ORIGINAL RESEARCH

Anaesthetic management of omphalocele repair at a tertiary hospital in Ibadan, Nigeria: A review of medical records from January 2008 through December 2017

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Abstract

Background
An omphalocele is a congenital defect of the anterior abdominal wall, characterized by herniation of midline abdominal content through an extraembryonic part of the umbilical cord. Management of this condition is challenging, particularly in resource-limited settings.

Methods
Using a standardized data collection instrument, we retrospectively reviewed the medical records of all patients who underwent surgical omphalocele management over a 10-year period at a tertiary care hospital in Ibadan, Nigeria. The review included documentation of perioperative complications, anaesthetic and surgical techniques, and patient outcomes.

Results
From January 2008 through December 2017, 57 neonates underwent surgical omphalocele repair (59.6% boys; mean age, 2.7 days; mean birth weight, 3.06 kg). In total, 33 neonates (57.9%) had major omphaloceles, and 24 (42.1%) had minor omphaloceles. At the time of surgery, about 77.2% of patients were categorized as class 1 or 2 according to the American Society of Anesthesiologists Physical Status Classification System. In total, 15 patients (26.3%) had comorbidities, including sepsis (n=10, 17.5%), anaemia (n=3, 5.3%), jaundice (n=2, 3.5%), and congenital anomalies (n=6, 10.5%). General anaesthesia with a relaxant technique was administered to all neonates, and primary closure was conducted on 52 patients (91.2%). Intraoperative complications included difficult intubation (n=5, 8.8%), hypothermia (n=7, 12.3%), tachycardia (n=37, 64.9%), and bradycardia (n=3, 5.3%). Postoperatively, 15 neonates (26.3%) required mechanical ventilation and intensive care management, and 14 (24.6%) died.

Conclusions
At this tertiary care centre in Nigeria, an appreciable number of patients with omphaloceles were surgically managed, primarily using primary wound closure. Poor postoperative outcomes, including mechanical ventilation and mortality, were common.

Keywords: omphalocele, anaesthesia, perioperative care, neonatal surgery, Nigeria

Introduction

An omphalocele is a congenital defect of the anterior abdominal wall, characterized by herniation of midline abdominal content through an extraembryonic part of the umbilical cord. This herniation results from a failure of the 4 embryonic folds to meet in the midline and form the umbilical ring.[1] Omphaloceles occur in as many as 1 in 6000 births, either as an isolated finding or in association with other congenital abnormalities, including trisomies 13, 15, 18, and 21, as well as other syndromes like Beckwith–Wiedemann syndrome.[2],[3] Omphaloceles can be minor or major. Traditionally, an omphalocele is classified as minor if it is associated with a defect diameter <5 cm and a sac containing only bowel loops; a major omphalocele is characterized by a diameter ≥5 cm and a sac containing internal organs or an association with other major congenital anomalies.[4],[5] However, omphaloceles have been reclassified to include an intermediate category for patients who have defects ≥5 cm in diameter with no associated major anomalies and for whom bedside reduction can be achieved without cardiorespiratory compromise.

Table 1. Demographic and clinical characteristics of neonates who underwent surgical omphalocele management at the University College Hospital, Ibadan, Nigeria, between January 2008 through December 2017 (N=57)

Characteristic	Quantity
Sex, n (%)	
Boys	34 (39.6)
Girls	23 (40.4)
Age, mean ± SD, years	2.7±3.26
Birth weight, mean ± SD, kg	3.06±0.54
Omphalocele type, n (%)	
Major	33 (57.9)
Minor	24 (42.1)
ASA physical status, n (%)	
Class 1	4 (7.1)
Class 2	40 (70.1)
Class 3	11 (19.3)
Class 4	2 (3.5)

ASA, American Society of Anesthesiologists; SD, standard deviation

Surgical omphalocele management includes primary closure of minor or intermediate defects, or staged silo closure for major defects.[4],[6] The anaesthetic management of surgical interventions for patients with omphaloceles may be complicated by common neonatal conditions, including prematurity, low birthweight, hypothermia, sepsis, dehydration, other congenital anomalies, and small abdominal cavity.[7] Postoperatively, the abdominal cavity may be too small to accommodate the eviscerated organ when it is reintroduced into the abdomen, and this can lead to respiratory failure.

Recent advances in anaesthesia and neonatology have greatly improved the survival of neonates with omphaloceles, but it remains a complex condition that can be challenging to treat. In Nigeria, the omphalocele incidence is not known, and data regarding patient outcomes following surgical intervention are scarce. This study aimed to describe outcomes of surgical and anaesthetic omphalocele management in neonates at a high-volume teaching hospital in Ibadan, Nigeria.

Methods

We conducted a retrospective review of medical records of all patients who underwent surgical omphalocele repair in the main operating theatre at the University College Hospital, Ibadan, Nigeria, over a 10-year period (January 2008 through December 2017). Neonates with gastroschisis were excluded from the review. Information retrieved from medical records included age, sex, birth weight, size of the sac, associated congenital anomalies, ASA (American Society of Anaesthesiologists) physical status, anaesthetic induction technique, use of muscle relaxants, type of surgery, intraoperative events and postoperative complications, length of hospital stay, intensive care unit (ICU) admission status, and final outcome. Ethical approval for the study was obtained from the University of Ibadan and University College Hospital Research Ethics Committee (study number UI/EC/18/0461). Data collection and analysis were conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

Anaesthetic technique

We administered general anaesthesia with endotracheal intubation, muscle relaxation, and intermittent positive pressure ventilation to all preoperative neonates with omphaloceles. Anaesthesia was administered by consultant physicians formally trained in paediatric anaesthesia or senior registrars with at least 4 years of postgraduate training. General anaesthesia was induced with either intravenous ketamine or an inhalational agent; halothane or sevoflurane and tracheal intubation were facilitated by suxamethonium administration. The sizes of endotracheal tubes for intubation were between 2.0 mm and 3.5 mm in internal diameter. All neonates were premedicated with atropine to reduce secretions and increase heart rate. Controlled ventilation was used for all patients, and anaesthesia was maintained with isoflurane, 100% oxygen, and atracurium. Analgesic therapy was with fentanyl and paracetamol. Monitoring was conducted by pulse oximetry, electrocardiography, capnography, measurement of body temperature, assessment of urinary output, and measurement of blood glucose. Postoperatively, after the reversal of neuromuscular blockade, patients with delayed recovery or respiratory distress were transferred to the general ICU, whereas patients with full recovery and no distress were transferred to the recovery room.

Data management and statistical analysis

Data were initially entered into a structured data collection form; these were later transferred into SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, NY, USA). Continuous data were evaluated using means and standard deviations, and categorical variables were evaluated using frequencies and percentages.

Results

From January 2008 through December 2017, 57 neonates underwent surgical omphalocele repair (Table 1). The mean age at presentation was 2.7 days (range, 1-14 days), 59.6% of the patients were boys, and the mean birth weight was 3.06±0.54 kg; 5 patients (8.8%) had birth weights <3.0 kg. Four patients (7.0%) were categorized as ASA class 1, 40 patients (70.2%) as class 2, 11 patients (19.3%) as class 3, and 2 (3.5%) as class 4. More than 90% of the mothers of the affected neonates resided in urban areas; only 2 mothers had received prenatal omphalocele diagnoses via ultrasonography.

At presentation, major and minor omphaloceles were diagnosed in 33 (57.9%) and 24 (42.1%) infants, respectively. Ten neonates (17.5%) had ruptured omphaloceles. The most

Table 2. Preoperative associated comorbidities among neonates who underwent surgical omphalocele management at the University College Hospital, Ibadan, Nigeria, between January 2008 through December 2017 (N=57)

Comorbidity	n (%)
Congenital heart disease	2 (3.5)
Beckwith–Wiedemann syndrome	2 (3.5)
Intestinal atresia	2 (3.5)
Sepsis	10 (17.5)
Anaemia	3 (5.3)
Jaundice	2 (3.5)

common preoperative comorbidities were sepsis (n=10, 17.5%), anaemia (n=3, 5.3%), and jaundice (n=2, 3.5%). Associated congenital anomalies were congenital heart disease (n=2, 3.5%), Beckwith–Wiedemann syndrome (n=2, 3.5%), and intestinal atresia (n=2, 3.5%) (Table 2).

Surgical procedures and outcomes

For administration of anaesthesiology, most neonates (n=40, 70%) underwent rapid sequence induction, while 17 (30%) underwent inhalational induction. Nearly all patients (n=52, 91.2%) underwent primary omphalocele closure with or without closure of the umbilical facial defect. For each of the 5 patients who did not undergo primary closure, a silo was constructed to manage wound closure; each of these 5 patients had presented with a ruptured omphalocele. The mean length of hospital stay was 16.6 days (range, 7-30 days).

Intraoperative complications included tachycardia (n=37, 64.9%), hypothermia (n=7, 12.3%), difficult intubation (n=5, 8.8%), and bradycardia (n=3, 5.3%). Difficult intubation was observed in the 2 patients with Beckwith–Wiedemann syndrome. Postoperative complications included delayed recovery (n=8, 14.0%), respiratory failure (n=7, 12.3%), wound infection (n=6, 10.5%), burst abdomen (n=2, 3.5%), and persistent hypoglycaemia (n=1, 1.8%) (Table 3). In total, 10 neonates (17.5%) were admitted into the general ICU, and 14 (24.6%) died, including the 5 who presented with omphalocele rupture. Sepsis was observed to be the major cause of death.

Table 3. Postoperative complications among neonates who underwent surgical omphalocele management at the University College Hospital, Ibadan, Nigeria, between January 2008 through December 2017 (N=57)

Complication	n (%)
Respiratory distress	6 (12.7)
Wound infection	6 (12.7)
Burst abdomen	2 (3.5)
Persistent hypoglycaemia	1 (2.1)
Death	14 (16.9)

Discussion

We evaluated the records of 57 patients who underwent surgical omphalocele management in urban Nigeria, finding a mortality rate of 24.6%, which was similar to the rates of 22.9% and 32.4% reported for this condition elsewhere in Nigeria,[8],[9] but considerably lower than the rate of 64% reported at the study hospital 4 decades ago.[10] Mortality in the study cohort was higher than that reported for patients undergoing surgical omphalocele repair in high-income countries (range, 5.9%-23%).[11],[12] During the period under study, approximately 6 patients presented to the study hospital annually for omphalocele management, highlighting the low but appreciable frequency of presentation of this condition in tertiary care settings in Nigeria. Our observed omphalocele rate was similar to that reported for the same hospital during the period of 1973 through 1978,[10] and it was lower than the rate reported for Benin, Nigeria, where 96 patients with omphaloceles were encountered over a 10-year period.[8]

In our study, surgical omphalocele treatment with primary closure of the defect was conducted for over 90% of the patients. However, postoperative management of primary closure is often complicated by respiratory distress resulting from increased intra-abdominal pressure, which makes extubation difficult.[13] Indeed, respiratory failure occurring in over 10% of our patients was among the common postoperative complications observed, and this contributed substantially to the mortality in the study cohort. A similarly high rate of respiratory distress associated with primary omphalocele closure has been reported elsewhere in Nigeria.[9] To reduce postoperative respiratory distress, respiratory airway pressure after primary closure should be assessed by measuring intra-abdominal[14] or intravesical[15],[16] pressure, and extubation should be conducted when the pressure is <20 mmH_2O.[17] This is not the practice at our centre because we lack the requisite device for measuring these pressures. However, silastic silos were used for staged omphalocele repair in most severe cases in the study cohort; this may help prevent postoperative respiratory insufficiency.

Our mortality rate following surgical omphalocele repair was higher than those of cohorts from high-income countries, where survival of neonates with omphaloceles has been attributed to the availability of neonatal ICUs (NICUs) and parenteral nutrition.[11],[18] Delayed recovery and respiratory distress after surgery, the most common postoperative complications in our study, are usually managed with mechanical ventilation and postoperative monitoring in a NICU. However, as with other major medical centres in Nigeria, at our centre, neonates are managed postoperatively in the general ICU with equipment intended for managing adult patients.[19] We conjecture that the lack of a well-equipped NICU contributed to the high postoperative mortality in the study cohort.

Administration of anaesthesia by rapid sequence induction, primarily used for patients at high risk of pulmonary aspiration, was provided for 70% of study patients, underscoring the clinical fragility of the patients in this cohort. Difficult intubation, observed in 8.8% of neonates in the study, is a common challenge in neonatal surgery, occurring in 10% of patients with craniofacial anomalies[20] and a higher percentage of patients with associated syndromes like Beckwith–Wiedemann syndrome.[21] The anatomical airway features of neonates, including the long and floppy epiglottis and relatively large tongue (as observed in the 2 neonates with Beckwith–Wiedemann syndrome), add to the incidence of difficult intubation. Expert airway management is essential for the safe and effective administration of general anaesthesia.

The anaesthetized neonate is at risk of hypothermia. The rate of hypothermia in our series was similar to findings from elsewhere.[7],[9] These patients have little insulator subcutaneous fat, along with heat loss from the exposed gut. Efforts were made to maintain normothermia in these babies by covering the sac with warm saline–soaked gauze and transferring them to the operating theatre in an incubator. The problem of hypothermia may be compounded by a cold operating theatre environment and dry anaesthetic gases. We adopted heat conservation strategies, including placing the neonates on warm mattresses, increasing the operating room temperature, warming intravenous fluids, and ensuring that the patients were consistently swaddled.

Sepsis was the most common preoperative complication and the primary cause of death in our study. The sepsis rate among our patients with omphaloceles (17.5%) was lower than the 37.5% reported for a Nigerian tertiary hospital between 2002 and 2009.[9] Sepsis associated with omphaloceles may be due to the handling and care of the intact sac, which can easily be soiled by faeces and urine. The avascular sac is easily infected despite appropriate preoperative antibiotic therapy.[10] Sepsis is believed to contribute significantly to the morbidity and mortality associated with omphaloceles.[8]

The practice of neonatal anaesthesia at our centre has improved over the last decade from postoperative manual ventilation in the first 1 to 2 years of this study to mechanical ventilation, provision of modern equipment, safe drug administration, and structured training of physician paediatric anaesthetists. The latter years witnessed a change from the use of manual ventilation to mechanical ventilation, and this impacted patient surgical outcomes, including those of children and neonates. Thus, there are generally ongoing marginal improvements in morbidity and mortality in neonatal surgery, including in association with omphalocele repair.

Conclusions

Omphalocele repair is a challenge to both the surgeons and the anaesthetists working in resource-limited settings. Omphaloceles are frequently associated with sepsis, hypothermia, fluid and electrolyte imbalances, and hypoglycaemia—conditions that must be corrected before surgery. General anaesthesia is safe and effective, but problems of difficult intubation, drug metabolism, and postoperative respiratory distress should be anticipated. The additions of neonatal mechanical ventilation, neonatal intensive care, and parental nutrition to the present protocol should continue to reduce morbidity and mortality in this high-risk group.

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