injectate. Interestingly, studies in cadavers reported from North America have demonstrated spread along the injected space, but no spread of injectate across the ribs occurred [6, 7]. This probably represents a difference in injection techniques and not an anatomical variant.

In contrast to injection methods, successful cryoanalgesia depends on placing the tip of the probe in contact with the nerve. Direct vision intercostal cryoanalgesia performed peroperatively produces significant analgesia with fewer respiratory complications [8]. Percutaneous intercostal cryoanalgesia performed using conventional techniques resulted in significant failure rate [2]. The present study showed that the intercostal nerve does not commonly lie in the subcostal groove—and in fact did so in only 16% of cadavers. This explains the failure to locate the nerve using a standard block technique. Post-thoracotomy intercostal neuralgia may be a result of various causes including neuropraxia, neurotmesis and the presence of direct nerve suture [9].

It is interesting to note the similarity between the frequency of subcostal nerve position (16%) and the incidence of intercostal neuralgia occurring after insertion of Tuohy needles into the intercostal space by a subcostal approach (10%) [5]. This complication should, therefore, be considered when large diameter needles are inserted into the intercostal space to permit cannulation techniques.

In conclusion, significant variation in "normal" anatomy exists and this may result in failure of regional analgesic techniques based on conventional teaching of anatomy. This is particularly the case when techniques such as cryoanalgesia are performed. This variation does not influence conventional local anaesthetic techniques.

**ACKNOWLEDGEMENTS**

The author would like to thank Professor B. Wood, Department of Anatomy in the University of Liverpool, for access to specimens, and Imperial Chemical Industries, plc, for financial support.

**REFERENCES**