

"Cable Suturing Technique" a Dural Obliteration Method for the Prevention of Cerebellar Herniation through a Large Occipital Meningocele

Abstract

The authors present a patient who had a large occipital meningocele, which was transformed into an encephalocele after primary closure due to a large skull defect. Thus, the technical importance of classifying patients with occipital meningocele with a large skull defect and a tight dural obliteration is crucial, not to leave a wide dead space with a potential risk of cerebellar herniation. Encephalocele and meningocele are embryological anomalies, which result in intracranial structures herniation due to inborn skull defect. Acquired encephalocele may develop through the same defect with normal cerebellar tissues; since the prognosis of occipital encephalocele may worsen as the size of herniation increases, the patient underwent a modified dural obliteration technique (Cable Suturing Technique) to adjust the size of the dura and to strengthen it to prevent the risk of future herniation followed by cranioplasty and the cerebellar herniation regressed significantly after the procedure.

Keywords: Cranioplasty, dural repair, herniation, meningocele, occipital encephalocele

Introduction

Large occipital encephaloceles are more challenging in terms of management and future neurological/neurocognitive outcome. Extent of brain tissue herniation through a cranium bifidum has a proportional risk of poor neurological outcome. Individualization of patients in the setting of management is important to reduce postoperative morbidity.

Secondary viable brain tissue herniation through skull defect is of rare occurrence, and few literature reports of split cranioplasty repair in anticipation for a large occipital encephalocele have been reported.

Case Report

A Newborn baby boy, Full term, Product of cesarean section diagnosed Antenatally with occipital swelling. On Examination, 3 x 2 cm fluid filled swelling with normal covering skin was noted at the occipital area with no pulsation. Preoperative MRI brain showed a CSF filled swelling herniating through a large occipital defect with no intervening brain tissue and no

hydrocephalus consistent with Meningocele [Figures 1].

The patient underwent uneventful primary meningocele repair through horizontal skin incision at the center of the mass, subcutaneous dissection was carried out, and dura was separated and obliterated and stitched and the cranial defect was kept intact. Two months postoperatively, the patient was asymptomatic. Serial imaging and the clinical course did not suggest development of hydrocephalus. However, 4 months post operatively, he had small bulge over the surgical site and his Brain MRI showed outward cerebellar herniation accompanied by brainstem shift through the same defect with expansion of the prepontine cistern on the right side [Figures 2 and 3]. The patient underwent a second surgical repair through revision of previous surgical site using multiple dural suturing (cable sutures technique) to enforce the dura by folding as much as possible and tight long sutures (as cables). This technique is useful for proper adjustment of the floppy relaxed dura to fit in place and to strengthen it to prevent future herniation. A fitted cranioplasty was made by using polymethyl methacrylic implant. The attention was

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Access this article online

Website: www.asianjns.org

DOI: 10.4103/ajns.AJNS_60_19

Quick Response Code:



How to cite this article: Alojan AA, Alsaad IS, Alghareeb FY, Al-issawi WM, Ammar AS. "Cable suturing technique" a dural obliteration method for the prevention of cerebellar herniation through a large occipital meningocele. Asian J Neurosurg 2019;14:1044-7.

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Figure 1: Magnetic resonance imaging of brain (A) Axial view T2 weighted image, (B) Sagittal view T1 weighted image showing a cerebrospinal fluidfilled Meningocele through an occipital defect. (C) Reconstructed computed tomography skull imaging showing a large round occipital skull defect measuring around 2.5 cm × 3.5 cm

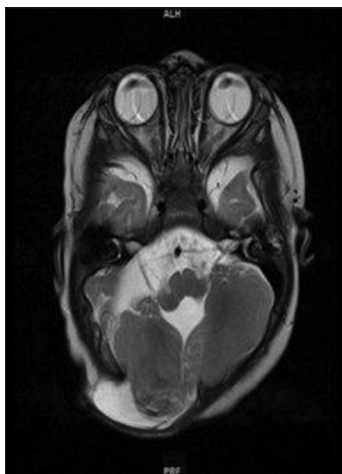


Figure 2: Magnetic resonance imaging brain T2 view showing a postprocedural right cerebellar herniation through defect with a brainstem shift and prepontine cistern expansion

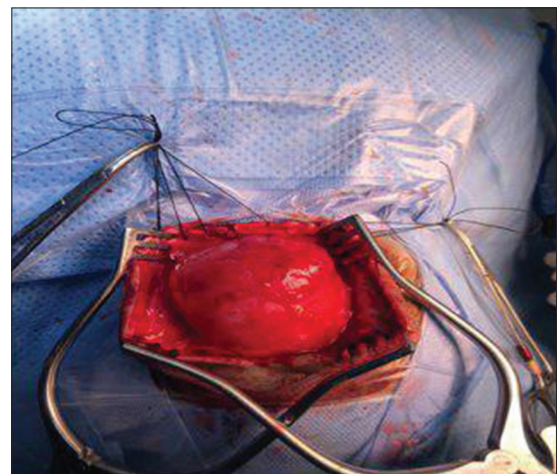


Figure 3: Intraoperative photograph showing bulging of dura with herniated cerebellar tissue within

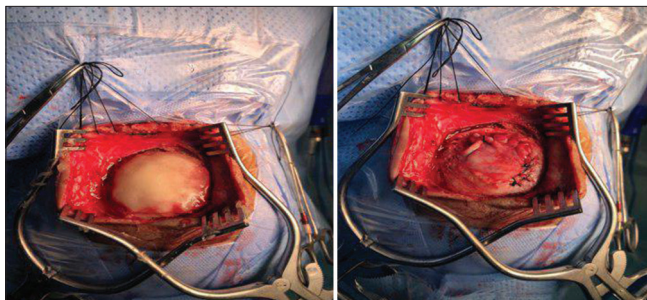


Figure 4: Application of polymethyl methacrylate cranioplasty, with miniplates screws fixation after dural obliteration

made to insert the methyl methacrylate 2-3 millimeters over the edges of the bone defect, so the cranioplasty will not interfere with the bone growth causing skull deformity [Figure 4].

Three months post second repair, a Follow up MRI Brain showed Significant regression of cerebellar herniation and brainstem shift and patient remain asymptomatic and neurologically intact [Figures 5 and 6].

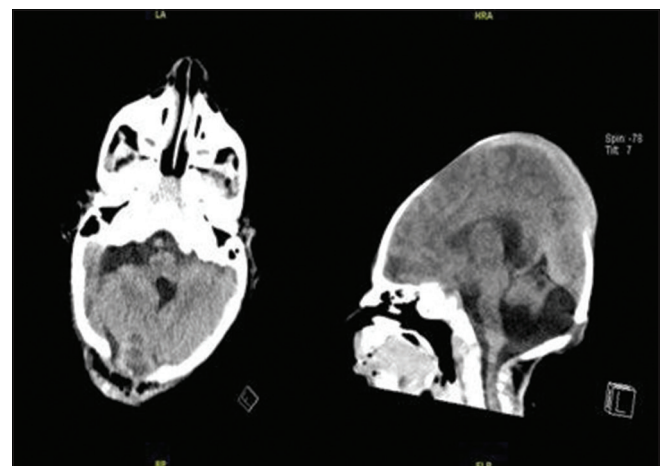


Figure 5: Immediate postcranioplasty computed tomography scan showing regression of cerebellar herniation

Discussion

Encephalocele (also known as cranium bifidum) is considered as incomplete cranial neuropore closure during neural tube formation (day 24 gestational age) where

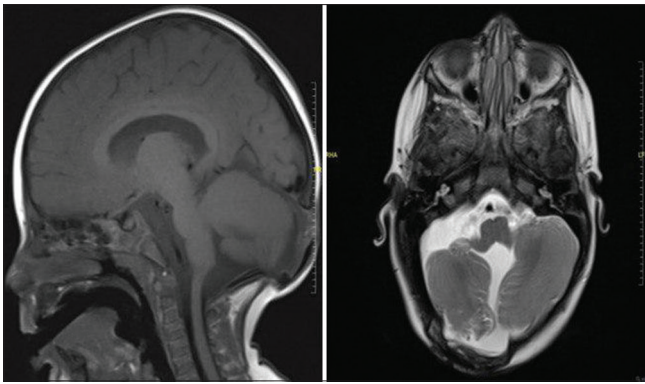


Figure 6: Secondary post operative brain magnetic resonance imaging showing further regression of cerebellar herniation, Brainstem and prepontine cistern shift

intracranial structure herniates outside skull confines,^[1-6] including brain tissues, meninges, and cerebrospinal fluid (CSF).^[5,7,8]

Encephalocele can be classified according to the anatomic location of the defect, with the occipital location being the most common one.^[2,7]

The prevalence of encephalocele is around 1 for every 500 live birth. Incidences of (posterior) occipital encephalocele are more common in females. While anterior encephalocele is more common in males.^[8-10]

Encephalocele has multifactorial etiology; risk factors are mainly related to neural tube defects, such as not using folic acid before pregnancy, poor parental health monitoring, low socioeconomic status, and certain medications. Furthermore, environmental factors have a role such as intrauterine infections.^[2-6,11]

In case of acquired encephalocele, the cerebellar tissue within the defect is usually normal and herniates through a skull defect.^[12]

The concept of surgical repair of meningocele mandates dural obliteration either by opening the dura, draining the CSF then suturing it and having it back through skull confines which carries a risk of CSF leak. Our surgical intervention in this case was a modified (cable suturing technique) which was modified from a technical note by one of this paper's authors Ammar *et al.*,^[13] where dura dissected from subcutaneous tissue and especially from bone edges then sutured repeatedly in different oblique plane and stretched tightly to keep dura under tension (Illustration; [Figure 7]) without opening the dura, this will eliminate the dural bulge, leaving no dead space and omit the hustle of probable CSF leak with good results, followed by polymethyl methacrylate cranioplasty with miniplates screws fixation to cover the large defect; in order to prevent further cerebellar protrusion as a first stage cranioplasty till the patient get older.

For skull defect repair, different methods of using cranioplasty in children are in literature, including expansile

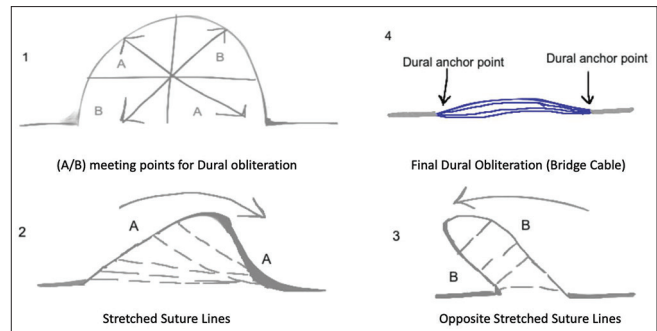


Figure 7: An illustrative drawing of so called (Cable suturing technique) through Dural suturing in different plane under tension

autologous calvarial bone, methyl acrylic, titanium, plastics and metals.^[14-18] while the first fetal allogeneic cranial bone cranioplasty was introduced in monkeys.^[19]

Autologous cranioplasty is favored upon synthetic material (PMMA, Titanium) which lack the potential to expand as child grows which might need revision in the future. But, although autologous (expansile) cranioplasty has good outcome in preserving brain parenchyma,^[10,12] it has a disadvantage of relative risk of bleeding, donor site morbidity as well as risk of resorption, thus some authors would advocate a later - staged - cranioplasty.^[1,3,5,14-17]

Bozinov *et al.*,^[1] reported a case of large encephalocele where an expansile cranioplasty was performed by placing a graft in the dura followed by harvested autologous parietal bone graft with a good operative results.

However, some reports classified large encephalocele as a defect of more than 5 cm wide where cranioplasty is warranted as a first stage and found autologous calvarial bone safe and effective, leaving smaller defect without cranioplasty.^[20]

The prognosis of occipital encephalocele mainly depends on the size and the amount of herniated tissues, as large amount can increase the risk of mental and physical retardation,^[1,5,21] chances of CSF leakage, and wound infection.^[3,5,22]

Postoperative complications are mainly hydrocephalus that can also happen preoperatively and may need ventricular drainage.^[5] However, it must be carefully drained as removing large amount of CSF fluid can lead to electrolyte imbalance especially in neonates.^[7,9,21]

Conclusion

Careful and thorough preoperative planning and examination are important to identify patients at risk and reduce such rare incidence. Autologous vs synthetic cranioplasty graft in children have been reported in the literature, where staged cranioplasty might be used in patients who showed failure of skull defect obliteration upon growth. Our proposed "Cable Suturing Technique" was of great value in the management of patient

sequela, maintaining tight dural fold and prevent further herniation.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms, including intraoperative images, patients Imaging scans and clinical data to be published in this journal. The authors certify that this article has gained an institutional review board certificate from IRB committee at imam Abdulrahman bin Faisal University, Dammam, Saudi Arabia.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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