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Primary Closure Consideration and Local Flap Reconstruction in a Neonate with Giant Occipital Meningoencephalocele: A Case Report and Technical Considerations

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ABSTRACT

Introduction: Meningoencephalocele is a rare congenital neural tube defect characterized by herniation of meninges and brain tissue through a cranial defect. Giant occipital lesions in neonates present substantial neurosurgical and reconstructive challenges owing to fragile tissues, limited physiological reserve, and increased risk of cerebrospinal fluid (CSF) leakage, wound complications, and infection. Despite well-established neurosurgical principles, optimal strategies for soft tissue reconstruction in this population remain insufficiently reported.

Case Description: An 11-day-old female neonate presented with a large midline occipital mass that had been present since birth. Clinical examination revealed a soft, fluctuant, skin-covered lesion without neurological deficits or signs of infection. Cranial imaging revealed an occipital skull defect with herniation of the meninges and brain tissue, consistent with occipital meningoencephalocele. Following a multidisciplinary evaluation, primary closure was considered but deemed unsafe because of excessive tension. Therefore, staged surgical management was performed. Neurosurgical excision of the non-functional herniated tissue and watertight dural repair was followed by tension-free scalp reconstruction using a local occipital rotation flap. The post-excisional defect measured approximately 8 × 6 cm, and the total operative time was approximately 180 minutes. No intraoperative complications occurred. The postoperative course was uneventful, with stable wound healing, intact flap viability, and no evidence of CSF leakage, wound dehiscence, infection, or neurological deterioration during the early follow-up.

Conclusion: A staged multidisciplinary approach integrating precise neurosurgical repair with well-planned local flap reconstruction enables safe closure, preserves neural protection, minimizes complications, and provides favorable functional and aesthetic outcomes in neonatal occipital meningoencephalocele.

Keywords

Meningoencephalocele, Neonate, Occipital Defect, Scalp Reconstruction, Plastic Surgery, Multidisciplinary Approach

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INTRODUCTION

Meningoencephalocele is a rare but clinically important neural tube defect characterized by the herniation of the meninges, cerebrospinal fluid, and variable amounts of brain tissue through a congenital cranial defect. Its incidence varies geographically, with overall encephalocele rates estimated at approximately 0.8–4 per 10,000

live births, with higher burdens reported in parts of Asia [1]. Giant occipital lesions represent a particularly complex subset because of their size, posterior cranial location, and frequent association with intracranial abnormalities, including hydrocephalus, Chiari malformation, and cortical dysplasia [2]. The volume and functional relevance of herniated neural tissue remain major determinants of neurological prognosis and long-term developmental outcomes [3].

The surgical objectives are clear but technically demanding: to preserve viable neural structures, achieve watertight dural closure, prevent cerebrospinal fluid leakage and infection, and restore durable cranial soft-tissue coverage [4]. In neonates, these goals must be achieved within a narrow physiological margin, as limited blood volume, immature thermoregulation, fragile skin, and airway challenges caused by large occipital masses substantially increase the perioperative risk [5,6]. Therefore, successful treatment requires not only neurosurgical precision but also careful anesthetic, neonatal, and reconstructive planning to prevent complications. Although neurosurgical principles for sac excision, neural tissue preservation, and dural repair are well described, soft-tissue reconstruction in neonates with giant meningoencephaloceles remains less clearly defined. Large defects may exceed the capacity of primary closure, and excessive wound tension can compromise perfusion, increase dehiscence, and jeopardize the underlying dural repair [7]. Therefore, flap selection, multilayer closure, vascular preservation, and strategic placement of suture lines are essential technical considerations for reducing cerebrospinal fluid leakage, wound breakdown, infection, and donor-site morbidity [8,9]. This case report describes the consideration of primary closure and local flap reconstruction in an 11-day-old neonate with a giant occipital meningoencephalocele. By detailing preoperative planning, intraoperative decision-making, neurosurgical repair, and tension-free occipital flap coverage, this report highlights the reconstructive principles that support neural protection, infection prevention, and durable functional and aesthetic outcomes in complex neonatal cranial defects [10].

CASE DESCRIPTION

An 11-day-old female neonate was referred to a tertiary care center with a large occipital mass present at birth. According to the parental history, the lesion was identified immediately after delivery and progressively increased in prominence during the early postnatal period. The mass was soft, fluctuant, and covered by intact skin without erythema, ulceration, or discharge. The infant remained hemodynamically stable with adequate feeding, although mild irritability was observed. There was no history of seizures, vomiting, altered consciousness, or clinical features suggestive of increased intracranial pressure (ICP). The patient was born at term via cesarean section following prenatal detection of a cranial tumor. The birth weight was appropriate for the gestational age, and Apgar scores were within normal limits. The maternal history revealed suboptimal antenatal care, including inconsistent folic acid supplementation during early pregnancy. No family history of neural tube defects or congenital anomalies was noted. On physical examination, the neonate was alert and responsive, with stable vital signs, including a heart rate of 140 beats per minute, respiratory rate of 40 breaths per minute, temperature of 36.7°C, and oxygen saturation of 98% on room air. A large spherical mass was observed in the midline occipital region, measuring approximately 8–10 cm in diameter (Figure 1).

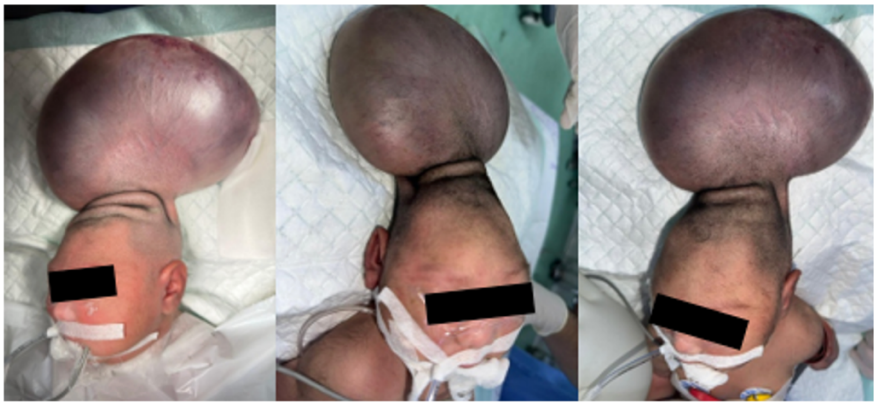

Figure 1 Preoperative clinical presentation of giant occipital meningoencephalocele.

The lesion was soft-elastic, fluctuant, and non-pulsatile, with an intact overlying skin. The anterior fontanelle was flat, and neurological examination revealed intact primitive reflexes, symmetrical muscle tone, and no focal deficits. Ancillary investigations revealed normal laboratory parameters, including hematological and biochemical profiles. Transthoracic echocardiography revealed no structural abnormalities in the heart. Cranial imaging using computed tomography and/or magnetic resonance imaging confirmed an occipital bone defect with herniation of the meninges and brain tissue into an extracranial sac, consistent with occipital meningoencephalocele. Following a multidisciplinary evaluation involving neurosurgery, plastic and reconstructive surgery, anesthesiology, and neonatology, staged surgical management was planned. Neurosurgical intervention included excision of nonfunctional herniated neural tissue, preservation of viable structures, and watertight dural closure to prevent cerebrospinal fluid leakage (Figure 2).

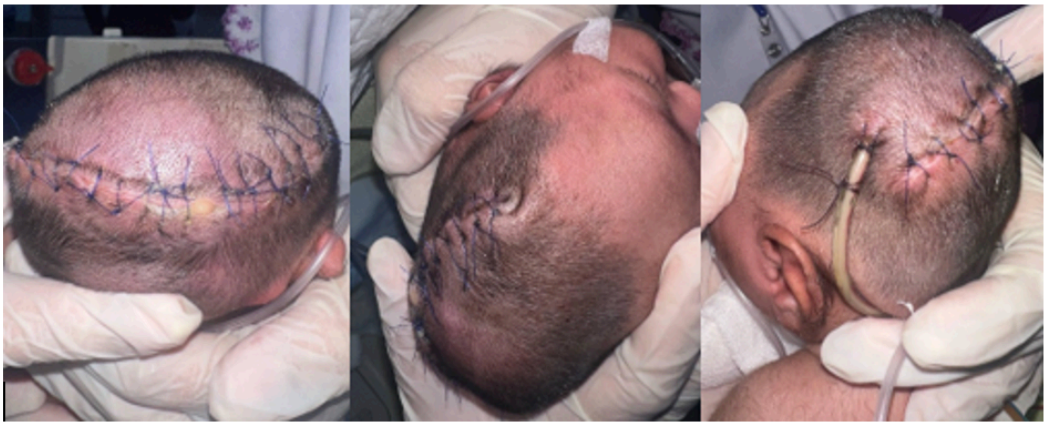

Figure 2. Postoperative outcome following occipital rotation flap reconstruction demonstrating tension-free closure with intact wound edges and preserved flap viability.

Subsequently, a post-excisional soft-tissue defect measuring approximately 8 × 6 cm was observed. Primary closure was considered but was deemed unsafe because of excessive tension. Therefore, reconstruction was performed using a local occipital rotation flap elevated in the subgaleal plane with preservation of the perforator vascular supply. The flap was designed with an approximate 1:1 flap-to-defect ratio to achieve tension-free coverage, and the donor site was primarily closed. Layered wound closure was performed using absorbable sutures, with the final skin suture line positioned away from the dura repair. Total operative time was approximately 180 minutes. The postoperative course was uneventful, and the patient was monitored in the neonatal intensive-care unit. No early complications, including cerebrospinal fluid leakage, wound dehiscence, infection, or neurological deterioration, were noted.

DISCUSSION

The reconstruction of giant occipital meningoencephalocele in neonates represents a complex interplay between neurosurgical precision and biologically constrained soft-tissue repair. Neonatal skin demonstrates incomplete structural maturation, with reduced thickness, impaired barrier function, and diminished tensile strength compared to adult tissue, resulting in limited tolerance to mechanical stress and increased susceptibility to ischemia and wound breakdown [10]. These intrinsic characteristics mandate atraumatic handling and strict adherence to tension-free closure principles, particularly in large cranial defects, where primary approximation is often biomechanically unsustainable. Wound healing in neonates further amplifies this risk. Early collagen deposition is dominated by immature type III collagen, with a delayed transition to type I collagen, resulting in markedly reduced tensile strength during the critical early postoperative period—approximately 3% in the first week and only 30% by three weeks [11-13].

In this context, closures relying on tissue elasticity or high-tension approximation are inherently unstable and predisposed to dehiscence. Accordingly, flap-based reconstruction, which redistributes tension and enhances vascular perfusion, is not only advantageous but also biologically essential for maintaining wound

integrity and protecting underlying neural structures. Systemic physiological factors also critically influence the outcomes of reconstruction. Neonates are highly susceptible to hypothermia, fluid imbalance, and hypoalbuminemia, all of which impair microcirculatory perfusion and wound healing [14-16]. Reduced oncotic pressure promotes interstitial edema, compromising flap viability, while perioperative stress responses further exacerbate capillary leak and tissue swelling [17]. These considerations highlight the necessity of minimizing operative time, maintaining thermal stability, and optimizing perioperative fluid and nutritional statuses to support durable reconstruction. Within this framework, the principle of tension-free closure is paramount. Excessive wound tension compromises microvascular circulation, impairs fibroblast activity, and increases the risk of ischemia and necrosis, effects that are particularly pronounced in neonatal tissues with fragile vascular networks [18]. In meningoencephalocele, failure of soft tissue closure has severe consequences, including cerebrospinal fluid (CSF) leakage, exposure of neural tissue, and risk of life-threatening central nervous system infection [19]. Therefore, any closure associated with mechanical strain should be abandoned in favor of multilayer and vascularized flap reconstruction. Current evidence supports a hierarchical approach to reconstruction based on the defect size and tissue availability. While primary closure may be feasible for small defects, it becomes unsafe for moderate-to-large defects due to excessive tension and high complication rates [20]. Flap-based techniques, including Limberg flaps, V–Y advancement flaps, and keystone-design perforator island flaps (KDPIF), offer superior outcomes by redistributing tension and preserving vascular supply [20-22]. Among these, perforator-preserving local flaps are particularly advantageous in neonates, providing reliable perfusion, shorter operative times, and minimal donor site morbidity. In contrast, tissue expansion and free flap reconstruction are generally impractical in acute neonatal settings because of the prolonged operative time, small vessel caliber, and increased physiological risk [23,24].

Comparative data further reinforce this. Primary closure of moderate-to-large defects has been associated with high rates of CSF leakage and wound dehiscence, whereas flap-based reconstruction significantly reduces these complications and improves short-term outcomes [25]. The present case is consistent with these findings, demonstrating that local occipital rotation flap reconstruction achieved stable, tension-free coverage of an 8 × 6 cm defect without any early postoperative complications. The technical execution of this procedure remains critical. Successful flap reconstruction depends on the preservation of perforator vascularity, geometric redistribution of tension, and maintenance of subfascial vascular networks [20]. Practical strategies, including an appropriate flap-to-defect ratio, avoidance of midline suture placement over dural repair, and optimization of three-dimensional flap design, significantly reduce CSF leakage and improve wound stability [26]. Systemic optimization, particularly nutritional status, is equally important. Hypoalbuminemia is consistently associated with impaired wound healing, increased edema, reduced collagen synthesis, and higher rates of dehiscence [27]. Therefore, preoperative assessment and correction of albumin levels should be considered integral to reconstructive planning in neonatal patients. Finally, successful management of neonatal meningoencephalocele relies on a multidisciplinary team (MDT) approach. Coordinated collaboration between neurosurgeons, reconstructive surgeons, anesthesiologists, and neonatal intensivists enables the optimization of surgical timing, operative strategy, and perioperative care. Evidence suggests that MDT-driven care reduces complications, including CSF leakage, infection, and wound failure, while improving overall surgical outcomes [28]. This study is limited by its single-case design and short follow-up duration, which restricts generalizability and long-term outcome assessment. Additionally, much of the available comparative evidence is derived from heterogeneous cohorts, particularly from myelomeningocele studies. Nevertheless, the biological principles and reconstructive strategies described are consistent across the literature and remain highly relevant for neonatal cranial reconstruction.

CONCLUSION

This case underscores that optimal management of neonatal giant occipital meningoencephalocele requires a staged, multidisciplinary strategy integrating meticulous neurosurgical excision and watertight dural repair, with early, well-planned reconstructive intervention. Tension-free, vascularized local flap coverage tailored to neonatal tissue biology is critical for minimizing cerebrospinal fluid leakage, preventing wound-related

complications, and ensuring durable protection of neural structures. Accordingly, early involvement in reconstructive surgery should be considered an essential component of care to achieve reliable functional and aesthetic outcomes in complex neonatal cranial defects.

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R.A. contributed to the conception and design of the study, data acquisition, and manuscript drafting. I.H. contributed to data interpretation, methodological supervision, and critical revision of the manuscript for important intellectual content. S.R. provided clinical expertise, contributed to data validation, and critically reviewed and approved the final manuscript. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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