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Case Report

Anesthetic Management of Neonatal Occipital Meningoenchephalocele-Comparative Analysis of Lateral versus Supine Intubation Techniques

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ABSTRACT

Occipital meningoencephalocele is a rare neural tube defect presenting challenging anesthetic management due to a difficult airway and risk of sac rupture. This report presents two neonates with different lesion sizes managed using contrasting intubation techniques: lateral positioning with manual finger guidance in a 15-day-old with a massive lesion and microcephaly, and supine positioning with doughnut-shaped cushion support in a 2-day-old with a moderate lesion. Both cases achieved successful first-pass intubation with no intraoperative complications. This comparison demonstrates the importance of individualized airway management strategies based on lesion size and anatomy.

Introduction

One of the most difficult anesthetic presentations in pediatrics is occipital meningoencephalocele, which accounts for about 75% of neonatal neural tube defects [1]. The condition requires early surgical repair because it causes meninges and brain parenchyma to herniate through an occipital bone defect. Anatomical limitations that prevent traditional positioning, the possibility of sac rupture with catastrophic CSF leak, and the possibility of massive bleeding from highly vascularized neural tissue complicate anesthetic management [2]. Numerous intubation methods have been reported, but there is still a dearth of comparative research on various positioning approaches, particularly in neonates. This report highlights technique selection based on lesion size and associated anomalies by describing two successful cases using different approaches.

Case Report

Case 1: Lateral intubation technique

A giant unruptured occipital meningoencephalocele (16 × 14 cm, circumference 35 cm) was present in a 15-day-old female neonate weighing 3.6 kg (PBW 3 kg), height 53 cm, with microcephaly (head circumference 30 cm, third percentile Fenton chart). Gestational diabetes mellitus and hypoalbuminemia were present in the mother's medical history; a cesarean section was performed due to a suspected fetal abnormality. Physical examination revealed an alert, active infant with a GCS of 15. Respiratory status: spontaneous ventilation, RR 38/min, SpO_2 98% on room air. Cardiovascular: HR 133 bpm regular, warm acral extremities, no murmurs. The

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neurological exam is age-appropriate. The meningoencephalocele was intact, soft distally, and firm at the sub-occipital junction, with positive distal transillumination.

Investigations

Laboratory findings (28-01-2025): Hemoglobin 10.8 g/dL (anemia), hematocrit 31.5%, WBC 15.01, platelets 835,000 (thrombocytosis). Renal function is normal (BUN 9.0, creatinine 0.4). Liver function is normal (SGOT 40, SGPT 42). Electrolytes are normal (Na 138, K 5.40 mmol/L). Coagulation studies are normal (PT 9.9 sec, aPTT 23.4 sec). CT head with angiography: Occipital defect of 1.8 × 1.9 cm with brain parenchymal herniation (15.7 × 6.3 × 15.6 cm). Vascular involvement of bilateral posterior cerebral arteries and sagittal sinus through the defect. Minimal midline shift (7.1 mm). Normal ventricular system, no hydrocephalus.

Anesthetic Management

Premedication and induction: To prevent sac compression, the patient is positioned in true lateral decubitus with the affected occiput oriented superiorly. After 5 minutes of preoxygenation with 100% oxygen, the patient was given 0.06 mg of atropine IV, 5 mg of propofol, and 6 mcg of fentanyl. IV. The doses of all three drugs were based on the patient's predicted body weight rather than their actual body weight, because the large occipital mass makes the measured weight higher than it really is. This is why PBW is a better way to estimate the patient's pharmacologically active body mass.

Intubation technique: Intubation was done with great care, keeping the sniffing position and avoiding any pressure on the occipital meningoencephalocele to lower the risk of sac rupture. Using a Miller blade size 1, a 3.5-mm cuffed ETT was put into a depth of 9 cm. The presence of an $ETCO_2$ waveform, symmetric chest rise, equal breath sounds on both sides, and direct visualization of the tube passing through the vocal cords confirmed that the first attempt at intubation was successful. Maintenance and monitoring**:** For the maintenance of anesthesia, use 3% vol. sevoflurane and controlled ventilation (40 breaths per minute, PEEP 3–4 cmH_2O). After intubation, an arterial line was inserted into the right radial artery for invasive blood pressure monitoring. The core temperature was kept between 36.8 and 37.0°C.

Surgical Course and Outcome

With cautious meningoencephalocele protection, the patient moved to a prone position. Three hours were spent on the procedure. Operative findings include a 2x2 cm occipital bone defect, viable brain parenchyma, and CSF aspiration (620 mL, clear-yellowish). Procedures: bilateral skin undermining in the subgaleal plane to the frontal and temporal regions, durorraphy for watertight closure, and layered closure. adequate hemostasis. There were no complications during surgery. Blood loss is estimated to be between 80 and 150 mL. Post-operative: Continued NICU intubation is optional. stable course following surgery.

Case 2: Supine with doughnut-shaped cushion

An occipital meningoencephalocele measuring 9 by 12 cm was present for surgical repair in a 2-day-old female neonate weighing 3.5 kg (PBW 3.3 kg) and measuring 56 cm. Maternal history: G2P2002, advanced age, and full gestation. Meconium staining during cesarean delivery. Neonatal resuscitation is necessary; initial SpO_2 is 49%, CPAP is started (PEEP is 7 cmH_2O, FiO_2 is 30%), and room air is weaned through surgical assessment.

Physical exam: Alert, active infant, GCS 15. Respiratory: RR 47/min, SpO_2 98% on room air. Cardiovascular: HR 147 bpm, warm peripheries, no murmurs. FOC 34 cm (borderline -1 to 0 SD on the WHO chart, no microcephaly).

Investigations

Results of the laboratory (23-07-2024): WBC 12.09, platelets 285,000, hematocrit 43.1%, and hemoglobin 15.0 g/dL. regular kidney function. Coagulation: PT 14.0 sec (prolonged), aPTT 36.3 sec (prolonged), indicating hemostasis in an immature newborn. Na 139, K 5.00 mmol/L, and chloride 108.0 mmol/L (hyperchloremia) are electrolytes. To treat coagulopathy, a fresh frozen plasma transfusion was administered before surgery. Echocardiography, July 25, 2024: 80% ejection fraction and normal cardiac anatomy. Mild to moderate tricuspid regurgitation (PG 23 mmHg) and patent ductus arteriosus (0.1 cm). Not a single structural heart condition.

Head CT: Occipital deformity, meningoencephalocele, 2.5 x 4.3 cm, 6.5 × 5.6 × 9.0 cm with partial fourth ventricle herniation, bilateral posterior horn involvement, cerebellar tissue, and the parieto-occipital lobe. There is no notable hydrocephalus.

Anesthetic Management

Positioning and induction: The patient was placed in a supine position with a doughnut-shaped cushion supporting the head on both the anterior and lateral sides, allowing the occipital meningoencephalocele to occupy the hollow center without direct pressure. In the neutral inline cervical position, the head is kept. Atropine 0.07 mg IV, propofol 5 mg, and fentanyl 7 mcg IV were administered after a 5-minute preoxygenation (100% O_2).

Intubation: Standard Miller blade size 1 with conventional laryngoscopy. 3.5 mm cuffed ETT inserted to 9 cm depth. First-pass intubation was successful. Confirmed by $ETCO_2$, symmetric chest rise, and bilateral equal breath sounds. Maintenance: Sevoflurane 3% vol., ventilation parameters identical to Case 1. Arterial line post-intubation. Careful hemodynamic monitoring is given concurrent with PDA and tricuspid regurgitation.

Surgical Course and Outcome

Careful repositioning to the prone. Surgery duration: 3 hours. Operative findings: Gliotic (non-viable) brain tissue, 2.5 × 4.3 cm occipital defect. Procedures: Excision of gliotic tissue, duraplasty with successful CSF watertight closure (Valsalva negative), periosteal graft, primary bone flap closure with 3-0 suture, and layered skin closure. Hemostasis achieved. Intraoperative course stable. Post-operative: Elective NICU ventilation, stable course.

Discussion

Neonatal occipital meningoencephalocele is an uncommon but serious anesthetic emergency that calls for a customized airway management plan [3]. These two cases show that, when lesion size, intracranial anatomy, and operator capability are taken into account, successful first-pass intubation can be accomplished using two different positioning strategies. Standard supine positioning was anatomically impossible due to the massive 16 × 14 cm lesion and concurrent microcephaly in Case 1. Safe neck extension and head positioning necessary for a traditional laryngoscopy were not possible due to the large posterior mass taking up a substantial amount of skull volume and the decreased total intracranial space (FOC 30 cm, third percentile). The anesthetic induction was done carefully, and all drug doses were based on the predicted body weight instead of the actual body weight. This was because the large occipital mass made the measured weight seem higher. For this reason, PBW was thought to be the best way to figure out the patient's pharmacologically active body mass. The best course of action in this situation was lateral intubation using a manual finger-guided technique, which completely avoided sac compression while preserving sufficient airway access (Figure 1). In resource-constrained environments without sophisticated airway devices, the operator's little finger offering tactile feedback for tracheal alignment is an inventive adaptation requiring only common equipment [4]. The operator must maintain intense concentration during laryngoscopy and tube advancement, avoiding excessive or forceful movements, as inadvertent pressure on the occipital area may compress the meningoencephalocele and trigger sac rupture. On the other hand, Case 2's moderate 9 x 12 cm lesion without microcephaly made it possible to safely lie down on a doughnut-shaped cushion support (Figure 2). This method decreased operator anxiety, allowed for standard laryngoscopic technique, and maintained familiar airway anatomy. By distributing head support circumferentially and permitting sac occupancy without direct pressure, the hollow center of the cushion offered mechanical protection. In both situations, effective anesthetic management was largely dependent on thorough preoperative evaluation and optimization. Given the predicted massive blood loss from highly vascularized neural tissue, Case 1's moderate anemia (Hb 10.8 g/dL) created significant perioperative vulnerability. Hemodynamic reserve and oxygen-carrying capacity were enhanced by red blood cell transfusion before surgery. Preoperative correction of initial electrolyte abnormalities (documented hyponatremia and hyperkalemia on prior evaluation) improved hemodynamic stability and decreased the risk of dysrhythmia.

A prolonged coagulation profile (PT 14.0 sec, aPTT 36.3 sec), indicating immature neonatal hemostasis, necessitated preoperative correction with fresh frozen plasma in Case 2. In the early neonatal period, hyperchloremia (108.0 mmol/L) was indicative of relative dehydration. Furthermore, careful perioperative fluid management and hemodynamic monitoring were required to prevent worsening right ventricular strain due to echocardiographic findings of patent ductus arteriosus with secondary tricuspid regurgitation [5].

Preoperative optimization is essential for safe anesthetic management of complex neonatal neurosurgery, as both cases demonstrate.

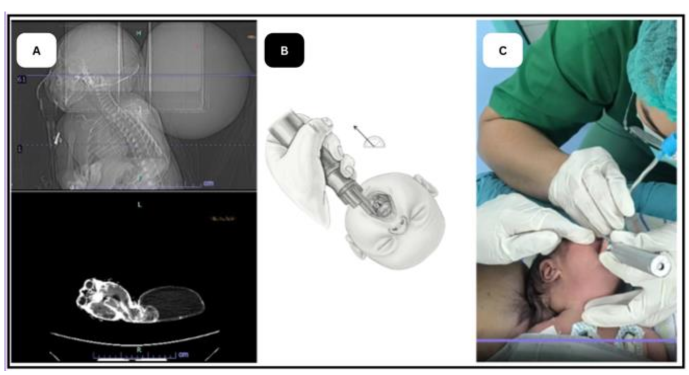

Figure 1- (Case 1) Panel A shows radiologic images of a newborn with a giant occipital meningoencephalocele. These include a lateral radiograph and an axial CT scan that show how big the cranial mass is. Panel B shows how to do direct laryngoscopy and intubation on an infant while they are lying on their side, with a focus on getting the best view. Panel C shows a neonate being intubated in a clinical setting. It shows an anesthesiologist doing an oral laryngoscopy.

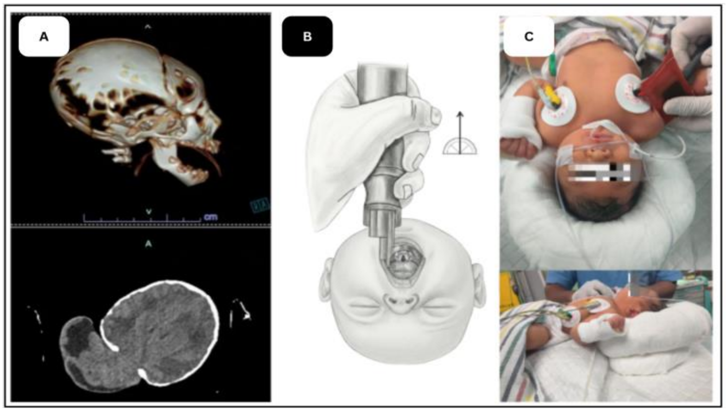

Figure 2- (Case 2) Panel A shows a three-dimensional and axial CT scan of a newborn with occipital meningoencephalocele. It shows the bone defect and the brain tissue that has herniated. Panel B shows how to do direct laryngoscopy on a baby lying on their back. Panel C shows clinical pictures of the patient lying on a doughnut-shaped cushion, which shows how to keep the airway open and protect the lesion during anesthesia.

Table 1- Clinical Characteristics and Considerations for Two Intubation Positioning Techniques.

Aspect	Lateral Position (Case 1)	Supine with Cushion (Case 2)
Sac Protection	Complete avoidance of compression	Protected by a hollow center design
Anatomic Approach	Non-standard lateral access	Standard anterior approach
Operator Familiarity	Requires specialized training	Standard technique for most providers
Laryngoscopy Modification	Required (lateral blade insertion)	None; standard visualization
Special Equipment	None; standard Miller blade only	Doughnut-shaped cushion required
First-Pass Success	Achieved (1/1 attempts)	Achieved (1/1 attempts)
Learning Curve	Higher, unconventional positioning	Lower; familiar anatomy
Applicability for Very Large Lesions	Superior (>15 cm or microcephaly)	Limited anatomically
Resource Requirements	Minimal; ideal for limited settings	Specialized cushion needed
Transition to Prone Position	Requires coordinated movement	Straightforward repositioning

The successful completion of first-pass intubation in both situations is the result of a combination of skillful operator execution, suitable technique selection, and adequate preparation. This is very significant because:

1. In neonates with very few other airway options, multiple intubation attempts raise the risk of airway trauma, mucosal edema, and possible airway loss [6].
2. Not everyone has access to advanced airway devices: in many practice settings, fiberoptic bronchoscopy and videolaryngoscopy may not be available [7].
3. Appropriately modified standard techniques: Conventional Miller blade size 1 was used in both lateral and supine approaches, eliminating the need for specialized tools.
4. Planning and experience are more important than a particular technique: More crucial than positioning technique were proper patient positioning, sufficient preoxygenation, suitable induction dosing, and expert laryngoscopy execution [8].

Instead of being extubated right away, both patients received elective continuous mechanical ventilation in the neonatal intensive care unit. This is the gold standard for major neonatal neurosurgery and offers several advantages, including hemodynamic stability without requiring respiratory effort, neurological monitoring for elevated intracranial pressure or seizure activity, ongoing sedation and analgesia management, and prevention of aspiration during the early postoperative period. Neither patient experienced postoperative issues that needed to be addressed. When these cases are compared, a crucial clinical finding is revealed: The size of the lesion and the anatomy of the skull should influence the choice of technique (Table 1) [9]:

1. Severe microcephaly or very large lesions (>15 cm): When supine positioning becomes anatomically impossible, the lateral intubation technique is recommended.
2. Moderate lesions (8–12 cm) without skull dysplasia: Depending on the operator's experience, the resources at hand, and the institutional capabilities, either approach is feasible.
3. Small lesions (less than 8 cm): Conventional or different positioning options may be possible [10].

For anesthesiologists handling these uncommon but crucial cases, this size-based stratification offers useful clinical advice.

Conclusion

Lateral and supine intubation procedures are both safe and effective for the management of infant occipital meningoencephalocele when applied appropriately. The choice of procedure should be customized according to: 1. Size and extent of the lesion (>15 cm or associated with microcephaly → lateral approach) 2. Intracranial anatomy derived from imaging 3. The training and experience of the operators 4. Available tools and resources 5. Associated irregularities necessitate vigilant oversight. Anesthetic induction must be executed with caution, utilizing predicted body weight for drug dosage calculations instead of actual body weight, as the substantial occipital mass may skew the measured weight; thus, PBW offers a more accurate estimation of pharmacologically active body mass. During laryngoscopy and tracheal intubation, the operator must maintain complete focus and refrain from any actions that apply pressure to the occipital region to prevent compression of the meningoencephalocele and potential sac rupture. Both procedures require extensive preoperative evaluation and optimization, including the management of anemia and coagulopathy. When employed by proficient healthcare practitioners who are well-equipped, these techniques guarantee secure airway control and effective surgical intervention in this complex neonatal demographic.

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