



## ORIGINAL ARTICLE

# Neonatal surgery in a developing country: Outcome of co-ordinated interdisciplinary collaboration

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**Aim:** Neonatal surgery in low-income and middle-income countries has a poorer outcome when compared with high-income countries. This study evaluated the management challenges and outcomes of neonatal surgery before and after the introduction of focused interdisciplinary team management in 2013.

**Methods:** We retrospectively analysed neonatal surgery undertaken at two referral hospitals in Enugu, south-eastern Nigeria from January 2011 to November 2015. Cases managed prior to July 2013 (group A) were compared with those managed from July 2013 (group B).

**Results:** There were 91 cases (group A, 47; group B, 44). The common neonatal conditions were oesophageal atresia (21), anorectal malformation (18) and intestinal atresia (18). The surgical conditions, birthweight, age at presentation and associated anomalies did not differ in the two groups. The treatment was also similar except in oesophageal atresia, where cardiac banding was added to the temporary gastrostomy in late presenting cases with undernutrition in group B. Postoperative complications occurred in 43 (47.3%) cases (group A, 55.3%; group B, 38.6%;  $P > 0.05$ ), and the overall mortality was 33 (35.3%: group A, 48.9%; group B, 22.7%:  $P < 0.05$ ). Causes of mortality were unremitting sepsis (group A, 11; group B, 5), anaesthesia complications (group A, 5; group B, 0) and respiratory complication (group A, 7; group B, 5). Delayed presentation, inadequate facilities and defective health insurance scheme were challenges in the two groups.

**Conclusion:** Despite the persisting challenges, co-ordinated team management may result in the modest improvement of outcomes of neonatal surgery in our setting. Addressing these challenges may further improve outcomes.

**Key words:** challenges; delayed diagnosis; developing country; global surgery; international collaboration; team management.

## What is already known on this topic

- 1 Neonatal surgery has witnessed significant advancements in the past decades.
- 2 Early diagnosis and improved perioperative care results in improved outcome.
- 3 Neonatal surgery in low-income and middle-income countries has a poorer outcome when compared with high-income countries.

## What this paper adds

- 1 In our setting, a significant number of our neonatal surgical cases present late for definitive treatment.
- 2 There are persisting barriers to the care of surgical neonates.
- 3 International clinical exposures and local interdisciplinary team management may improve care and outcome of neonatal surgery in a developing country.

Despite the refinements in the diagnosis and perioperative care in neonatal surgery in the past decades, there is still significant disparity in the outcome of neonatal surgery between high-income countries (HICs) and low- and middle-income countries (LMICs). Published literature indicates that the disparity stems from challenges like late diagnosis, inadequate neonatal intensive care facilities and dearth of trained surgeons and support personnel among other factors that are common in LMICs.<sup>1–4</sup> These

challenges result in an unacceptably high rate of morbidity and mortality following neonatal surgery in this setting. Previous studies have espoused some interventions that may address these challenges. The advocated initiatives range from improvements in antenatal and perinatal diagnosis, enhanced primary care and transportation, specialised anaesthetic and perioperative care to reductions in post-surgical sepsis.<sup>1–9</sup> However, substantial reductions in mortality may not be consequential on these interventions alone.<sup>2,10,11</sup> Interdisciplinary team management and international collaboration are potential mediations that have received scant mention in literature.

In 2013, we introduced co-ordinated interdisciplinary team management for neonatal surgical disorders following short-term training programmes of some staff of our hospital on neonatal surgery in some centres in Europe and the USA. This study evaluated the management challenges and short-term outcome of

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neonatal surgery before and after the introduction of team management in the two hospitals covered by the trained staff.

## Methods

We retrospectively analysed neonatal surgical cases managed from January 2011 to November 2015 at the University of Nigeria Teaching Hospital and Mother of Christ Specialist Hospital, Enugu, to evaluate outcomes before and after focused interdisciplinary team management in 2013. In 2011 and 2012, a paediatric surgeon, an anaesthesiologist, a perioperative nurse and a ward nurse undertook a 3-month clinical observer training course in neonatal surgery at Nationwide Children’s Hospital Columbus Ohio, St. Georges Hospital London and Texas Children’s Hospital. The exposure covered neonatal surgery, neonatal anaesthesia and neonatal nursing care. Prior to the introduction of interdisciplinary team management in 2013, the surgeons and any anaesthesiologists, nursing staff and other specialties on duty routinely undertook the procedures. Regarding the team management, there are preoperative and postoperative discussions on the best possible options in terms of operative procedure, anaesthesia and postoperative care. In some cases, a delay of 12–18 h may be unavoidable in order to give optimal care. In both the hospitals, most of the surgical neonates were outborn, and there are no facilities for total parenteral nutrition, no paediatric ventilator and no nurses specially trained in neonatal surgical intensive care. Through the advocacy of the team, a 4-cot neonatal care unit equipped with monitors, incubators and radiant warmer was established in the last 6 months.

For this study, we excluded neurosurgical cases. The data collected from the case notes, theatre records and discharge summaries were: age at onset, presentation and operation; gestational age at birth; birthweight and weight on presentation; gender; presentation; documented reason for delayed presentation (i.e. presentation after 24 h of onset of symptoms); and findings on evaluation. The other data gathered were diagnosis, preoperative management, anaesthesia, findings at operation and operative procedure, outcome, follow-up and documented challenges in management of the cases. The records were hard copies as our patients’ records are yet to be computerised. We compared these parameters from cases managed prior to July 2013 (group A) with those managed from July 2013 (group B).

**Table 1** Patient characteristics of the 91 neonates

Parameter	Overall	Group A	Group B
Total cases	91	47	44
Median birthweight (kg)	2.9	2.8	3.0
Preterm, <i>n</i> (%)	12	9 (19.2)	3 (6.8)
Neonates with associated anomalies, <i>n</i> (%)	17	8 (17)	9 (20)
Median age at presentation (days)	4	4	4.5
Delayed presentation, <i>n</i> (%)†	59	30 (63.8)	29 (65.9)

†Cases presenting more than 24 h after onset of symptoms.

## Data analysis

Statistical Package for Social Sciences (SPSS 21.0 version; SPSS Inc., Chicago, IL, USA) was used for data entry and analysis. Results were expressed as percentages or mean. Data were analysed by the chi-square test with the significance level set at *P* < 0.05.

## Results

A total of 102 cases were managed during the study period, but adequate data for analysis were available for 91 patients (two cases were taken away by parents before treatment, and nine cases had incomplete data). The 91 neonates (group A 47; group B 44) had a median age at presentation of 4 days (group A, 4.0 days; group B, 4.5 days) with an interquartile range (IQR) of 2–10 days. Overall, there were 60 (65.9%) males and 31 (34.1%) females. Table 1 summarises the patients’ characteristics.

Associated anomalies were noted in group A (cardiac (3), hypospadias (2), spina bifida (2) and ectopic anus (1)) and in group B (cardiac 4, Down’s syndrome 2, spina bifida 2 and dextrocardia 1).

## Diagnosis

The neonatal pathologies managed were oesophageal atresia (*n* = 21; 23.1%), anorectal malformation (*n* = 18; 19.9%), intestinal atresia (*n* = 18; 19.9%), obstructed inguinal hernia (*n* = 9; 9.9%), anterior abdominal wall defect (*n* = 8; 8.8%), malrotation with midgut volvulus (*n* = 5; 5.5%), sacrococcygeal teratoma (*n* = 4; 4.4%), three cases each of bladder exstrophy and cervical teratoma and two cases of necrotising enterocolitis. Table 2 shows the distribution of the pathologies in the two groups.

## Management

In cases with oesophageal atresia, 4 had primary repair (2 in each group), 7 cases had delayed primary repair after treatment of pneumonitis (group A 4 cases; group B 3 cases), and 10 patients had delayed primary repair after treatment of pneumonitis and temporary gastrostomy (group A, Stamm gastrostomy in 5; group B, gastrostomy and cardia banding in 5). There was more weight gain following gastrostomy in group B cases (overall mean 0.5 kg, range 0.3–0.9 kg; group A 0.3 kg; group B 0.7 kg). Of the 18 neonates with anorectal malformations, 16 had defunctioning colostomy, and 2 had perineal anoplasty. All the cases of intestinal atresia had primary repair. In the neonates with obstructed hernia, two in group B had strangulation required segmental ileal resection, and the remaining seven had groin exploration and repair of the hernia. Of the abdominal wall defects, six patients (four in group A; two in group B) had primary closure, and one case each had delayed primary closure (group A) and mesh repair (group B). The patients with malrotation, cervical teratoma, sacrococcygeal teratoma and bladder exstrophy had Ladd’s operation, excision and primary repair, respectively. The two cases with necrotising enterocolitis were managed by ileostomy (group A) and peritoneal drainage (group B), respectively.

## Outcome

Overall, a total of 43 (47.3%) neonates developed surgery-related postoperative complications. The complications included surgical wound infection (13), anastomotic leakage (8), wound dehiscence (7), peristomal excoriation (7), prolonged ileus (6) and postoperative bowel adhesion (2). The complication rate in group A was 55.3% (26/47) compared to 38.6% (17/44) in group B ( $P > 0.05$ ).

The overall mortality was 33 (36.3%: group A, 48.9%; group B, 22.7%:  $P = 0.017$ ). Causes of mortality were unremitting sepsis in 16 cases, respiratory complication in 12 cases and anaesthesia complications in 5 cases. Table 3 summarises the outcome in the two groups. The cases with mortality are summarised in Table 4.

## Discussion

In the present report, the number of neonatal surgical cases and their distribution might not be a true reflection of the actual incidence in our setting. As some previous studies<sup>5,8,11–16</sup> have indicated, some of these cases do not come to the attention of the mainstream care facility as a result of sociocultural factors, ignorance and poverty.

In our setting, where there is delayed presentation of most cases and lack of parenteral nutrition, the treatment of some of the pathologies differed from the established procedures. This was more pronounced in cases of oesophageal atresia where

gastrostomy was performed for 47% of the cases, and cardia banding was added following introduction of team management. In this disorder, temporary gastrostomy may be applied in rare cases with severe pneumonia and other major congenital anomalies and some cases of pure atresia with long-gap defect.<sup>17</sup> In this study, gastrostomy was performed for tracheoesophageal fistula (TEF) that presented late with severe malnutrition and pneumonitis. The major drawback of the procedure is regurgitation of feeds into the airway. Introduction of temporary cardia banding, as our study shows, might address this and improve nutrition prior to definitive repair. Temporary gastric banding has also been previously used in cases of premature babies with TEF and severe respiratory distress.<sup>18,19</sup> Intestinal atresia and abdominal wall defects also witnessed some changes in management. In intestinal atresia, we used smaller, delayed, absorbable sutures like sizes 5/0 and 6/0 instead of 3/0 for tapering enteroplasty and single layer interrupted anastomosis. For abdominal wall defects, we introduced the use of mesh and skin flap cover to reduce abdominal tension. In the other cases, the procedures did not differ substantially before and after the introduction of team management. What differed was the anaesthesia and postoperative nursing care. In the team management, the trained personnel managed the cases. Anaesthetic management of neonatal patients has been shown to significantly affect outcome. While reports from HICs<sup>1,3</sup> indicate that these challenges have been systematically addressed, some reports from some developing countries<sup>5,7,11</sup> highlight the persistence of inadequate trained personnel and lack of facilities. Lessons from HICs point to

**Table 2** Distribution of the various neonatal pathologies in the two groups

Diagnosis	Group A	Group B	Total
	<i>n</i> (median age at presentation, days)	<i>n</i> (median age at presentation, days)	
Oesophageal atresia	11 (7)	10 (7)	21
Proximal atresia with TEF	9	10	0
Pure atresia	2	0	0
Anorectal malformation (ARM)	8 (2)	10 (2)	18
High ARM	5	7	0
Cloacal malformation	1	3	0
Low ARM	2	0	0
Intestinal atresia	10 (4.5)	8 (7.5)	18
Duodenal atresia	2	2	0
Type 1 JIA	2	4	0
Type 2 JIA	1	1	0
Type 3 JIA	2	0	0
Type 4 JIA	3	1	0
Obstructed inguinal hernia†	4 (21)	5 (20)	9
Anterior abdominal wall defect	5 (1)	3 (3)	8
Gastroschisis	4	0	0
Ruptured omphalocele	1	3	0
Malrotation with volvulus‡	3 (6)	2 (8)	5
Saccrococcygeal teratoma	1 (5)	3 (6)	4
Bladder exstrophy	2 (3)	1 (3)	3
Cervical teratoma	1 (1)	2 (1)	3
NEC	1 (8)	1 (8)	2

†Mean duration from onset to presentation was 2.0 days for group A and 2.5 days for group B. ‡The mean duration from onset of bilious vomiting to presentation was 3.0 days in each group. JIA, jejunoileal atresia; NEC, necrotising enterocolitis; TEF, tracheoesophageal fistula.

**Table 3** The distribution of the postoperative complications and the causes of mortality in the two groups

Outcome	<i>n</i>	Group A	Group B
Postoperative complications			
Surgical wound infection	13	8	5
Anastomotic leakage	8	5	3
Wound dehiscence	7	4	3
Peristomal excoriation	7	4	3
Prolonged ileus	6	3	3
Postoperative bowel adhesion	2	2	0
Causes of mortality			
Unremitting sepsis	16	11	5
Respiratory complications	12	7	5
Anaesthesia complications	5	5	0

**Table 4** The distribution of the cases with mortality in the two groups

Diagnosis	<i>n</i>		Mortality (%)	
	Group A	Group B	Group A	Group B
Oesophageal atresia	11	10	10 (90.1)	4 (40)
Anorectal malformation	8	10	2 (25)	1 (10)
Intestinal atresia	10	8	6 (60)	2 (25)
Abdominal wall defect	5	3	3 (60)	2 (66.7)
NEC	1	1	1 (100)	1 (100)
Cervical teratoma	1	2	1 (100)	0

NEC, necrotising enterocolitis.

advantages of training in neonatal anaesthesia to sufficiently understand the peculiarities of these cases and adequately manage them. The marked reduction of mortality related to anaesthesia following improved anaesthetic management in the present report may attest to that.

The overall outcome of treatment of these patients was poor compared to the outcome in HICs.<sup>20–22</sup> The poorer outcome in our setting as well as some other developing countries<sup>23–25</sup> might be related to continuing barriers to care imposed by delayed presentation, inadequate facilities and general lack of funding at both personal and public levels. A closer look at our findings will show that mortality in this series was contributed mostly by conditions such as oesophageal atresia, intestinal atresia and abdominal wall defects where intensive care is critical to good outcome. This highlights the need for provision of facility and training in intensive care. Despite the non-availability of adequate intensive care, there was better outcome in cases managed with the multidisciplinary team, indicating contributions of modification of procedure, improved anaesthesia and nursing care. Firstly, the introduction of gastric banding in TEF might have contributed to the significantly improved outcome in this disorder. Secondly, better overall outcome with team management was noticed mostly in cases where anaesthesia and postoperative care are

paramount to good outcome and may indicate that good operative skill and procedure alone might not be enough to ensure good outcome. These advantages may have accrued from the international clinical exposure, which indicate that well-thought-out international collaboration may offer opportunity for training in areas of skills, improved care and organisation. The training and exposure, however, need to be focused and directed to address the local needs of the trainee institutions with a provision for regular update and occasional invitation of foreign trainers to visit and train more local specialists in anaesthesia, perioperative nursing care, neonatal intensive care and some operative procedures.

Other cause of mortality such as sepsis may require resolute efforts in the areas of training the staff on infection control, establishing protocol for routine cleaning of cots and incubators and minimising thoroughfare in newborn wards.<sup>26,27</sup>

### Limitations of the study

This study was limited by small number of cases and the retrospective nature. The small number of cases was due to the tertiary hospital-based records and might not reflect the actual incidence of these disorders in our setting. The retrospective nature did not allow for adequate evaluations of the contributions of the team effort in the outcome.

### Conclusion

Despite the persisting challenges, the introduction of multidisciplinary team management of neonatal surgical conditions in our setting offered modest improvement of outcome. Addressing the challenges of management and the persisting causes of mortality and refining the team management may further improve outcome.

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Dougal by Riley Campton (age 12) from Operation Art 2016