http://www.banglajol.info/index.php/JNINB

Case Report

DOI: https://doi.org/10.3329/jninb.v9i1.68185

Journal of National Institute of Neurosciences Bangladesh,
January 2023, Vol. 9, No. 1, pp. 88-95

ISSN (Online) 2518-6612
ISSN (Print) 2410-8030

Pediatric Dorsal Intradural Extra-Medullary Epidermoid Cyst (Non-Dysraphic): An Illustrative Case with Literature Review

Sudipta Kumer Mukherjee[1], DM Arman[2], Abdullah Al Mahbub[3], SIM Khairun Nabi Khan[4], Jack Wellington[5]

[1]Associate Professor, Department of Pediatric Neurosurgery, National Institute of Neurosciences and Hospital, Dhaka, Bangladesh; [2]Assistant Professor, Department of Pediatric Neurosurgery, National Institute of Neurosciences and Hospital, Dhaka, Bangladesh; [3]Medical Officer, Department of Pediatric Neurosurgery, National Institute of Neurosciences and Hospital, Dhaka, Bangladesh; [4]Associate Professor, Department of Pediatric Neurosurgery, Bangabandhu Sheikh Mujib Medical University Hospital, Dhaka, Bangladesh; [5]Medical Student, Cardiff University School of Medicine, Cardiff University, UK

Abstract

Background: Spinal epidermoid cyst is a rare congenital tumour that may be associated with spinal dysraphism. Congenital spinal epidermoid cysts without spinal dysraphism are rare. Here we are reporting a rare and interesting case of thoracic Intradural extra-medullary epidermoid cyst not associated with spinal dysraphism. Epidermoid cysts (EC) represent less than 1.0% and are rarely seen as an intradural extra-medullary spinal cord tumor. Preoperative Clinico-radiological assumption is important for surgical planning. *[Journal of National Institute of Neurosciences Bangladesh, January 2023;9(1):88-95]*

Keywords: Epidermoid; Spinal dysraphism; Intradural Extra-medullary; Dorsal

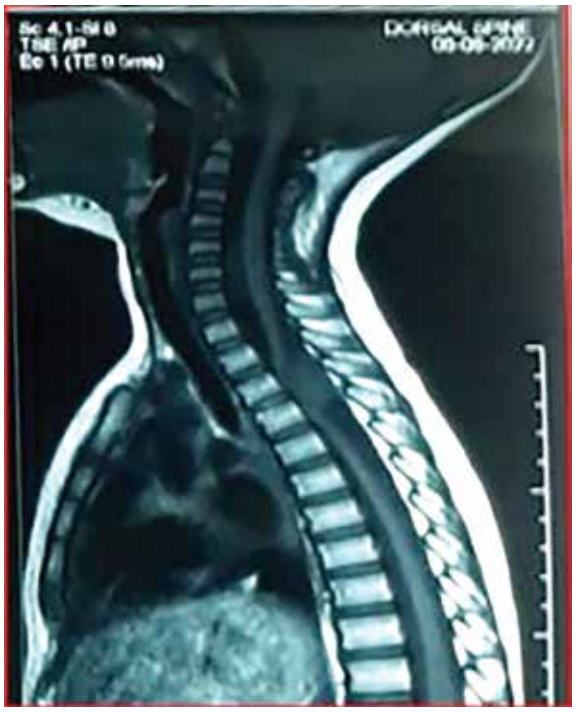
Introduction

Congenital epidermoid cysts originate from displaced ectoderm inclusions arising in early fetal life, between 3 and 5 weeks of gestation[1]. They typically occur in pediatric patients and may be associated with dysraphism and/or dermal sinus. Given the pathogenesis of acquired spinal epidermoid cysts, the lumbar spine represents the most common location, whereas epidermoid cysts of the thoracic and cervical spine have been less frequently described[2]. The pediatric population is more frequently involved[3-4]. Barbagallo et al[2] and Anuj et al[5] revealed that only eight cases of isolated spinal intradural extra-medullary epidermoid cysts had been reported six cases of which were in the thoracic region. Akgun et al[6] reported a case of intradural extra-medullary epidermoid cyst in a 3-year-old male at L1 to L2 level presenting with increasing leg weakness6. Ganapathy et al[7] reported another case of spinal intradural extra-medullary epidermoid cyst in a 1-year-old female child at the level of D-10 presenting to the outpatient clinic with a brownish discoloured skin patch on the back with a slight swelling observed since birth[7]. This brings the total number of reported spinal intradural extra-medullary epidermoid cysts to 11, including ours out of which only 8 are reported in thoracic location. Spina bifida, spinal dysraphisms, scoliosis and cutaneous/dermal defects are often associated with congenital ECs[8-11].

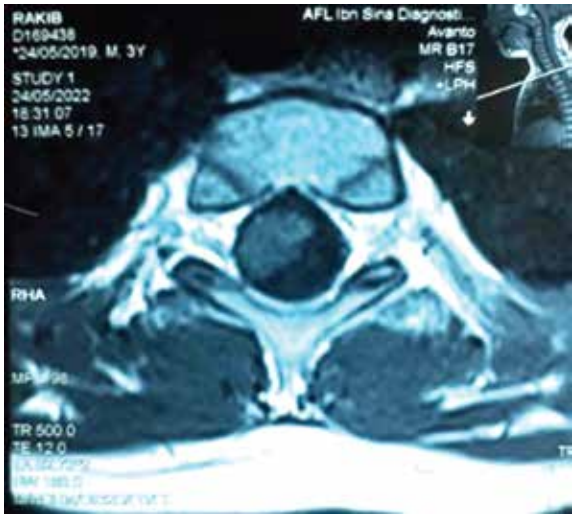
Epidermoid cysts (ECs) are benign tumours, which are commonly observed in the intracranial region. Cruveilhier originally named ECs “tumeurs perlées (pearly tumours)” in 1829, because they had a pearl-like appearance and After extensive literature review we found this case is rare[12-14]. Although ECs rarely occur in the intraspinal region accounting for less than 1.0% of all primary spinal cord tumours spinal ECs may cause spinal cord or nerve root compression enlarging the spinal canal[8,15].

Since Chiari first reported an intramedullary EC in 1883[16], over 100 cases of spinal ECs have been reported in the literature[17-18]. It has been reported that the etiologies of spinal ECs are both congenital and acquired. Congenital spinal ECs are thought to have arisen from aberrant ectodermal cells during the closure of the neural tube in the embryonic period, and spinal

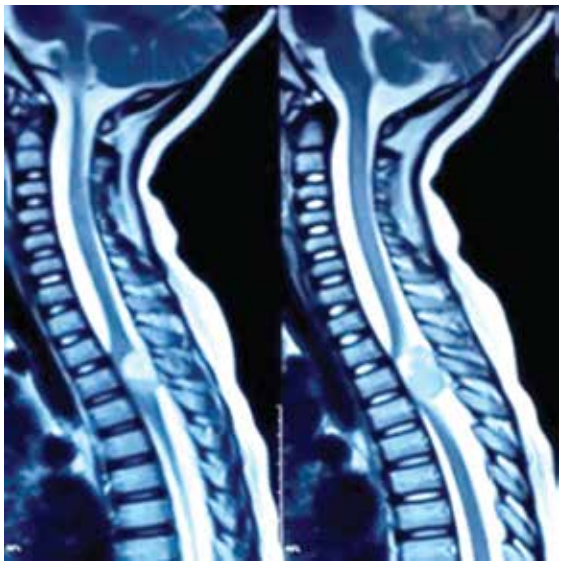
Correspondence: Dr. Sudipta Kumer Mukherjee, Associate Professor, Department of Pediatric Neurosurgery, Room- 737, National Institute of Neurosciences and Hospital, Sher-E-Bangla Nagar, Agargaon, Dhaka-1207, Bangladesh; Email: sudipta70@hotmail.com;
Cell No.: +8801711709096,
ORCID: https://orcid.org/0000-0003-4618-459X.



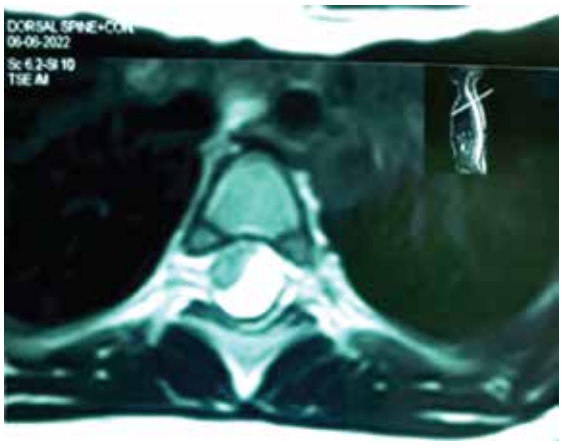
Ia



Ia



Ia



Ia

Figure Ia: Elongated isolated lesion at the level of D3-4 compressing the spinal cord to the central and right side (T1 Sagittal). Ib: (T2 Sagittal) showed mixed intensity. Ic: Hypo intense tumour present at left posterior region. Significantly compress spinal cord (T1 Axial) Id: (T2 Axial) Hyperintense lesion, T2 weighted image

ECs in the conus medullaris region were reported to occur as an intramedullary tumour[9,18-19].

Case Presentation

A 3-year-old boy presented with paraparesis, MRC grade III in Rt lower limb and grade IV in Lt lower limb and urinary retention for 3 weeks, which were gradually increasing. Cutaneous signatures of spinal dysraphism were not observed.

Neuro Imaging Study: Magnetic Resonance Imaging (MRI) revealed Intradural Extramedullary (IDEM) SOL in D3 to D4 levels (Figure Ia, Ib, Ic, Id). Mixed intensity mass without any enhancement with gadolinium (GAD), compresses the spinal cord in the intradural extramedullary compartment.

Operation Note: A French door laminoplasty D3-5 was performed under the guidance of C-arm. A typical pearly white, avascular, lesion appeared under the dura, on the left side, covered by the arachnoidal sheet and entirely occupying the dorsal portion of the spinal canal (Figure IIa). Following arachnoidal opening over the most prominent tumour component, microsurgical debulking of the tumour was started. (Figure IIb). After its reduction in volume, careful identification and dissection of the tumour membranes were started, trying

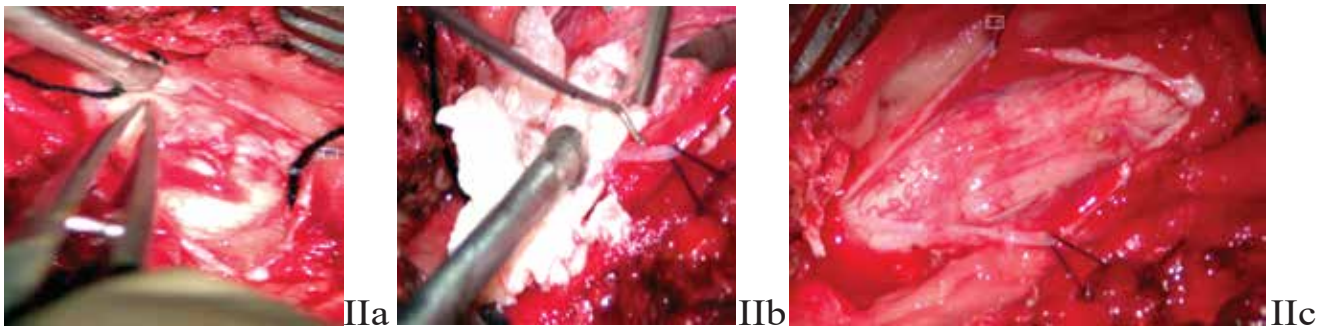


Figure IIa: Pearly white content of tumour. IIb: Arachnoid separated from tumour capsule on the wall as the spinal cord. IIc: Gross Total Removal (GTR) of the lesion. No remnant of tumour tissue cord compression

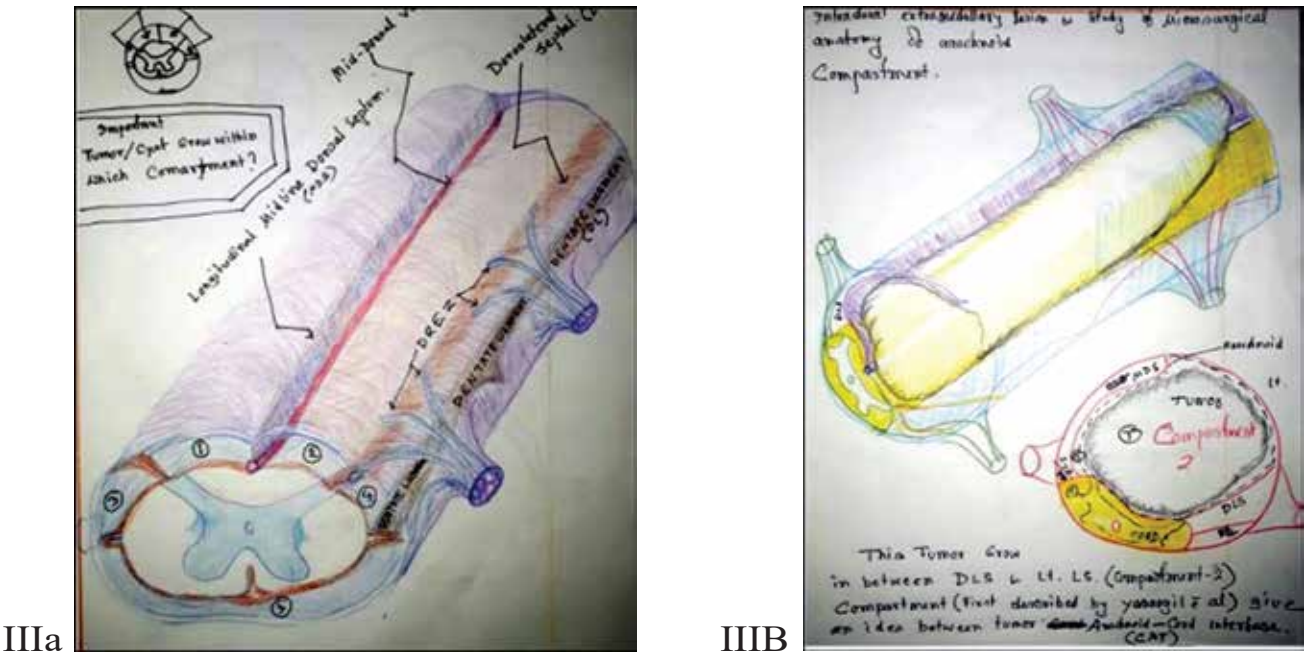
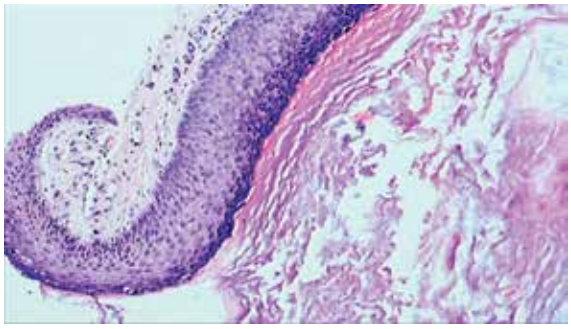


Figure IIIa: This tumour grows in between DLS & Lt LS (Compartment-2), compartment (First described by Yasargil et al.). Arachnoid Cord Interface (CAT) Figure IIIb: Tumor grows within which compartment- 2

to respect arachnoidal planes and avoiding coagulation. The medial dorsal arachnoidal septum was identified during the dissection of tumour membranes off the right side of the spine. (Figure IIc) It was fenestrated and displaced to the right side where it was attached to the right posterolateral arachnoidal septum.

Both the medial dorsal septum and right postero-lateral septum had been stretched by the tumour mass and dislocated over the right dorsal rootlets. Consequently, the dissection of tumour membranes from arachnoid planes on the right side did not cause any traction on nerve roots (Figure IIIb). Conversely, on the medial side tumour membranes were adherent to the left postero-lateral arachnoid septum. This was widely fenestrated and pushed over the left dorsal nerve rootlets. A gentle dissection of left-sided residual tumour membranes was started from the postero-lateral arachnoid septum toward the midline. Avoidance of inadvertent traction of neural structures was helped by the presence of the postero-lateral arachnoid septum, albeit incomplete, covering the left dorsal rootlets. After removing the tumour and its membranes dentate ligaments were visualized on both sides. The anterior subarachnoid compartment was also exposed and fenestrated at the end of the procedure. (Figure IIIa). The tumour was encapsulated, and there was mild adhesion between the tumour and the arachnoid membrane. Initially, we attempted to separate the capsule from the arachnoid membrane. The capsule was very thin, it was opened, and the content was pearly white. Then, we removed the pearly white content.

IVa 

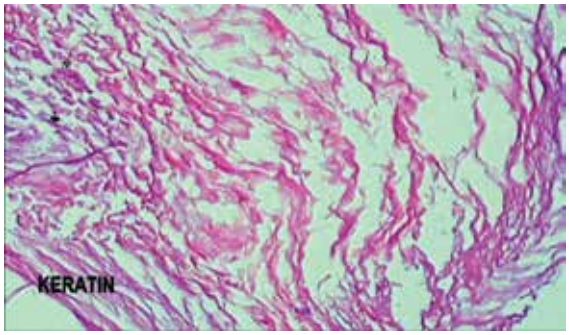
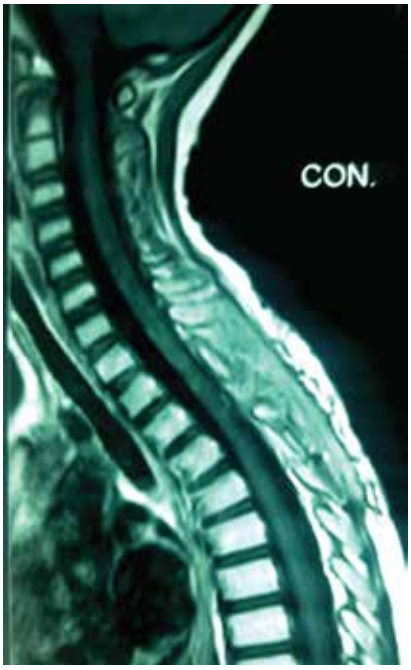
IVb 

Figure IVa & IVb: Photomicrograph Show a cyst lined by stratified squamous epithelium. The cavity contains lamellated layers of keratin. The cyst wall is composed of fibro collagenous tissue. No glial, nerve sheath or meningothelial tumour is seen. No evidence of malignancy is seen

Va 

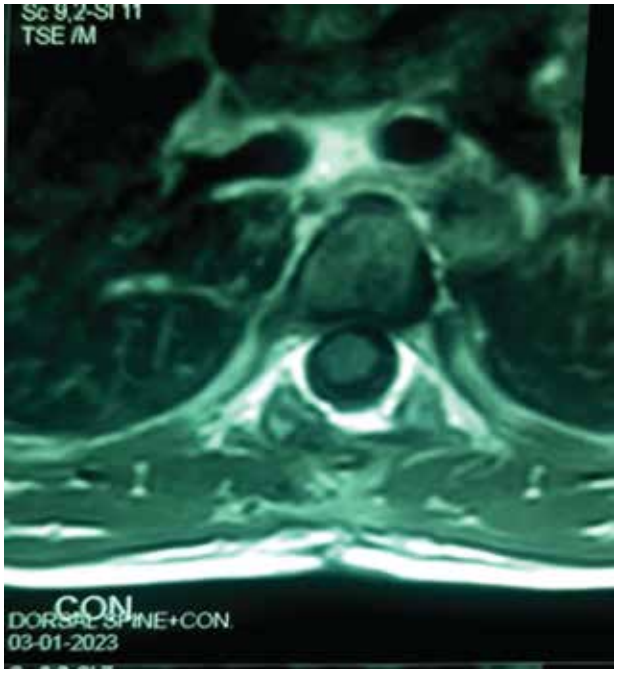
Vb 

Figure Va, Vb: Post-Operative MRI, Post-Operative MRI. No tumour identified in post-operative MRI show spinal cord has no residual or recurrence of the tumour

Gross total removal of the lesion was achieved with the help of microscopy, the upper and lower end of the tumour were protected with cotton to prevent any spillage. Per-operative intravenous methylprednisolone was used. After the removal of the content, the capsule was meticulously separated from arachnoid matter. Gross total removal (GTR) achieved. The wound was closed in layers. No complications after surgery occurred. Motor power regained slowly, two months after surgery patient was running.

Histopathology Shows a cyst lined by stratified squamous epithelium. The cavity contains lamellated layers of keratin. The cyst wall is composed of fibrocollagenous tissue. No glial, nerve sheath or meningothelial tumour is seen. No evidence of malignancy is seen. (Figure IVa, IVb)

Post-Operative Follow Up: There were no residual or recurrence of lesions seen in MRI (Plain and contrast) on 6 months' follow-up. No compression was detected. Lamina maintains its anatomical configuration (Figures Va & Vb). Patient motor and autonomic function was normal.

Discussion

Since the clinical symptoms of spinal ECs are variable and nonspecific with slow progression, the diagnosis

Table 1: Published Cases of Congenital Pediatric Dorsal Non-Dysraphic Spinal Intradural Extramedullary Epidermoid Cysts are Tabulated[8, 12, 13]

SL	Author	Patients Particulars	Location of Lesion	Year
1.	Chang et al[19]	9 Y/F	Upper thoracic	1996
2.	Akgun et al[6]	3 years/ Male	Conus	2018
3.	Sibhi Ganapathy et al[7]	1 year/ Female	D10	2019
4.	Swamy et al[20]	13y/ Male	D5-D7	2002

can be delayed[9]. In this case report, the patient visited us two weeks after he noticed weakness in both lower limbs. However, the majority of patients with spinal ECs usually have long disease duration due to their slow-growing nature[8,18].

Roux et al[8,18]. reviewed 47 cases of intramedullary ECs, and they reported that the mean disease duration was 6 years. Morita et al[18]. reviewed the literature on 81 spinal ECs since 1962, and they found that the mean disease duration was 26 months in congenital ECs and 15 months in acquired ECs. Currently, the disease duration seems to be shorter because of the introduction of MRI15. To the authors' best knowledge, this is the fifth case reported of a congenital pediatric spinal IDEM Epidermoid cyst[8, 12-13].

Spinal ECs are difficult to diagnose on clinical symptoms alone. Penisson-Besnier et al.[16] first reported an intramedullary EC diagnosed by MRI[16]. MRI is useful for the diagnosis of spinal ECs, demonstrating that the tumour is hypo-intense on the T1-weighted view and hyper-intense on the T2-weighted view. However, it is sometimes difficult to detect small cysts, because spinal ECs show the same signal as the cerebrospinal fluid on MRI[20-21]. Discrepancy in the intensity characteristics occurs due to varying lipid and protein components[17,22].

Histological examination is critical for differentiating ECs from other tumours, especially from a dermoid cyst[8]. A specific feature of the histological finding is a lined stratified squamous keratinizing epithelium surrounded by the outer layer of collagenous tissue with the absence of skin adnexa. The desquamation of keratin from the epithelial lining creates numerous cholesterol crystals[23].

The etiologies of spinal ECs are thought to be both congenital and acquired. Acquired ECs were mostly reported in the region of the cauda equina below the L1 level[24-25]. Among the spinal epidermoids, the thoracic region is the most common site of occurrence, followed by the sacral and cervical regions[26].

Surgical treatment is required when the patients develop neurological deficits. Complete excision of ECs is essential for surgical treatment[27]. However, complete resection of the encapsulated tumour is difficult for all cases, because the EC's capsules are very thin and the tumour often adheres to the arachnoid membrane, spinal cord, or nerve roots. Thereby, subtotal resection is also commonly performed[28-30]. The surgical management of such lesions is highlighted and the importance of spinal arachnoidal space anatomy is discussed. Knowledge of "classical" microsurgical anatomy was useful to perform a safe and effective tumour dissection[2].

The recurrence rate of spinal ECs was reported from 10 to 29.0% in previous literature. Although ECs are benign tumours, local recurrence is reported especially after subtotal excision[18,20,25]. It is suggested that incomplete excision of basal germinal cells of the tumour induces tumour recurrence[16]. Because the tumour content includes fat and cholesterol, they may also produce an inflammatory reaction leading to meningitis[8,17,21,23]. In our case, complete resection of the tumour's capsule with emptying of the cyst material was achieved, although the tumour's capsule opened during the procedure. Fortunately, the patient did not develop any inflammatory reactions or neurological deterioration postoperatively. We use cotton patties to prevent spillage as well as local and systemic methylprednisolone injection to prevent an inflammatory reaction. There was no recurrence at the Six-month follow-up with a good clinical outcome. However, long-term follow-up is required for the potential risk of tumour recurrence.

Anatomical Study: Key, Axel and Magnus Gustaf Retzius published a famous anatomical book "IN 1875 where they describe subarachnoid space. Later, Prof. Yasargil conducted an extensive study on the same issue[31,32]. they found -the arachnoid membranes consist of an outer condensed layer that is continuous and watertight. From this outer, condensed arachnoid membrane, there are numerous strand-like attachments to the pial surface of the spinal cord which are particularly numerous along the dorsal aspect of the spinal cord and relatively sparser ventrally. In almost

all specimens, there was a distinct longitudinal midline dorsal septum, variably fenestrated, which extended from the dorsal midline of the outer condensed arachnoid to attach to the subjacent spinal cord along a middorsal vein. This midline dorsal septum typically extends from the mid-cervical area down to upper lumbar cord levels[32].

The midline dorsal vein appears to influence the attachment of the midline dorsal septum to the spinal cord, and when the vein is tortuous, it may impart a similar tortuosity on the midline dorsal septum (Figure III a,b). In addition to the midline dorsal septum, there are two series of dorsolateral septa, one series on each side, with each element of the series oriented along the oblique course of the dorsal rootlets clustered at each segmental level. These septa extend from the dorsal root entry zone to envelop the dorsal rootlets (grouped at each segmental level) and attach to the outer arachnoid membrane dorsolateral. In most cases, the attachment tethers the dorsal rootlets dorsolateral and ensures clearance between the dorsal rootlets and the lateral parts of the spinal cord. The arachnoid enveloping the dorsal rootlets continues laterally on the inner surface of the outer arachnoid membrane to extend into the root sleeve where it appears progressively more condensed as the nerve bundles themselves condense to form the definitive dorsal root[32].

The dorsolateral septa were considerably more irregular than the generally smoother, compact, and distinct midline dorsal septum. Along the ventral surface of the spinal cord, no arachnoid condensations or septations were ever seen. The dorsolateral septa were most distinct at thoracic and low cervical levels but were still evident further rostral and caudal. The pia mater of the spinal cord appeared to condense laterally to form the dentate ligament, which is attached to the outer arachnoid and through it to the overlying dura mater approximately halfway between the root exits. A better appreciation of the spinal arachnoid can be pertinent to the operating neurosurgeon in the following ways[33].

Knowledge of the arachnoid septations can allow for a smoother opening and subsequent reclosing of the arachnoid. For instance, when the midline dorsal septum is well-formed, it will resist opening exactly on or across the middorsal line. It may be advantageous to open the arachnoid slightly lateral to the middorsal line and then, if necessary, break down the midline dorsal septum separately to preserve the coherence of the outer arachnoid for subsequent closure. Of course, at upper cervical and lower lumbar levels, the midline dorsal septum is rarely encountered in recognizable form, being largely fenestrated at those levels, and one can usually open the arachnoid there in the exact midline as desired. When the dorsal vein, visible through the outer arachnoid, is noted to be tortuous, the surgeon can be forewarned that the midline dorsal septum may be similarly tortuous and an arachnoid incision planned accordingly. Another similar advantage to the neurosurgeon is the knowledge that the arachnoid septations may guide the dissection of a benign tumour. Of course, a tumour may displace the septations, but anticipating the presence of septation. However, deviation by tumour mass may allow for easier recognition of a plane of dissection at operation. A potential advantage may relate to preventing the formation of an arachnoid cyst after surgery. If an arachnoid cul-de-sac is appreciated following the removal of a tumour, it may be advantageous to break down the arachnoid septations to ensure free communication of the spinal fluid compartments involved[32].

Conclusion

Here we report a case of isolated (non-dysraphic) intradural extramedullary spinal epidermoid cyst which is uncommon, especially in the dorsal area. Though uncommon, it is not rare. For any dorsal intradural extramedullary lesion an epidermoid cyst keeps as a differential diagnosis. Complete resection as well as maintaining spinal anatomy is the goal. Getting an idea about tumour location concerning the arachnoid compartment is very important. A good preoperative image gives an idea and thus helps in the operative decision. A thorough knowledge of spinal subarachnoid space anatomy is helpful to distinguish between tumour membranes and arachnoidal planes and achieve a safe and complete resection, to avoid recurrences.

Abbreviations

EC: Epidermoid cysts
IDEM: Intradural Extramedullary
MRI: Magnetic Resonance Imaging
SOL: Space Occupying lesion
MRC: Medical Research Council

Acknowledgements

Prof. Mohammad Kamal, eminent pathologist, “The Laboratory” Dhaka for photomicrograph.

Conflict of interest: There is no conflict of interest relevant to this paper to disclose.

Financial Disclosure

There was no financial sponsorship.

Contribution to authors: SKM, KNK and AAM did this surgery, SKM write this article, DMA- check grammar then editorial formatting done by JW.

Data Availability
Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Consent for publication: Informed consent was taken from a patient guardian. All methods were performed in accordance with the relevant guidelines and regulations.

How to cite this article: Mukherjee SK, Arman DM, Mahbub AA, Khan SIMKN, Wellington J. Pediatric Dorsal Intradural Extra-Medullary Epidermoid Cyst (Non-Dysraphic): An Illustrative Case with Literature Review. J Natl Inst Neurosci Bangladesh, 2023;9(1):88-95

Article Info
Received on: 27 October 2022
Accepted on: 2 December 2022
Published on: 1 January 2023

References

1. Wang X, Gao J, Wang T, Li Z, Li Y. Intraspinal dermoid and epidermoid cysts: Long-term outcome and risk factors. J Spinal Cord Med. 2020;43(4):512-7.
2. Barbagallo GMV, Maione M, Raudino G, Certo F. Thoracic Intradural-Extramedullary Epidermoid Tumor: The Relevance for Resection of Classic Subarachnoid Space Microsurgical Anatomy in Modern Spinal Surgery. Technical Note and Review of the Literature. World Neurosurg. 2017;108:54-61.
3. Deogaonkar M, Goel A, Pandya SK. Thoracic intradural anterior epidermoid manifesting as sudden onset of paraplegia--case report. Neurol Med Chir (Tokyo). 1995;35(9):678-9.
4. O'Brien DP, Singh J, Dias PS. Spinal epidermoid cyst and cauda equina syndrome in a teenage girl. Ir J Med Sci. 1992;161(12):675-8.
5. Anuj AKT, Rizwan Z, Mufti S, Patahak S, Gupta O, Kumar P. Isolated extramedullary intradural thoracic epidermoid cyst: A rare case report. IP Indian Journal of Anatomy and Surgery of Head, Neck and Brain. 2021;7:81-4.
6. Akgun B, Ergun AC, Ozercan IH, Kok S. Intradural Extramedullary Epidermoid Cyst at the Conus Medullaris Level with Thoracic Syringomyelia: A Case Report. Acta Medica (Hradec Kralove). 2019;62(1):39-42.
7. Ganapathy S, Priyamvadha K, Verma A, Baliga V (2019) Dorsal Intradural Extramedullary Epidermoid in a One Year Old Child – A Case Report and Review of Literature. J Pediatr Neurol Med 4: 135. doi:10.4172/2472-100X.1000135
8. Roux A, Mercier C, Larbrisseau A, Dube LJ, Dupuis C, Del Carpio R. Intramedullary epidermoid cysts of the spinal cord. Case report. J Neurosurg. 1992;76(3):528-33.
9. Bostroem VE. Ueber die pialen Epidermoide. Dermoide und Lipome und duralen Dermoide Zentbl allg Path path Anat. 1897;8:1-98.
10. Sarma DP, Carter CF, Weilbaecher TG. Intraspinal epidermoid cyst. J Surg Oncol. 1984;25(1):64-6.
11. Lunardi P, Missori P, Gagliardi FM, Fortuna A. Long-term results of the surgical treatment of spinal dermoid and epidermoid tumors. Neurosurgery. 1989;25(6):860-4.
12. Mongia S, Devi B, Shaji K, Hegde T. Spinal subdural epidermoids - a separate entity : report of 3 cases. Neurology India. 2002;50(4):529-31.
13. Musali SR, Mohammed I, Gollapudi PR, Maley SK. Dorsal Spinal Intradural Intramedullary Epidermoid Cyst: A Rare Case Report and Review of Literature. J Neurosci Rural Pract. 2019;10(2):352-4.
14. Swamy MN. A Case of Intramedullar Epidermoid Cyst. Med J Armed Forces India. 2008;64(1):72-3.
15. Funao H, Isogai N, Daimon K, Mima Y, Sugiura H, Koyanagi T, et al. A rare case of intradural and extramedullary epidermoid cyst after repetitive epidural anesthesia: case report and review of the literature. World J Surg Oncol. 2017;15(1):131.
16. Penisson-Besnier I, Guy G, Gandon Y. Intramedullary epidermoid cyst evaluated by computed tomographic scan and magnetic resonance imaging: case report. Neurosurgery. 1989;25(6):955-9.
17. Manno NJ, Uihlein A, Kernohan JW. Intraspinal epidermoids. J Neurosurg. 1962;19:754-65.
18. Morita M, Miyauchi A, Okuda S, Oda T, Aono H, Iwasaki M. Intraspinal epidermoid tumor of the cauda equina region: seven cases and a review of the literature. J Spinal Disord Tech. 2012;25(5):292-8.
19. Chandra P, Manjari T, Devi B, Chandramouli B, Srikanth S, Shankar S. Intramedullary spinal epidermoid cyst. Neurology India. 2000;48(1):75-7.
20. Teo BT, Lin CC, Chiou TL, Chen SC, Yen PS. Unusual magnetic resonance characteristics of a cerebellopontine angle epidermoid cyst with upper cervical spinal canal extension. J Clin Neurosci. 2006;13(7):781-4.
21. Munshi A, Talapatra K, Ramadwar M, Jalali R. Spinal epidermoid cyst with sudden onset of paraplegia. J Cancer Res Ther. 2009;5(4):290-2.
22. French la, peyton wt. Mixed tumors of the spinal canal. Archives of Neurology & Psychiatry. 1942;47(5):737-51.
23. Er U, Yigitkanli K, Kazanci A, Bavbek M. Primary lumbar epidermoid tumor mimicking schwannoma. J Clin Neurosci. 2006;13(1):130-3.
24. Baba H, Wada M, Tanaka Y, Imura S, Tomita K. Intraspinal epidermoid after lumbar puncture. Int Orthop. 1994;18(2):116-8.
25. Gardner DJ, O'Gorman AM, Blundell JE. Intraspinal epidermoid tumour: late complication of lumbar puncture. Cmaj. 1989;141(3):223-5.
26. Manara R, Severino M, Mandari R, Mattisi G, Dal Pozzo S, Carollo C. Chronic cystic lesion of the sacrum: characterisation with diffusion-weighted MR imaging. Radiol Med. 2008;113(5):739-46.
27. Yin H, Zhang D, Wu Z, Zhou W, Xiao J. Surgery and outcomes of six patients with intradural epidermoid cysts in the lumbar spine. World J Surg Oncol. 2014;12:50.
28. Scarrow AM, Levy EI, Gerszten PC, Kulich SM, Chu CT, Welch WC. Epidermoid cyst of the thoracic spine: case history. Clin Neurol Neurosurg. 2001;103(4):220-2.

29. Gonzalvo A, Hall N, McMahon JH, Fabinyi GC. Intramedullary spinal epidermoid cyst of the upper thoracic region. J Clin Neurosci. 2009;16(1):142-4.
30. Fereydoonian NA, Bakhti S, Fereshtehnejad SM, Tabibkhooei AR. Intramedullary thoracic spine epidermoid cyst with myelopathic presentations: a report of a rare case. Clin Neurol Neurosurg. 2013;115(6):841-3.
31. Grant G. Gustaf Retzius (1842–1919). Journal of Neurology. 2011;258(4):706-7.
32. Nauta HJ, Dolan E, Yasargil MG. Microsurgical anatomy of spinal subarachnoid space. Surg Neurol. 1983;19(5):431-7.
33. Yen CP, Kung SS, Kwan AL, Howng SL, Wang CJ. Epidermoid cysts associated with thoracic meningocele. Acta Neurochir (Wien). 2008;150(3):305-8; discussion 8-9.