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Original Article

Improvised Adaptations in Neonatal Surgery: Experience from a Resource-Constrained Tertiary Hospital in Nigeria

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Abstract

Background: In many low-resource settings, neonatal surgical care is delivered without access to the specialised equipment and consumables considered standard in high-income environments. Clinicians must often adapt available materials to support safe perioperative care. ***Objective:*** To describe selected improvised techniques used in the perioperative care of neonates at a resource-limited tertiary hospital in South-South Nigeria. ***Methods:*** This descriptive report is based on clinical experience from the neonatal surgical unit of a tertiary hospital in South-south, Nigeria, between 2018 and 2024. Commonly used improvisations were selected based on their frequency and relevance to perioperative care. As the report does not involve data collection or experimental interventions, no statistical analysis or outcome measurements were included. ***Results:*** Five areas of adaptation were identified: thermoregulation, abdominal wall coverage, nutritional support, vascular access, and electrosurgical dissection. Techniques included the use of room heaters, sterile urine bags for silo creation, intravenous fluids with amino acid supplementation, umbilical vein catheterisation, and modified needle-tip cautery. While effective in our context, these methods have limitations compared to standard equipment. ***Conclusion:*** In resource-constrained settings, neonatal surgical teams can develop practical, context-appropriate adaptations. Documenting these experiences may support local protocol development and encourage innovation in similar environments.

Keywords: ***Neonatal Surgery; Improvisation, Medical; Resource-Limited Settings; Parenteral Nutrition; Catheterization, Central Venous.***

Introduction

Neonatal surgery represents one of the most complex and time-sensitive areas of paediatric surgical practice. In high-income countries, advances in prenatal diagnosis, neonatal intensive care, anaesthesia, and surgical technology have markedly improved survival and outcomes [1]. However, in low- and middle-income countries (LMICs), particularly in sub-Saharan Africa, these procedures continue to be associated with high morbidity and mortality due to multiple systemic and infrastructural limitations [2,3]. Nigeria, like many resource-constrained settings, faces significant barriers to the delivery of optimal neonatal surgical care, including delayed referrals, absence of neonatal transport services, limited intensive care services, and shortages of specialised personnel and equipment [4,5].

Despite these challenges, surgical teams in such settings continue to provide care to neonates through pragmatic, context-specific adaptations. These often involve improvisations using readily available materials to replicate the function of standard surgical tools or devices. For instance, Foley catheters and nasogastric tubes have been adapted for use as feeding gastrostomy tubes or as improvised peritoneal dialysis catheters in neonates and infants [6-8].

Although most of these innovations are familiar to many practitioners in similar contexts, they remain underrepresented in the published literature. As a result, opportunities for shared learning, refinement of techniques, and external support remain limited. Furthermore, there is a need to advocate for the development and validation of affordable, context-appropriate technologies tailored to low-resource settings.

This paper aims to report some challenges encountered in the surgical care of neonates at a tertiary hospital in Nigeria, and the improvised solutions used to address them. We hope these experiences will contribute to the ongoing conversation around neonatal surgery in resource-limited settings and encourage further context-driven innovation, collaboration, and policy support.

Methods

This descriptive report is based on experiences from the neonatal surgical unit at University of Uyo Teaching Hospital (UUTH), a 500-bed tertiary referral facility located in Uyo, South-South Nigeria. UUTH provides specialist medical and surgical services and serves as a referral centre for paediatric surgical cases from within and outside Akwa Ibom State. The hospital supports a catchment population of over six million people. The improvisations

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documented here were drawn from routine clinical practice between 2018 - 2024. We selected adaptations through internal team consensus, based on their frequency of use and relevance to perioperative management in neonates.

This report does not involve data collection or experimental interventions. We did not perform statistical analysis or present outcome data, as this was not the focus of the article. For the same reason, ethical clearance was not required. We obtained informed caregiver consent for all clinical photographs and ensured that no identifiable patient information was included. The techniques we describe represent locally adapted practices, introduced in the best interest of the patients in a resource-limited setting.

Results and Discussion

The adaptations covered include strategies for thermoregulation, temporary abdominal wall coverage, nutritional support, vascular access, and electrosurgical precision. Though these innovations have proved useful in our context, they are not without limitations. We describe each technique with relation to its practical application, potential risks, and implications for quality of care in a resource-limited setting.

1. Temperature Regulation

Thermoregulation is a critical component of neonatal surgical care. It refers to the body's ability to balance heat production and loss to maintain a core temperature compatible with life. Neonates and young infants are particularly vulnerable to hypothermia due to their immature thermoregulatory systems, large surface area relative to body mass, and limited subcutaneous fat. Unlike older children and adults, neonates cannot generate heat through shivering; their primary mechanisms for thermogenesis are brown fat metabolism and peripheral vasoconstriction. They lose heat rapidly through evaporation, conduction, convection, and radiation, and this risk is further heightened under anaesthesia and during surgical procedures[9,10].

Hypothermia in neonates, defined as a core body temperature below 36°C, is common in neonatal surgical patients, and has been associated with adverse outcomes [10-12]. The risk of intraoperative hypothermia is exacerbated by general anaesthesia and the exposure of the neonate’s thin, moist skin to cool operating room temperatures and dry ventilation gases, as well as the infusion of unheated intravenous fluids. While a modest fall in core temperature is often expected under general anaesthesia, preventing this drop is essential in neonates due to their unique physiological vulnerabilities [10-13].

Standard protocols for thermal protection recommend maintaining core temperature at or above 36.5°C through the use of incubators, radiant warmers, heated transport systems, warmed IV fluids and blood products, humidified airways, circulating water mattresses, and forced warm air blankets [10,11]. Unfortunately, many of these devices are either unavailable or unreliable in our setting. Incubators and radiant warmers, where present, are often insufficient in number or are non-functional due to lack of maintenance or spare parts.

In our practice, perioperative thermal care often relies on improvised methods such as warmed intravenous fluid bottles, hot water bottles wrapped in cloth, and room heaters (**Figure 1**). Low-cost strategies like kangaroo care and warm water bottles have been recognised as lifesaving in low-income settings [10,14]. However, these methods must be used with caution in surgical neonates. Continuous skin-to-skin care is not feasible for unstable infants who require resuscitation or mechanical ventilation, and hot water bottles, though helpful, have been associated with burn injuries in neonates due to difficulties in regulating their temperature [15,16]. In addition, while we place the room heater at a safe distance and monitor it closely, it lacks the thermostatic feedback and focused control of standard radiant warmers, creating a risk of uneven heat distribution. Despite this limitation, it has enabled us to maintain operative warmth in the absence of specialised equipment, with careful team oversight during use.

Figure 1: Improvised thermal care during neonatal surgery using a portable room heater. The heater is positioned approximately one metre from the infant to provide warmth in the absence of a standard radiant warmer.

2. Temporary Abdominal Coverage

Gastroschisis and ruptured omphaloceles are congenital anomalies in which abdominal organs, primarily small and large bowel, protrude through a defect near or at the umbilicus, resulting in the neonate being born with exposed intestines [17]. The goal of management is to promptly and safely reduce the bowel into the abdominal cavity and close the abdominal wall defect. Delay in covering the exposed bowel can lead to significant fluid loss, bowel oedema, desiccation, increased risk of hypothermia, sepsis, trauma, and mesenteric constriction or torsion at the site of the defect. These complications may further result in bowel hypoperfusion, ischemia, and injury [18].

One of the principal challenges in achieving early closure, particularly in gastroschisis, is the disproportion between the relatively small abdominal cavity and the large and often oedematous herniated bowel. In high-income countries (HICs), a widely adopted approach involves the use of a preformed silo (PFS), which is a sterile spring-loaded device that encloses the bowel, allowing for gradual reduction over several days [19]. Once the contents have returned to the abdomen, surgical closure of the defect is performed. With access to surgical expertise and total parenteral nutrition (TPN), survival rates for gastroschisis in HICs now exceed 96%. In contrast, in many tertiary centres across sub-Saharan Africa, survival remains below 25% [20].

The PFS devices and customised synthetic silos are often unavailable in low-resource environments. Consequently, various authors have reported practical alternatives using sterile, low-cost materials readily accessible in the operating room. These include urine collection bags, intravenous fluid bags, and female condoms[17,18,21,22].

At our institution, we have successfully adapted urine drainage bags as improvised silo materials. These are secured to the abdominal wall using an oil filter O-ring, which has been sterilised in Cidex™ OPA solution, and suture sewn into the opening of the bag (Figure 2). The ring is carefully advanced through the abdominal wall defect to rest just beneath the fascia inside of the anterior abdominal wall, thereby eliminating the need for fascial sutures. One advantage of this technique is that it can be performed at the bedside under mild sedation, avoiding the risks of emergency surgery under suboptimal conditions.

While we have not encountered complications with the use of the urine bag, we recognise some theoretical limitations. Unlike commercial preformed silos, the urine bag tends to expand into a broader, mushroom-like shape, which may reduce control during gravity-assisted reduction [17]. Nevertheless, in our experience, the improvised silo has remained safe, stable, and effective when applied with care and closely monitored.

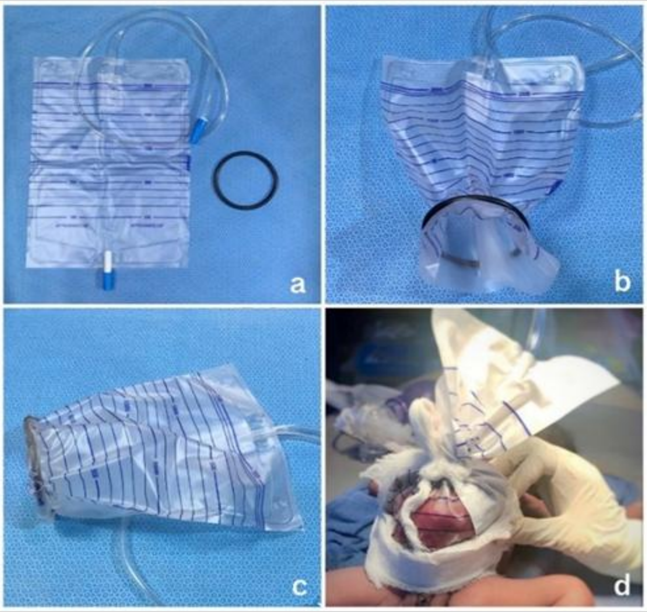

Figure 2: Stepwise creation and application of an improvised silo for gastroschisis using a sterile urine collection bag and an oil filter O-ring. (a) Materials used include a sterile urine bag and a 6-7cm diameter O-ring. (b) The urine bag is cut at the base, and the O-ring is sewn into the base of the bag to anchor the silo within the abdominal wall. (c) Completed silo. (d) Application of the improvised silo in a neonate with gastroschisis. Gauze is tied to the summit for serial reduction of the intestine.

3. Parenteral Nutrition

Newborn infants, especially those who require surgery, are in a critical phase of organ maturation and neurodevelopment. Their unique physiology, characterised by limited nutrient reserves, increased energy demands, and sensitivity to stress, places them at risk of postoperative morbidity and mortality if nutrition is not adequately addressed [23]. In recent decades, advances in neonatal intensive care and paediatric surgery have markedly improved survival rates for neonates with congenital or acquired gastrointestinal anomalies, with outcomes exceeding 90% in many high-income settings [24]. A major contributor to this progress has been the development of early nutritional support, particularly parenteral nutrition (PN), which allows for the intravenous delivery of essential macronutrients and micronutrients during periods when enteral feeding is not feasible [25]. PN supports tissue repair, immune function, and metabolic stability while the gastrointestinal tract recovers. Moreover, growing evidence highlights the importance of adequate nutritional support not only in reducing immediate morbidity and mortality, but also in promoting optimal long-term growth, neurodevelopment, and overall quality of life after surgery[26].

In our setting, access to comprehensive PN remains limited. Commercial formulations are often prohibitively expensive and are not routinely stocked in most public hospitals [27]. In-house compounding of PN using locally sourced components would require specialised equipment, trained pharmacy personnel, and close monitoring for safety and sterility [28,29]. These resources are not yet available in our institution. Nevertheless, we have adopted practical strategies to support neonatal nutrition in the perioperative period. Where PN is unavailable, we initiate intravenous dextrose-containing maintenance fluids and supplement them with amino acid solutions and B-complex injections. We estimate caloric needs at approximately 100 kcal/kg/day and aim for a non-protein calorie to nitrogen ratio of 150:1, as recommended, to minimise catabolism and support tissue repair [30,31]. While this approach may not fully meet the metabolic needs of all patients, it provides essential interim support and allows us to transition to cautious enteral feeding as early as the clinical condition permits. This has improved the survival of many surgical neonates despite the resource constraints.

4. Central Venous Catheterisation

Central venous catheter placement is an essential component of neonatal intensive care, particularly in clinical situations where peripheral access is difficult or inadequate [32]. It is especially useful in surgical neonates who require frequent blood sampling, administration of intravenous fluids, medications, or parenteral nutrition [33].

Umbilical vein catheterisation offers a unique and practical route for central access in neonates. In our setting, it is often the preferred option because it can be performed quickly after birth, does not require ultrasound guidance, and avoids the risks associated with percutaneous central line insertion in unstable neonates. In high-income countries, polyethylene and polyvinyl umbilical vein catheters (UVCs) specifically designed for this purpose are readily available and considered safe [34]. However, these devices are often unavailable or unaffordable in resource-limited settings such as ours.

To address this gap, small caliber feeding tubes (typically size 5Fr) are frequently used as improvised UVCs. Under strict aseptic conditions, the feeding tube is flushed with sterile saline and gently inserted into the umbilical vein to a depth of 5-10 cm in term neonates. This is deep enough to provide access while avoiding inadvertent entry into the portal vein [32,35]. The tube is then secured with a suture placed through the umbilical stump and reinforced with adhesive tape.

Although improvised feeding tubes lack the soft, atraumatic, radio-opaque tips and length markers of standard UVCs, they offer a practical and effective alternative in settings where commercial devices are inaccessible [32,35].

5. Electrosurgical Precision

Electrosurgical precision is essential during neonatal surgical procedures, particularly when working with fragile tissues that require controlled dissection. A sharp-tip cautery enables more concentrated energy delivery at the point of contact, allowing higher power density at lower voltage settings, often reducing the conventional 40-watt requirement to less than 10 watts [36]. This focused energy transfer permits fine dissection, minimises tissue necrosis, and may contribute to improved wound healing in the immediate postoperative period.

Needle-tip monopolar cautery pens, which offer such precision, are standard in high-resource surgical settings. However, these devices are costly and not routinely available in low-resource environments, necessitating practical adaptations [36,37]. To meet this need, we have developed a locally improvised solution using a 21-

gauge injection needle, a standard monopolar cautery handpiece with a blade electrode, and sterile silk suture. The device is prepared under sterile conditions in the operating room. First, the shaft of the 21 G needle is carefully detached from its plastic hub by rocking it back and forth with artery forceps. The needle is then tightly secured to the blade electrode using multiple turns of silk suture to ensure firm contact between the two conductive surfaces (**Figure 3**).

This improvised fine-tip cautery is used for neonatal soft tissue dissection with satisfactory results. In addition, we have occasionally used it at very low current settings to serve as a crude muscle stimulator during anoplasty. When gently applied to the anal dimple, visible muscle contractions help identify the sphincter complex, improving the accuracy of neo-anus positioning.

While we have used this technique as a valuable substitute, we acknowledge its potential limitations, including the risk of instability or dislodgement, and variability in heat transfer if not properly secured.

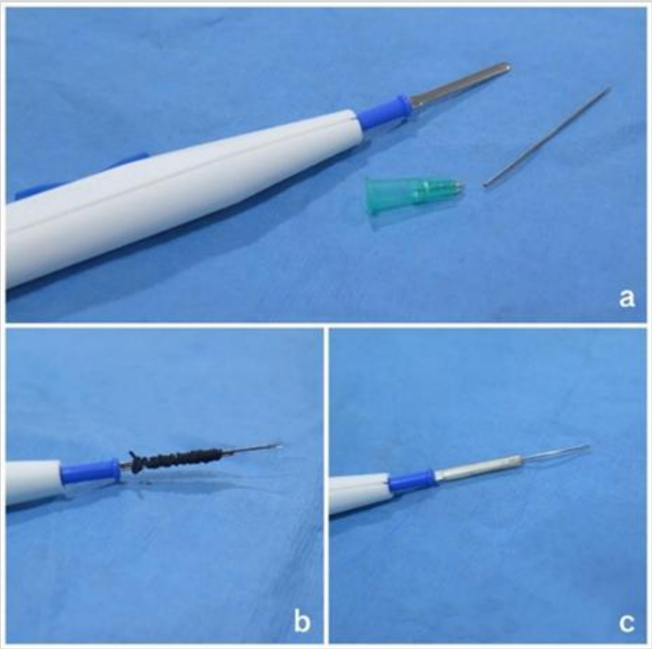

Figure 3: Improvised creation of a needle-tip cautery pencil: (a) Materials used include a standard monopolar cautery pencil with a blade electrode, a 21-gauge needle, and a silk suture or size 8 feeding tube. (b) The shaft of the needle is detached from its hub and firmly tied to the cautery blade using silk suture. (c) Alternatively, the needle is secured to the blade electrode using a small segment of a size 8Fr feeding tube instead of suture.

Conclusion

In low-resource settings such as ours, providing neonatal surgical care presents daily challenges. The absence of specialised equipment and standard technologies often forces clinicians to work under less-than-ideal conditions. Yet, paediatric surgical teams continue to respond with creativity, developing practical, context-driven adaptations, while upholding the principles of safe neonatal surgery.

These adaptations are, however, not without limitations, and their use reflects the need for investments in neonatal surgical infrastructure and supply chains. As we share our experiences, we hope to encourage discussion and support the development of context-specific guidelines that acknowledge the constraints of delivering neonatal surgical care in low-resource settings.

Declarations

Ethical Considerations

Ethical clearance was not required for this report as we did not use patient data. Informed consent was obtained to publish all patient-related photographs used.

Conflicts of Interest

None declared

Funding Statement

None

Author Contributions

Conceptualisation: EA
Methodology: EA, IA, MI, AE, EE
Data Curation and Documentation of Practices: EA, IA, AE, EE
Writing - Original Draft Preparation: EA
Writing - Review & Editing: MI, IA, AE, EE
Supervision: EA, MI
Project Administration: EA, IA

All authors reviewed and approved the final version of the manuscript.

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