Interactive CardioVascular and Thoracic Surgery 13 (2011) 175-178

Best evidence topic - Thoracic non-oncologic

Does the nerve of Kuntz exist?

Ann C. McCormack, Omar A. Jarral, Alex R. Shipolini, David J. McCormack*

Department of Cardiothoracic Surgery, The London Chest Hospital, London, UK

Received 13 February 2011; received in revised form 2 May 2011; accepted 4 May 2011

Summary

A best evidence topic was written according to a structured protocol. The question addressed was, in what proportion of patients is the nerve of Kuntz identifiable? A total of 55 papers were found using the reported search, of which six represented the best evidence to answer the clinical question. The authors, date, journal, study type, population, main outcome measures and results are tabulated. The nerve of Kuntz was originally described in 1927 as being a connection from the second intercostal nerve to the first thoracic ventral ramus. Controversy exists as to whether it is present universally and thus whether it should be identified during thoracoscopic sympathectomy. The six studies highlighted involved dissection of the upper thoracic sympathetic chain of adult cadavers with descriptions of the anatomical variations. A study by Cho et al. [Cho HM, Lee DY, Sung SW. Anatomical variations of rami communicants in the upper thoracic sympathetic trunk. Eur J Cardiothorac Surg 2005;27:320–324] suggested that anatomical variation was more common at T2 compared to T3 and T4, of which 60% corresponded to the original description of the nerve of Kuntz. A similar prevalence was found by Marhold and colleagues [Marhold F, Izay B, Zacherl J, Tschabitscher M, Neumayer C. Thoracoscopic and anatomic landmarks of Kuntz's nerve: implications for sympathetic surgery. Ann Thorac Surg 2008;86:1653–1658], who also suggested that open dissection led to significantly easier identification of this anatomy than thoracoscopy. The same authors frequently found that the nerve of Kuntz was associated with a superior intercostal vein located parallel to it, meaning that these subpleural veins may act as an anatomical landmark. In four of the papers where cadavers were dissected bilaterally, variations in the anatomy of the sympathetic chain were not always symmetrical. We conclude that most patients will have some form of variation in the anatomy of their T2 ganglion, which often corresponds to the original description of the nerve of Kuntz. The appreciation of this variation may be more difficult during thoracoscopy as compared to open anatomic dissection.

Keywords: Anatomic variation; Nerve of Kuntz; T2

1. Introduction

A best evidence topic was constructed according to a structured protocol. This is fully described in the ICVTS [1].

2. Three-part question

In [what proportion of patients] is it possible to [identify] the [nerve of Kuntz]?

3. Clinical scenario

During a thoracoscopic cervical sympathectomy, you ask the consultant if she could point out the nerve of Kuntz. She abruptly tells you that it does not exist. You resolve to search the literature for an answer.

4. Search strategy

Search strategy using Medline from 1950 to December 2010 using the PubMed interface (‘Nerve of Kuntz’).

5. Search outcome

Fifty-five papers were found using the reported search on PubMed. From these, six papers were identified that provided the best evidence to answer the question. These are presented in Table 1.

6. Results

The nerve of Kuntz, a connection from the second intercostal nerve to the first thoracic ventral ramus was originally described in 1927 [2]. More recent studies have reasserted this definition [8]. However, controversy as to whether it is present universally exists.

Kuntz observed that despite extirpation of both the stellate ganglion and its connection with the brachial plexus, some upper limb sympathetic innovation persisted. Kuntz examined 48 cadavers and found that there was an intrathoracic ramus connecting T1 to T2 that was present bilaterally in 21 cadavers and unilaterally in nine [2]. In six of the cases, this intrathoracic ramus joined the first intercostal nerve distal to its origin. In the other 24 cases, the ramus joined the first intercostal nerve proximal to its origin.

Cho et al. [3] dissected the upper thoracic sympathetic chains, sympathetic ganglia and communicating rami in 42 adult Korean cadavers (i.e. 84 thoracic chains). They classified variants according to the relationship of the thoracic sympathetic ganglia to the intercostal nerves:

- Normal: the communicating rami, whether transverse or oblique, connects to the intercostal nerve at its same level;
Table 1. Best evidence papers

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kuntz, (1927), Arch Surg, USA, [2]</td>
<td>Forty-eight adult cadavers</td>
<td>The lower cervical and upper thoracic sympathetic trunks were examined in 48 cadavers</td>
<td>An intrathoracic ramus connecting T1 to T2 was present bilaterally in 21 cadavers and unilaterally in nine</td>
<td>The original study by Kuntz described the anatomical variability of the T1–T2 sympathetic trunks. It is an early study and as such is limited in its description of the anatomical variability when compared to contemporary work</td>
</tr>
<tr>
<td>Cho et al., (2005), Eur J Cardiothoracic Surg, Korea, [3]</td>
<td>Forty-two adult (26 males, 16 females) Korean cadavers</td>
<td>Eighty-four sympathetic chains were dissected</td>
<td>Intra-thoracic nerve of Kuntz present in 59.5% (50/84)</td>
<td>Anatomical variation of T2 was found to be more frequent than either T3 or T4. Among the cadavers, only 14.3% (6/42) had similar anatomy bilaterally, suggesting great intrapersonal variability</td>
</tr>
<tr>
<td>Singh et al., (2005), Surg Radiol Anat, South Africa, [4]</td>
<td>Twenty adult cadavers</td>
<td>The 20 adult cadavers were bilaterally dissected and all neural connections of the second thoracic ganglion were recorded</td>
<td>‘Classical’ nerve of Kuntz was present in 27.5% (n=11/40)</td>
<td>Of the 20 cadavers, 19 were found to have alternate neural connections between the first and second thoracic ventral rami, including a nerve of Kuntz. It was suggested that these connections are not always evident during thoracoscopy, and by dissecting the pleura laterally along the second rib, an improved field of view is obtainable</td>
</tr>
<tr>
<td>Marhold et al., (2008), Ann Thorac Surg, Austria, [5]</td>
<td>Thirty-three thoracic cavities of human cadavers (within 48 hours of post-mortem)</td>
<td>Identification of the nerve of Kuntz through thoracoscopy</td>
<td>Using VAT, the nerve of Kuntz was identified in n=4 instances (12.1%)</td>
<td>The authors investigated landmarks for thoracoscopic identification of the nerve of Kuntz. The paper usefully compares the success in identification of the nerve of Kuntz through VAT and open dissection</td>
</tr>
<tr>
<td></td>
<td>Identification of the nerve of Kuntz following anatomical dissection</td>
<td>Using VAT, the nerve of Kuntz and a superior intercostal vein were identified in n=3 instances (9.1%). With anatomical dissection, this figure was n=18 (54.5%)</td>
<td>Using VAT, the nerve of Kuntz was identified using VAT (n=1, 3%). Anatomic dissection revealed the never in n=4 instances (12.1%)</td>
<td>This study supports employing a strategy to create a lesion in the region that the nerve would be expected to travel even if it is not visualised at VAT</td>
</tr>
</tbody>
</table>

(Continued on next page)
*Ascending rami (AR):* the rami communicates ascended to the intercostal nerve of the above level;

*Descending rami (DR):* the rami communicates descend to the intercostal nerve of the level below.

The authors showed that T2 had greater anatomical variation than either T3 or T4. Fifty-six of the thoracic sympathetic chains dissected had either an AR or a DR from T2, with 33.3% having both. The occurrence of either an AR or DR arising from T3 was 27/84, and from T4 11/84. Of these variations, 50/84 correspond to the nerve of Kuntz as originally described; 6/42 displayed similar anatomy of the rami communicates bilaterally.

Singh et al. [4] dissected the thorax of 20 cadavers bilaterally and found that 19 of these had some form of surrogate connection between the first and second thoracic ventral rami. The authors then used the ramus between the second intercostal nerve and the ventral ramus of the first thoracic nerve as a basis for classifying the additional connections as either type A or type B:

- **Type A:** sympathetic connections to one of the stellate ganglion, second thoracic ganglion or interganglionic part of the sympathetic chain.
- **Type B:** somatic connections between second intercostal nerve and the first ventral thoracic ramus, and/or the first intercostal nerve or its lateral cutaneous branch.

Of the 40 hemithoraces dissected, 19 demonstrated type A neural connections. Within the 18 with type B connections, 11 corresponded to the original description of the nerve of Kuntz.

Marhold et al. [5] performed video-assisted thoracoscopic (VAT) on 33 cadavers, followed by anatomical dissection. Using VAT, the nerve of Kuntz was identified bilaterally in four cadavers and unilaterally in one cadaver. On open dissection, the nerve of Kuntz was found bilaterally in 22 cadavers and unilaterally in four cadavers. The rate of identification with VAT was significantly lower (P=0.003) than when using open anatomic dissection. The authors found that subpleural veins parallel to the nerve of Kuntz were present with a frequency of 81.8%. It was suggested that these veins may serve as anatomical landmarks when locating the nerve of Kuntz.

Chung et al. [6] reported on the dissection of 66 thoracic sympathetic chains. In 27 of the cadavers, the thorax was dissected bilaterally (54 sides), and 12 cadavers were dissected on one side of the thorax only. The nerve of Kuntz was observed in 45 sympathetic chains and was found to be bilaterally present in 13 cadavers. The authors sub-classified the nerve of Kuntz:

- **Type A:** a connection from the T2 to the T1 nerve.
- **Type B:** a connection from T2 to the first intercostal nerve.
- **Type C:** a connection from T2 to the ramus communicans of T1 (and the stellate ganglion), this type matching the original description given by Kuntz for the aberrant connection.
- **Type D:** the extra connection branched at its insertion, originated at T2 and inserted into both the first intercostal nerve and T1.
These authors found that additional neural connections originating from T2 were extremely widespread, with only 7.2% of sympathetic chains dissected having an absent ascending communicating ramus from T2 (including communicating rami not classified as the nerve of Kuntz). A type A neural connection was found to be the most common connection between T2 and T1 (47%).

Wang et al. determined to identify the anatomical location of the T2 and T3 sympathetic trunk and the nerve of Kuntz [7]. They studied the anatomy of 70 patients undergoing bilateral subaxillary transthoracic endoscopic sympathectomy for palmar hyperhidrosis. What the authors considered to be the nerve of Kuntz was found in seven patients (10%), with it being on the right side in one patient (1.4%) and on the left in six (8.6%). The nerve they identified as the nerve of Kuntz was considered so because ‘it was noted to originate from the sympathetic trunk in the rib head area, running upward and passing over the proximal T-2 rib to the brachial plexus’. However, it must be noted that the nerves labelled as the nerve of Kuntz had no relationship to T2.

7. Clinical bottom line

The majority of the population will have a variation in the anatomy of T2 ganglion, and in some this corresponds to the nerve of Kuntz as originally described. Whilst open cadaveric dissection frequently demonstrates this connection, it is less often appreciable during thoracoscopic surgery. If a lateral diathermy burn is made along the second rib lateral to the sympathetic chain, these cadaveric studies would suggest that a meaningful sympathetic nerve would usefully be transected between 30% and 70% of the time. This approach is supported by large clinical observational studies [9].

References