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Original Research Article

Level of conus medullaris termination in adult Kashmiri population: a magnet resonance imaging-based study

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ABSTRACT

Background: The spinal cord is considered as the principle content of vertebral canal. It begins as a downward extension of medulla oblongata at the level of upper border of first cervical vertebrae (C1). The terminal part of spinal cord is conical and is termed as conus medullaris. In adults the level of termination of conus medullaris varies between T12 to L3 vertebrae. The level of termination of conus medullaris is clinically important to avoid injuries during spinal anaesthesia and lumber puncture.
Methods: The saggital magnetic resonance images of 168 patients were reviewed in the Department of Radiodiagnosis, Government Medical College, Srinagar from January 2022 to June 2022. The most caudal point of the cord was considered as the tip of conus medullaris. A line was drawn through the tip perpendicular to the long axis of spinal cord to determine its location with adjacent vertebra.
Results: The level of conus medullaris termination was most commonly located at T12-L1 intervertebral disc level. The results revealed a significant statistical difference in levels of termination of conus medullaris with respect to age and sex.
Conclusions: In literature, the highest level of conus medullaris termination is stated to be at T11-T12 Intervertebral disc and the lowest level at the body of L3 vertebra. Therefore, spinal anaesthesia and lumber puncture procedure should be done below L3 vertebral body in order to avoid iatrogenic complications.

Keywords: Conus medullaris, Magnetic resonance and imaging, Radiological anatomy

INTRODUCTION

The spinal cord is considered as principle content of the vertebral canal. It begins as a downward extension of medulla oblongata at the level of upper border of first cervical vertebrae (C1) to the level of lower border of first lumbar vertebrae (L1).[1] The terminal part of the spinal cord is conical and is termed as conus medullaris. In adults, the level of termination of conus medullaris varies between T12-L3 vertebrae, most of which correspond to the intervertebral disc space between L1 and L2.[2] In fetus, the spinal cord extends from foramen magnum to sacrum in the second trimester of pregnancy followed by subsequent relative shortening.[3]

The level of conus medullaris termination is at L2 vertebral body at the time of birth and ultimately reaches its final position by two years of age. The level of termination of conus medullaris is clinically important to avoid injuries during spinal anesthesia, lumbar puncture and during

treatment of tethered cord syndrome.[4] Because of its clinical importance several studies have been conducted on the level of termination of conus medullaris owing to its different clinical relevance with the help of ultrasound, MRI, Cadavers.[5] The actual position of conus medullaris termination is better assessed using MRI. This study was undertaken to determine the level of termination of conus medullaris in Adult Kashmiri population in terms of age by reviewing various MR images.

METHODS

The MR images of patients admitted to Associated Hospitals of Government Medical College Srinagar from January 2022 to June 2022 for the evaluation of back pain and hip pain were examined. Data regarding Age and Sex was taken from MRI reports. Patients with tumor, infection, trauma, spinal abnormalities were excluded from the study.

The sagittal MR images of 168 patients (84 males and 84 females) with age range of 18 to 60 years were reviewed. MRI was taken on 0.5-T field strength. The slice thickness was 4 mm for sagittal images with an interslice gap of 0.4mm. The most caudal point of the cord was considered as the tip of the conus medullaris. A line was drawn through the tip perpendicular to the long axis of the spinal cord in order to define its relation with the adjacent vertebrae.

The vertebral body just above the sacrum separated by an intervertebral disc space was designated as fifth lumbar vertebrae. Statistical Analysis was done by allotting a number to each conus level, in such a way that T_{12} corresponded to 1 and the L_2 -L3 intervertebral disc space to 6. This numbering system was used as a reference for determining the difference in the caudal level for each sex after calculating the mean value. The statistical analysis was performed using SPSS. Chi square test and Fisher exact test were performed. Statistically significant difference was considered to be present when the p value was <0.05.

RESULTS

The levels of conus termination of 84 females and 84 males between the age of 18 to 60 years were examined in healthy individuals. The frequency distribution for the level of termination of conus medullaris demonstrated that the conus was located at T12-L1 intervertebral disc level in most of the MR images (51.7%) shown in (Figure 2). The results revealed a significant statistical difference in levels of termination of conus medullaris with respect to sex and age (p value <0.05). Results revealed that in majority of males (71.4%) and females (32.1%) the termination of conus medullaris was at level 2. Results revealed that majority (51.7%) of the study participants having conus level termination at level 2 had a mean age of 37.5 followed by 21.4% study participants having conus level termination at level 4 with a mean age of 41.1.

Table 1: The level of Conus medullaris termination in healthy individuals of both sexes.

Level	Sex		Total
	Male	Female	
1	0	9	9
2	60	27	87
3	6	21	27
4	15	21	36
5	0	6	6
6	3	0	3
Total	84	84	168

Table 2: Level of termination of Conus medullaris with respect to age.

Level	Number of Individuals	Mean age (years)	SD
1	9	37.67	6.265
2	87	37.48	8.053
3	27	40.00	12.143
4	36	41.08	11.090
5	6	41.50	1.643
6	3	55.00	.000
Total	168	39.13	9.555

Figure 1: Sagittal MR image of the lumbar spine demonstrating the method for determining the level of conus medullaris.

DISCUSSION

In literature the first study regarding the level of conus medullaris termination is claimed to be a cadaveric study by Thomson in 1894.[6] This study of 198 cadavers reported that the conus medullaris termination varied between 5mm above the lower border of T12 and the upper border of L3. A study by Mc Cotter consisting of 234 cases reported that the level of conus medullaris termination between the middle of T12 and lower border of L2.[7] Reiman and Anson examined 129 adult specimens and reported that the level of conus termination in adults varied from lower third of T12 and middle third of L3.[8] A review of 184 lumbar MR

images was done by Wilson and Prince to determine the normal conus medullaris throughout childhood and found the range of conus medullaris level was at T12-L3 which attained adult levels within first few months of life.[9]

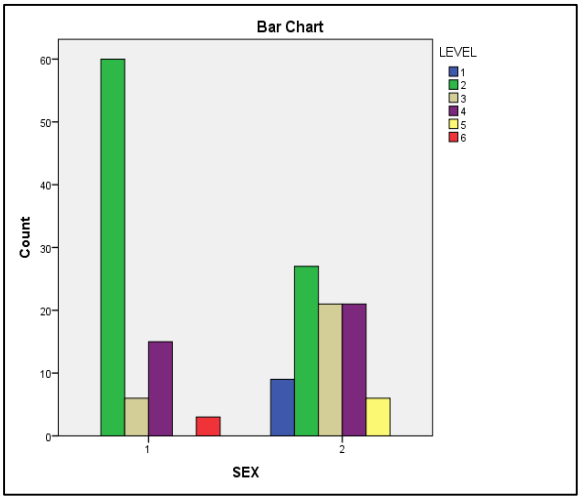

Figure 2: Frequency distribution of conus medullaris termination level with respect to sex showing significant correlation (p<0.05).

Total 504 lumbar MR images of living adults were assessed by Saifuddin et al to identify the variations in conus positions and concluded that the conus medullaris level ranged between middle third of T12 and upper third of L3.[10] Malas et al examined 75 cases comprising of 25 fetuses, 29 neonates and 25 adults. After using dissection technique for fetuses, ultrasonography for neonates and MR imaging for adults, they reported that the conus level terminated between L3 and L1 for fetuses, L1 and L3 for premature babies and T12 and L2 for adults.[11] In this study we found that the range of conus medullaris levels was the body of T12 vertebrae (5.3%) to intervertebral disc space of L2-L3 (1.78%). We found conus terminated at T12-L1 (51.8%) intervertebral disc space in majority of both the sexes A significant statistical difference was noted between male and female study groups (p<0.05) which is similar to the findings of Thomson et al, Mc Cotter et al, Anson et al, Prince et al, Demiryurek et al, Karabulut et al.[6-12] A significant statistical difference was noted in conus medullaris termination level with respect to increasing age (p<0.05) which agrees with the results of Ugale et al and contradicts with the studies of Mourlion et al, Soleiman et al and Kim et al.[13-16]

Limitations

One of the limitations of the study is the small sample size. If the study had used more Lumbar MRI scans, the data may have been predicted more accurately. Another limitation of the study is the lack of different positions of the body. The present study was done on transverse plane while the patient was in supine position; the data can be ifferent positions of the body are also included.

CONCLUSION

In the majority of the study participants (51.7%), the level of termination of conus medullaris was seen at the level of intervertebral disc between T12 and L1, out of which 71.4% were males and 32.1% were females. The mean age of this population was 37.5 years. The second most common level of termination of conus medullaris was the intervertebral disc between L2 and L3, seen in 21.4% of the study population. The mean age for this group was 41.1 years. The knowledge on the termination of conus medullaris can help to achieve more successful results in procedures like lumbar puncture and spinal anesthesia more confidently and effectively.

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