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Is spinal anaesthesia at L2–L3 interspace safe in disorders of the vertebral column? A magnetic resonance imaging study

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Key points

- The authors have described the impact of spinal disorders on the positioning of conus medullaris terminus (CMT).
- Magnetic resonance image scans of 1047 Chinese patients were reviewed retrospectively.
- A lower than normal location of CMT was seen in females, and in patients with thoracic vertebral compression.
- The risk of spinal cord injury during spinal anaesthesia at L2–L3 interspace is increased in female patients with thoracic vertebral compression.

Background. The varying point at which the spinal cord terminates in the lumbar spinal canal may affect the incidence of spinal cord injuries associated with needle insertion for spinal anaesthesia, especially in patients with vertebral body or intervertebral disc disease. This is a complication which has been frequently reported when spinal needle insertion was performed at higher lumbar spinal levels.

Methods. We retrospectively reviewed magnetic resonance images of the spine in 1047 Chinese patients to determine the conus medullaris terminus (CMT) in patients with and without vertebral disorders. Patients with tumours in and around the spine and those with congenital spinal anomalies were excluded from the study. Patients with mixed vertebral disorders were also excluded.

Results. Our data demonstrate that patients with thoracic vertebral compression fractures had lower ending points of the CMT than those without ($P<0.05$), while patients with lumbar compression fractures did not demonstrate such a correlation. With regard to this difference, females were significantly at higher risk for a lower CMT than males. Conversely, lumbar disc disorders such as intervertebral disc extrusion, herniation, or bulging did not have any significant influence on the level of CMT. Moreover, patients with spondylolisthesis or scoliosis did not demonstrate an abnormal CMT location.

Conclusions. When performing spinal anaesthesia, anaesthesiologists should be aware of potential differences of the CMT location, particularly in female patients with thoracic vertebral compression fractures, who may have a lower CMT than normal, extending to the level of L2. Performing spinal anaesthesia at the L2–L3 interspace would seem to be ill-advised in this patient population.

Keywords: conus medullaris; intervertebral disc disorder; spinal cord injury; subarachnoid block; vertebral disease

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One of the major concerns during needle insertion for spinal anaesthesia is the location of the conus medullaris terminus (CMT). Anaesthesiologists remain aware that any manoeuvre which places the spinal needle in contact with the spinal cord may lead to serious neurological injury.[1–6] This risk may be increased when the CMT is at a lower than expected level and the L2–L3 interspace is chosen as the needle entry site. The CMT may be lower in disorders of the vertebral column. The position of the CMT has been studied previously in cadavers,[7] but a possibly better evaluation of its true position, and one which might translate into clinical practice more readily, might be magnetic resonance imaging (MRI). It is widely known that MRI is an extremely accurate and practical way to evaluate the spinal cord, and a more accurate method of determining the location of the CMT than cadaveric examination.[8] Several retrospective studies[9–12] have investigated the influences of age, gender, and position of the body on the CMT previously; however, the influence of disorders of the vertebral bodies or intervertebral discs has not been well investigated. Our aim in this study is to investigate the effects of these disorders on the CMT location, especially with regard to the customary sites of needle insertion during spinal anaesthesia.

Methods

With institutional Ethics Board approval, we retrospectively studied MRIs of the spine of 1047 Chinese patients (444 males and 603 females), of age ranging from 10 to 79 yr, in order to determine the location of CMT. These patients

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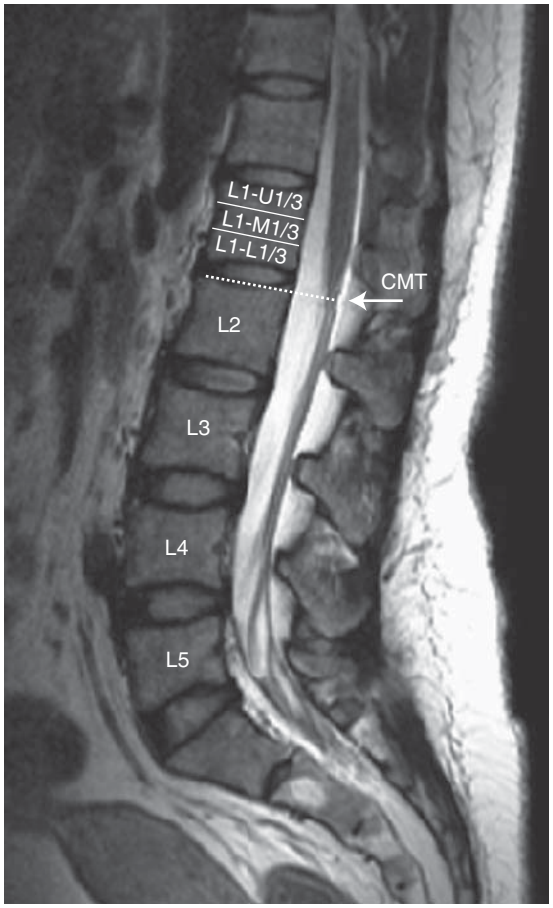

Fig 1 T2-weighted sagittal MRI of the lumbar spine, demonstrating the method used of dividing the vertebral bodies into three equal parts for the purpose of classification. The CMT is indicated by the arrow; the dashed line corresponds to its assigned spinal level (in this case, the L1–L2 intervertebral disc).

were outpatients who presented for diagnosis and/or treatment of low back pain, hip pain, and/or lumbar radiculopathic pain. Patients with diseases such as tumour, infection, ischaemia, or haemorrhage of the spine or spinal cord, patients with congenital spinal anomalies, and patients with the spine or spinal cord diseases that made CMT observations difficult were excluded. MRI examinations were performed as T2-weighted images on 1.5 T Visart (Toshiba, Tokyo, Japan) or 3.0 T Magnetom Trio (Siemens, Erlangen, Germany) systems; other technical specifications of the images obtained included: matrix 256×320, 4 mm slice thickness, and 0.8 mm interslice gap. All scans were obtained in the supine position. In each case which was used, the CMT was clearly visualized on the sagittal sequences.

For the purposes of quantification, we drew a perpendicular line from the ending point of the CMT to the long axis of the spine and determined the level of the surrounding vertebrae and intervertebral discs. Each vertebral body was divided into three equal parts (upper 1/3, middle 1/3, and lower 1/3, abbreviated as 'U1/3', 'M1/3', and 'L1/3', respectively); the entire intervertebral disc was considered an additional separate part (Fig. 1).

Table 1 Given values of CMT levels and age decades. T12-U1/3, upper 1/3 of T12; T12-M1/3, middle 1/3 of T12; T12-L1/3, lower 1/3 of T12; T12-L1 disc, intervetebral disc between T12 and L1; L1-U1/3, upper 1/3 of L1; L1-M1/3, middle 1/3 of L1; L1-L1/3, lower 1/3 of L1; L1-L2 disc, intervertebral disc between L1 and L2; L2-U1/3, upper 1/3 of L2; L2-M1/3, middle 1/3 of L2; L2-L1/3, lower 1/3 of L2; L2–L3 disc, intervetebral disc between L2 and L3. The youngest patient studied was 10 years old, corresponding to a value of 1 for age decade (10–19 yr); the oldest patient studied was 79 yr old, corresponding to a value of 7 for age decade (70–79 yr)

Value	CMT level	Age decade (yr)
1	T12-U1/3	10–19
2	T12-M1/3	20–29
3	T12-L1/3	30–39
4	T12-L1 disc	40–49
5	L1-U1/3	50–59
6	L1-M1/3	60–69
7	L1-L1/3	70–79
8	L1-L2 disc	—
9	L2-U1/3	—
10	L2-M1/3	—
11	L2-L1/3	—
12	L2–L3 disc	—

CMT levels were then assigned a value ranging from 1 (U1/3 of T12) to 12 (L2–L3 intervertebral disc) for the purpose of statistical analysis, which were the highest and lowest CMT levels observed in this population, respectively. This system of CMT level correlation to adjacent vertebrae or intervertebral discs as a method of measurement has been reported previously.[10–12 13–15]

On the basis of age, patients were stratified into seven groups, such that ages 10–19 yr corresponded to a value of 1, ages 20–29 yr corresponded to a value of 2, and every decade thereafter corresponded to the next value number, with value 7 corresponding to patients aged 70–79 yr (Table 1).

We performed all statistical analyses utilizing Statistical Package for the Social Sciences (SPSS) version 11.5 (Chicago, IL, USA). The Kolmogorov–Smirnov tests or the Skewness–Kurtosis tests were used to describe the distribution; two-sample *t*-tests were used for analysing variance. Statistical significance was defined as a *P*-value of <0.05.

Results

The location of the CMT in patients with and without various vertebral and intervertebral disc diseases demonstrated a normal age distribution among every disease cohort (Table 2). The mean position of the CMT for each disease cohort, as designated by its assigned value, is also shown in Table 2.

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