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Article *in* Pediatric Surgery International · February 2023

DOI: 10.1007/s00383-023-05386-1

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Pediatric Surgery International (2023) 39:130
https://doi.org/10.1007/s00383-023-05386-1

ORIGINAL ARTICLE

Assessment of the neonatal referral and transport system for patients with gastroschisis in Kenya

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Accepted: 22 January 2023

Abstract

Purpose To assess the neonatal referral and transport system for gastroschisis patients referred to a tertiary level hospital in Kenya.

Methods This was a prospective cross-sectional study carried out at Kenyatta National Hospital (KNH) which recruited patients with gastroschisis using consecutive sampling approach. Data were collected on pre-, intra-transit factors, time and distance covered. Assessment was done using pre and intra transit factors as per the standard transport protocols in literature.

Results Twenty-nine patients presented with gastroschisis during the eight month study period. Mean age was 7.07 h. There were 16 (55.2%) males and 13 (44.8%) females. Mean birthweight was 2020 g, and a mean gestational age of 36.5 weeks. Mean duration of transit was 5 h. Mean distance from referring facility was 153.1 km.

Most affected factors in the pre-transit protocol were lack of monitoring chart (0%), comment on blood investigations (0%), gastric decompression (3.4%), and prenatal obstetric scan (44.8%).

For intra-transit scores, most affected were incubator use (0%), bowel monitoring (0%), functioning nasogastric tube (13.8%), and adequate bowel cover (34.5%).

Conclusion This study demonstrates that pre-transit and transit care of neonates with gastroschisis is inadequate in Kenya. Interventions needed, as identified by this study, to promote care of neonates with gastroschisis are advised.

Keywords Paediatric surgery · Neonatal · Referral system · Transport system · Gastroschisis · Kenya

Abbreviations

BP	Blood pressure
CRT	Capillary refill time
HR	Heart rate
KNH	Kenyatta national hospital
PSU	Paediatric surgical unit
NGT	Nasogastric tube
RBS	Random blood sugar
RR	Respiratory rate

Introduction

Gastroschisis is a congenital abdominal wall defect through which intraabdominal organs herniate and it requires surgical intervention soon after birth [1]. In the past 30 years, there has been a steady rise in incidence of gastroschisis to a recent estimate of 1 in 2000–4000 live births [2–4]. With an estimated 32 million births per year in sub-Saharan Africa (SSA), an expected 16,000 neonates with gastroschisis are born in the region yearly [5]. A report from South Africa put gastroschisis at 15% of neonatal surgery admissions and another single centre report from Ethiopia calculates that abdominal wall defects made up 1.3% of all paediatric surgery conditions [6]. At KNH we see, on average, 30–40 cases per year. Management has remained a challenge in the low and middle-income countries (LMICS), with reported

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Published online: 16 February 2023

mortality rates ranging between 33 and 100%, whereas survival rates in high-income countries are above 95% [7].

In gastroschisis, the eviscerated intestine is a source of major fluid and heat loss and infection. These newborns can safely be transferred between health facilities, over long distances, provided some essential criteria are met. In spite of the availability of access to the neonatal surgical units, a poor survival outcome of these transferred newborn infants remains; firstly, because of possible complications that may develop during transportation, and secondly because of lack of knowledge of protocols for safe transfer. Although it has been shown that certain clinical features are associated with adverse events after transport, not much is known about factors that cause clinical deterioration during transport [8]. Transport protocols for neonates with gastroschisis exist and their implementation is key to survival. Understanding the level of implementation of these protocols during neonatal transport would help mitigate on the risk of clinical deterioration. In addition, understanding the effect of transport time intervals on outcomes during transport provides information on the quality of the neonatal transport process and may lead to better opportunity for improvement [9]. Therefore, the goal of this study was to identify the level of implementation with various management protocols involved in transit of patients including transport characteristics and duration of transport as these factors are known to be associated with increased risk of deterioration during transport.

Methodology

Patient recruitment

This was a cross-sectional descriptive study where implementation of pre-transit and intra-transit protocols were assessed including the individual components at the time of encounter with the patient.

The study was carried out at the Kenyatta National Hospital's Paediatric Surgical Unit, Paediatric Emergency Unit and Neonatal Intensive Care Unit (ICU). KNH is a national referral hospital and receives all referrals across the country with such conditions due to availability of expertise as well as resources such as Neonatal ICU to manage such cases.

Patients who were included were all neonates, born outside of Kenyatta National Hospital with gastroschisis who presented to Kenyatta National Hospital and whose parent/guardian and the accompanying officer-in-charge of transporting the neonate were willing to give consent for participation in the study.

Those excluded were any patient with primary intervention performed in other facilities prior to admission at KNH and any patient who was not a referral from a health facility.

Data collection

The protocols available include a national pretransit/postnatal management guidelines for transport of gastroschisis patients in Ireland, another one from Seattle Children's Hospital and also from Children's Hospital of Orange County in the USA [10]. For the relevance of this study the Irish guidelines were used. Some of their recommendations for pretransit protocol were:

1. Implementation of prenatal obstetric scan,
2. Pre-referral communication,
3. Intravenous access,
4. Administration of intravenous fluids,
5. Administration of prophylactic antibiotics,
6. Gastric decompression,
7. Adequate cover of bowel,
8. A written referral note,
9. Monitoring chart, and
10. Comment on blood investigations.

The requirements for adequate intra-transit transport include

1. Incubator,
2. Pulse oximetry,
3. Oxygen supply,
4. Temperature monitoring,
5. Blood pressure monitoring,
6. Accompaniment by skilled medical professional,
7. Adequate knowledge on neonatal resuscitation,
8. Patent peripheral access,
9. Functioning NGT,
10. Adequate baby cover,
11. Adequate bowel cover,
12. 15 min of bowel monitoring, and
13. Parental content.

For assessment of implementation of transport protocol for neonates with Gastroschisis, the standard transport protocol above was used to assess individual component implementation and overall implementation with neonatal pre and intra—transit protocol [10]. A score of 0 was applied if no treatment measure was applied whereas a score of 1 was assigned where a treatment measure was applied. This helped to derive total implementation score for each neonate.

Convenience sampling method was used in this study, where consenting parents/guardians of the patients and the accompanying healthcare worker were recruited into the study as they were received in the KNH until the desired sample size was achieved. The sample size was calculated

using the Cochran's formula (1963) and further adjusted for finite population correction. A structured data collection sheet was used to collect information of interest to the study.

For this study, the dependent variable was the implementation level of components required during pre- and intra-transit protocol as mentioned above and the independent variable was the distance of facility from KNH and time on transit

Data analysis

Stata 16 was used for data analysis. Descriptive statistics were used to describe characteristics of study participants such as mean birth weight, mean time of transit, and mean distance from referring facility.

Proportions and percentages were used to describe the various component indicators of adequacy of implementation. Spearman rank correlation was used to assess correlation between two continuous variables e.g. distance from KNH and transit time.

Ethical considerations

Permission and approval to conduct the study was sought from Kenyatta National Hospital-University of Nairobi Research and Ethics Committee with an approval number. The researchers did not use incentives or coercion to recruit participants. Participation into this study was purely voluntary by the consenting participants. Written informed consent was obtained from the parents/legal guardians and the accompanying medical personnel regarding participation in the study and publication of data.

Results

Demographic and clinical characteristics

The total number of patients with gastroschisis recruited were 29 over the 8-month period (October 2021–May 2022). Mean age of the study participants was 7.07 h, SD 3.41, median 6 h, range 3–18 h. There were 13 (44.8%) females compared to 16 (55.2%) males. The mean birth weight was 2019.8 g, SD 261.6, median 2000 g, range 1500–2695. Sex distribution is similar in males and females. This is not limited to our study but in other series too, which show a very similar sex patterns [5].

The mean gestational age was 36.5 weeks, SD 1.35, Range 33–38, median 37 weeks. These findings coincide with existing reports in literature which document the mean gestational age at spontaneous birth to be 36 weeks [11].

Table 1 Pre-transit factors

Factors assessed	Overall number of patients/29	Percent
Prenatal Obstetric scan	13	44.8
Pre-referral communication	23	79.3
IV access	29	100
IV fluids given	29	100
Prophylactic antibiotics given	22	75.9
Gastric decompression	1	3.4
Bowel covered	27	93.1
Written referral note	29	100
Monitoring chart	0	0
Blood investigations comment	0	0

The mean duration in transit was 5 h, SD 1.89, median 5, range 1–9. The mean distance to the national referral facility, KNH was 153.1 km, SD 87.8, median 140, range 19–348. There was a positive correlation between the distance to facility and time taken to arrive, p value <0.001.

The level of implementation of pre-transit protocol and the pre-transit factors affected for neonates with gastroschisis referred to KNH

From a total of 10 factors that should be implemented during pre-transit protocol the number of factors successfully implemented were given a score of 1 each. The frequency and percentage of the total scores for each patient were calculated to determine the level of implementation. A majority of the patients (48.3%) had a score of 6/10. None of the patients had a score of 10/10 (Table 1).

Thus from the table, most affected areas were prenatal obstetric scan, gastric decompression, monitoring chart and comment on blood investigations.

The level of implementation of intra-transit protocol and intra-transit factors affected for neonates with gastroschisis referred to KNH

From a total of 13 factors that should be implemented during transit protocol the number of factors successfully implemented were given a score of 1 each. The frequency and percentage of the total scores for each patient were calculated to determine the level of implementation. A majority of the patients (31%) had a score of 5/13; 24.1% of the patients had a score of 6. The maximum score was 9/13. None of the patients had a score of 13/13. Notably there were no incubators used in transport of all patients, pulse oximetry was only used in nine patients and gastric decompression only in 4 patients. Adequate bowel cover was only in 34.5%. In terms of place of delivery, our study demonstrates that 3 patients

Table 2 Intra-transit factors

Transit factors	Overall number of patients/29	Percent
Accompanying medical personnel	29	100
Oxygen supply	28	96.6
Baby covered well	25	86.2
Patent peripheral access	22	75.9
Neonatal Resuscitation training received	17	58.6
Temperature monitoring	16	55.2
Parent content	14	48.3
Blood pressure monitoring	13	44.8
Bowel cover adequate	10	34.5
Pulse oximetry	9	31.0
Functioning NGT	4	13.8
Bowel monitoring every 15 mins	0	0
Incubator availability	0	0

were born at home, 16 patients were born in a district level hospital, 9 patients in a community clinic and 1 patient in a private facility. Two out of 29 patients (6.9%) travelled using a private car rather than an ambulance (Table 2).

Discussion

It has been proposed that gastroschisis be used as a Bellwether to measure the capacity of a health institution to deliver a package of neonatal surgical care, because there are usually no associated co-morbidities but the condition tests the key elements that are involved in the successful management of any newborn with a surgical condition [2]. There are a number of factors that affect outcomes for this condition, for example, gestational age, type of gastroschisis, birth weight among others. The neonatal transport factor is just one of them. Compared to neonates born within the tertiary hospital or those born after maternal transfer, neonates who require acute postnatal transport have higher risk of morbidities.

Several factors have been associated with adverse neonatal outcomes after transport, including the condition of a neonate around the time of transport and lack of intensive care during transport [10]. Duration of transport may also affect the outcomes [12]. Data from our study indicate that 28/29 (96.5%) had a transfer time of greater than 3 h. Mean distance covered during transit was 153 km. Studies have associated the transfer time to complications and mortality. In a study conducted in Egypt by Shalaby et al. [13], a transfer time of lesser than 8 h is associated with a survival rate of 64% [13]. According to another study done in Japan, a greater duration of transit exceeding 90 min doubles the risk of mortality. Thus, recommends that air transport is a feasible means if transit time is expected to exceed 120 min [8]. Complications identified in literature to be associated with increased transfer time include metabolic derangements such as hyperglycaemia, metabolic acidosis, hypoglycemia and sepsis [14].

Delays in instituting the correct management plan for patients with gastroschisis invariably results in complications and mortality.

Pre-natal ultrasound can help in diagnosing this condition before birth and therefore aid in planning location of birth and care post-delivery. In our study, prenatal ultrasound was only conducted in 13/29 (44.8%) of the participants and of these only 2/13(15.4%) had an abnormality picked. A study in Uganda by Wesonga et al [3] found that only 24% of patients received prenatal ultrasound, and only 2% of these had a correct prenatal diagnosis [3]. According to Wesonga et al [3] in Kampala Uganda, 81% of patients did not have adequate bowel coverage, 54% had no intravenous access, 83% did not have a decompressing nasogastric tube, 52% were being breastfed, 58% arrived within 12 hour since birth, and ambulance transport was available for only 35% [3].

Our analysis of neonatal pre-transit and transit factors revealed significant contribution to the unfavourable outcomes associated with this condition.

Limitations

The study was limited by a small sample size which could have affected validity of the results. However, data was meticulously collected to ensure that the relevant information was captured as outlined in the study protocol. Our study did not measure the outcomes of these patients due to the multiple variables involved in the in-patient management of these patients.

Conclusion

Care of neonates with gastroschisis is critical to prevent morbidity and mortality. The findings of this study indicate gross inadequacies in care of such patients, both in the pre-transit period and intra-transit period. Improvement in such care would reduce mortality from gastroschisis complications.

Thus the following recommendations are suggested: (i) Establishment of guidelines targeting neonatal transport; (ii) Training of healthcare personnel on neonatal transport; (iii) Equipping district level facilities and ambulances with tools and equipment to support neonatal transport; (iv) Prenatal screening of gastroschisis with ultrasound to promote proper

planning of birth in an ideal facility; (v) Parental information on the need to deliver in the facilities.

Acknowledgements We would like to acknowledge the Department of Surgery, University of Nairobi, and the Department of Specialized Surgery, Kenyatta National Hospital.

Author contributions TJ and FO contributed to the study conception and design. The literature search and data analysis were performed by HG. The manuscript was written by HG. TJ, FO and DK critically revised the work. All authors read and approved the final manuscript.

Funding No funding was received for conducting this study.

Data availability The datasets used and/or analyzed during the current study are available from the corresponding author on request.

Declarations

Competing interests The authors declare no competing interests.

Conflict of interest The authors have no competing interests to declare that are relevant to the content of this article.

Ethical approval This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of University of Nairobi/KNH (Date 25th September 2021/ No. P635/07/2021).

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