ISSN 2073-9990 East Cent. Afr. J. surg

Factors Associated With Manual Reduction of Incarcerated Inguinal Hernia in Children

T.A. Lawal, D.I. Olulana, O.O. Ogundoyin, K.I. Egbuchulem
Department of Surgery University of Ibadan and Division of Paediatric Surgery, University College Hospital, Ibadan, Nigeria
Correspondence to: Dr. Taiwo A. Lawal, Email: taiwo.lawal@hotmail.com

Background: ***In patients with incarcerated inguinal hernia, initial manual reduction, which is not always feasible, rather than immediate surgery, is associated with fewer complications. The aim of the study was to evaluate factors associated with successful manual reduction of incarcerated inguinal hernia in children.***
Methods: ***A prospective cohort study between January 2010 and December 2014 of children admitted with incarcerated inguinal hernia to a single surgical unit.***
Results: ***A total of 34 patients with a median age of 4.2 months (range: 2 weeks to 14 years) were recruited. Manual reduction was attempted in 23 (67.6%) patients and successful in 13 (56.5%). A total of 9 (26.5%) patients had bowel strangulation. Shorter incarceration (median of 18.2 vs. 48.4 hours, p = 0.004) and longer duration of previous swelling (median of 20 vs. 3.5 weeks, p = 0.029) were associated with successful manual reduction. Bowel strangulation rate was higher amongst patients excluded from manual reduction, using the set criteria, compared to those who had failed reduction (77.8% vs. 22.2%, p = 0.044).***
Conclusions: ***Manual reduction is more likely to be successful in patients who present early after incarceration as well as those with wider internal rings***.

Keywords: children, incarceration, inguinal hernia, manual reduction, strangulation
DOI: http://dx.doi.org/10.4314/ecajs.v21i3.20

Introduction

Inguinal hernias occur in 0.8% to 5% of all children and virtually all has to be repaired since spontaneous resolution is rare[1, 2, 3]. The surgical repair is easy to perform, relatively safe and has minimal postoperative morbidities[4, 5, 6]. Delay in repair or failure to recognize and diagnose the condition may result in development of incarceration. Incarceration occurs due to irreducibility of hernia contents, mostly bowel loops, omentum, vas deferens and other cord structures. This may progress to frank intestinal obstruction and subsequent strangulation as entrapment of blood supply to the testis via the testicular artery and or bowel segment through the mesentery causes ischaemia and later, testicular infarction or bowel gangrene.

In the treatment of patients with incarcerated hernia, emergency surgery has been associated with a higher complication rate compared to an initial manual reduction because oedema impairs the visibility at surgery[6, 7]. Following a successful reduction, herniotomy is performed after some hours to a few days when the oedema is expected to have resolved. In developing countries, such as Nigeria, there is often a delay in presenting to the paediatric surgeon when incarceration occurs[1, 7, 8] and some patients may thus not be fit for manual reduction. It is therefore, necessary in such settings to have criteria developed for manual reduction to be attempted. This approach, will likely, lower the risk of reducing a gangrenous segment of bowel into the abdomen[9] and its associated morbidity as the patient is made to wait for a few days before herniotomy in a bid to encourage resolution of oedema of the hernia. It will also help in reducing the postoperative complications after emergency groin surgery.

A protocol in this regard was developed in the division to guide the management of incarcerated childhood inguinal hernia. The study thus aimed to describe the outcome of management of patients with incarcerated inguinal hernia at a single paediatric surgery unit in Nigeria, evaluate the factors associated with successful manual reduction following a protocol and compare the characteristics of patients who were ineligible for or had unsuccessful attempts with manual reduction.

Patients and Methods

This was a prospective cohort study conducted between January 2010 and December 2014 at the Division of Paediatric Surgery of the University College Hospital, Ibadan, Nigeria. All the patients who presented to the Children's Emergency Room on account of irreducibility of a groin swelling, confirmed to be an incarcerated or strangulated inguinal hernia on examination, were entered into the study. Incarceration

ISSN 2073-9990 East Cent. Afr. J. surg

was defined as irreducibility of the hernia by a surgeon. The incarcerated hernia was classified as strangulated if there were symptoms and signs suggesting bowel ischaemia from vascular compromise such as fever, persistent vomiting and abdominal distension[7]. Information was obtained on the patients' socio-demographic details, nature and duration of presenting symptoms, presence of groin swellings prior to the incarceration, examination findings, resuscitation measures, attempts made at reduction of the swellings, treatment offered, operation findings and the outcome of care – measured in terms of morbidity both before discharge and during follow up in the surgical outpatients.

Management of incarcerated hernia

Nasogastric decompression was instituted and intravenous antibiotics administered to those with intestinal obstruction. The patients with incarceration but without features of strangulation were offered manual reduction of the hernia using analgesia (intravenous pentazocine) and sedation (intravenous diazepam). Those that were not eligible for manual reduction were prepared for an immediate surgery. Exclusion criteria for manual reduction included persistent vomiting, constipation, fever and abdominal distension. Those who had successful reduction of the hernia were admitted to the ward, commenced on oral intake within 24 hours and scheduled for herniotomy on the next operation list. The patients who had failed manual reduction under analgesia and sedation had immediate surgery.

The information obtained was entered into a computer using SPSS version 21 software and data analysis performed. Descriptive data was presented using range and medians for continuous variables and percentages, ratios or proportions for categorical variables. The Mann-Whitney U test was used to compare continuous variables and Chi-square statistics or Fishers Exact test used to explore associations between categorical variables. The p value for statistical significance was set at 0.05.

Results

A total of 246 patients were managed for inguinal hernia during the period of the study of which 34 (13.8%) presented with incarceration. There were 31 (91.2%) males and the male to female ratio was 10.3:1. There were 24 (70.6%) hernias on the right and 10 (29.4%) on the left. The median age of the patients was 4.2 months with a range from 2 weeks to 14 years. A total of 22 (64.7%) patients, including six neonates, were aged 12 months or less; 3 (8.8%) were aged 1 to 2 years and 9 (26.5%) were older than 2 years.

The presenting features, apart from the irreducible groin or scrotal swelling, included obstructive symptoms of vomiting in 9 (26.5%), constipation in 4 (11.8%) and abdominal distension in 9 (26.5%) patients. Fever was present at presentation in 6 (17.6%) patients. The majority (22, 64.7%) had a groin swelling prior to presenting with irreducibility and the swelling had been present for 2 days to 2 years with a median duration of 6 weeks. The duration of groin pain or inconsolable crying heralding the incarceration ranged from 1 hour to 5 days (median of 2 days). Manual reduction was attempted in 23 (67.6%) patients and it was successful in 13 (56.5%) of those. Following the reduction, the patients were on admission for 48 to 96 hours and there was no post reduction peritonitis.

Twenty-one patients, consisting of 11 who were not suitable for manual reduction and 10 who had failed reduction, had emergency surgery; these included two exploratory laparotomies for generalized peritonitis and 19 groin surgeries. Findings at emergency surgery included small bowel gangrene in 9 (26.5%) patients of which 3 (8.8%) also had testicular infarction, and oedematous and dusky loops of small bowel that became pink after application of warm abdominal gauze packs in 8 (23.5%) patients. The entrapped bowel was oedematous and pink in 4 (11.8%) patients. A total of 9 (26.5%) patients, thus, had true strangulation.

All 34 patients had herniotomy, nine had bowel resection and anastomosis and three had orchidectomy. The surgeries were all done under general anaesthesia. The length of stay in the hospital after surgery ranged from 0 (discharged on the day of surgery in patients who had delayed herniotomy after successful manual reduction) to 7 days with a median of 4 days. Post operative complications included wound infection in 4 (11.8%) patients, wound dehiscence in 2 (5.9%) – both patients had laparotomies – and scrotal haematoma in 3 (8.8%). There was no mortality and there was no postoperative testicular atrophy at a median follow up period of 10 months (range of 2 months to 4 years).

ISSN 2073-9990 East Cent. Afr. J. surg

Factors associated with successful manual reduction

Patients who presented early (median of 18.2 hours) had more successful attempts at reduction compared to those who presented later (median of 48.4 hours), p = 0.004 (Table 1). Reduction was equally more likely to be successful in patients with a previous groin swelling of a longer duration than a shorter duration (median of 20 weeks vs. 3.5 weeks, p = 0.029). There was no significant relationship between the age at presentation and success with manual reduction (Table 1).

Table 1. Relationship of age at presentation, duration of symptoms and duration of previous groin swelling to outcome of manual reduction

Variable	Successful manual reduction					
	Categories	**Range (Median)**	**U****	**Z**	**r**	**p value**
Age at presentation (months)	Successful Not successful	0.6 – 177.5 (4.8) 0.7 – 120.7 (3.6)	131.0	-0.195	-0.033	0.845
Duration of symptoms (hours)	Successful Not successful	1.0 – 36.0 (18.2) 12.0 – 120.0 (48.4)	57.0	-2.998	-0.514	0.004*
Duration of previous groin swelling (weeks)	Successful Not successful	3.0 – 104.0 (20.0) 0.3 – 78.0 (3.5)	24.5	-2.155	-0.370	0.029*

* - Statistically significant, ** - Mann Whitney U Test statistic

Table 2. Comparison of patients who were excluded from manual reduction (not qualified for reduction) and those with failed reduction

Variables	Excluded from reduction No (%)	Failed reduction No (%)	Total No (%)	χ^2	p value
Gender					
Male	10 (52.6)	9 (47.4)	19 (100.0)	FET	1.000
Female	1 (50.0)	1 (50.0)	2 (100.0)		
Age					
≤ 12 months	7 (53.8)	6 (46.2)	13 (100.0)	0.029	0.864
> 12 months	4 (50.0)	4 (50.0)	8 (100.0)		
Duration of incarceration (hours) **< 36**	4 (44.4)	5 (55.6)	9 (100.0)	0.398	0.528
≥ 36	7 (58.3)	5 (41.7)	12 (100.0)		
Prior groin swelling					
Yes	8 (57.1)	6 (42.9)	14 (100.0)	0.382	0.537
No	3 (42.9)	4 (57.1)	7 (100.0)		
Bowel gangrene					
Yes	7 (77.8)	2 (22.2)	9 (100.0)	4.073	0.044*
No	4 (33.3)	8 (66.7)	12 (100.0)		
Testicular infarction					
Yes	2 (66.7)	1 (33.3)	3 (100.0)	FET	1.000
No	9 (50.0)	9 (50.0)	18 (100.0)		
Total	11 (52.4)	10 (47.6)	21 (100.0)		

* - Statistically significant, FET – Fishers Exact Test

Comparison of patients who had failed reduction and those excluded from manual reduction

The proportion of patients excluded from manual reduction, using the set criteria, who had bowel gangrene (77.8%) was higher than the proportion of those who had failed manual reduction under sedation and had evidence of bowel gangrene at surgery (22.2%), p = 0.044. There were no significant

ISSN 2073-9990 East Cent. Afr. J. surg

differences between the two groups of patients in terms of their gender, age, duration of incarceration, presence of prior groin swelling and testicular infarction (Table 2).

Discussion

Incarceration is a feared and largely avoidable complication of inguinal hernia in children. In settings where access to care is poor and delay in recognition and treatment is common, this complication can progress to strangulation and its sequelae of testicular atrophy and or bowel gangrene. In this study, 13.8% of the patients treated on account of childhood inguinal hernia presented with incarceration. This proportion, similar to the 14% incarceration rate reported in Ilorin – a city with similar socioeconomic and health indices as Ibadan, is much higher than 1.6% to 9% reported from centres in more developed countries with comparable hernia case loads[10, 11, 12]. The proportion is on the other hand, similar to the 12% rate reported amongst 6361 children with inguinal hernias treated by a single surgeon over a period of 35 years in Toronto, Canada. These variations may be due to differences in practice of referral of children with hernias by family physicians and paediatricians, waiting time to surgery and coding of diseases[10]. Furthermore, it may, be due to delay in seeking care by parents when bulges are observed in the groin as well as the economic implications of caring for children using out of pocket financing in resource challenged settings. This is corroborated by the fact that 65% of the parents knew that their child had a groin swelling for as long as two years without presenting to a hospital.

Nearly two thirds of the patients with incarcerated hernia in this study were infants and 74% had incarceration before the age of two years. Aboagye et al.[13] similarly reported that 56% of patients with inguinal hernia would have developed incarceration before their first birthday. Incarceration is noted to be more common in neonates than older children. In this study, 18% of the patients had incarceration during the first month of life. Incarceration is common in this age group because of the narrow size of the internal inguinal ring relative to the contents of the hernia sac. Thus, early repair of inguinal hernia has been advocated when discovered immediately after birth[14, 15]. Unfortunately, quite a number of children are delivered outside hospital settings in developing countries[7]. Public health education and enlightenment may therefore be necessary for traditional birth attendants, midwives and others that are involved in their deliveries in developing countries towards early recognition and prompt referral.

Manual reduction of the incarcerated hernia was attempted in 23 patients and successful in 57%. This is also a reflection of delay in presenting to the hospital of up to five days from onset of symptoms. In the study of 41 patients with incarcerated hernia in Ilorin, Nigeria, Bamigbola et al.[1] noted that patients presented between two hours and four days of onset of symptoms and manual reduction was successful in 46% of the patients. The present study found that manual reduction is more likely to be successful in patients who present early and in those who had a prior groin swelling that had been there for a longer period. Time is of essence in the progression from incarceration to obstruction and finally strangulation with the ability to successfully reduce the bowel mirroring this sequence[16]. A groin swelling that had been there for a longer time was found easier to reduce than one that had been there for a shorter time, perhaps because the older children in the study may have had their hernia for a longer time than the younger ones. A wider internal inguinal ring may also allow the content to be easing in and out of the inguinal canal much more readily, and thus stay for longer before becoming irreducible compared to a narrower inguinal ring[16].

In this study, manual reduction could not be attempted in 32% of patients. This group of patients had a significantly higher strangulation rate than patients who were offered reduction but the attempt failed. The criteria that were used to exclude patients from manual reduction thus appeared to be discriminatory as far as bowel gangrene was concerned. This has helped in the cohort of patients to avoid the risk of reducing a gangrenous bowel into the abdomen. It has been accepted in principle by paediatric surgeons that since this event could occur, a child who has had manual reduction of an incarcerated hernia should be observed closely over a period of 24 to 48 hours for features of peritonitis[7, 11, 17].

The patients who had successful manual reduction in this study were all admitted to the ward to allow oedema to subside and operated within 48 to 96 hours on the next available operating day. Although the practice varies from one hospital to the other and many may not recommend admission, this practice was adopted in our setting because the parents may not return for surgery on time if allowed to take the children home after successful manual reduction. This is particularly of importance because there may be repeat episodes of incarceration if there is further delay in performing the herniotomy. In a comparison of 75 paediatric patients who had herniotomy within 72 hours of reduction of incarceration and 108 who

ISSN 2073-9990 East Cent. Afr. J. surg

had delayed herniotomy one to four months after the reduction, 17 (15.7%) patients in the latter group had 34 episodes of repeated incarcerations between five days and four months after reduction[18]. It was therefore recommended that herniotomy be done at most five days after a successful manual reduction[18].

No major complication such as recurrence of the hernia, testicular atrophy or iatrogenic ascent of the testes was noted. A total of nine minor complications mostly related to surgical site infection or scrotal haematoma that were all managed conservatively were seen. The outcome of management of the patients in this study is comparable to what had been reported from similar settings where patients present late after onset of incarceration. A limitation of the study, however, was the short period of follow up of some of the patients. A longer period of observation may be required to monitor the development of testicular atrophy, which can occur as long as one year after surgery.

Conclusions

Incarcerated inguinal hernia can be safely managed in children. Manual reduction is more likely to be successful in patients who present early after incarceration as well as those with wider internal rings. The bowel strangulation rate is higher in patients who have fever or obstructive symptoms at presentation.

References

1. Bamigbola KT, Nasir AA, Abdur-Rahman LO, Adeniran JO. Complicated childhood inguinal hernias in UITH, Ilorin. Afr J Paed Surg 2012; 9: 227-230.
2. Meier AH, Ricketts RR. Surgical complications of inguinal and abdominal wall hernias. Semin Pediatr Surg 2003; 12: 83-88.
3. Ein SH, Njere I, Ein A. Six thousand three hundred sixty-one pediatric inguinal hernias: a 35-year review. J Paed Surg 2006; 41: 980-986.
4. Baird R, Gholoum S, Laberge JM, Puligandla P. Prematurity, not age at operation or incarceration, impacts complication rates of inguinal hernia repair. J Paed Surg 2011; 46: 908-911.
5. Kaya M, Huckstedt T, Schier F. Laparoscopic approach to incarcerated inguinal hernia in children. J Paed Surg 2006; 41: 567-569.
6. Nah SA, Giacomello L, Eaton S, de Coppi P, Curry JI, Drake DP, et al. Surgical repair of incarcerated inguinal hernia in children: laparoscopic or open? Eur J Ped Surg 2011; 21: 8-11.
7. Ameh EA. Incarcerted and strangulated inguinal hernias in children in Zaria, Nigeria. East Afr Med J 1999; 76: 499-501.
8. Ezomike UO, Ekenze SO, Amah CC. Irreducible inguinal hernias in the paediatric age group. Niger J Med 2013; 22: 230-233.
9. Strauch ED, Voigt RW, Hill JL. Gangrenous intestine in a hernia can be reduced. J Paed Surg 2002; 37: 919-920.
10. Gholoum S, Baird R, Laberge JM, Puligandla PS. Incarceration rates in pediatric inguinal hernia: do not trust the coding. J Paed Surg 2010; 45: 1007-1011.
11. Houben CH, Chan KW, Mou JW, Tam YH, Lee KH. Irreducible inguinal hernia in children: how serious is it? J Paed Surg 2015; 50: 1174-1176.
12. Stylianos S, Jacir NN, Harris BH. Incarceration of inguinal hernia in infants prior to elective repair. J Paed Surg 1993; 28: 582-583.
13. Aboagye J, Goldstein SD, Salazar JH, Papandria D, Okoye MT, Al-Omar K, et al. Age at presentation of common pediatric surgical conditions: Reexamining dogma. J Paed Surg 2014; 49: 995-999.
14. Antonoff MB, Kreykes NS, Saltzman DA, Acton RD. American Academy of Pediatrics Section on Surgery hernia survey revisited. J Paed Surg 2005; 40: 1009-1014.
15. Wiener ES, Touloukian RJ, Rodgers BM, Grosfeld JL, Smith EI, Ziegler MM, et al. Hernia survey of the Section on Surgery of the American Academy of Pediatrics. J Paed Surg 1996; 31: 1166-1169.
16. Glick PL, Boulanger SC. Inguinal hernias and hydroceles. In: Grosfeld JL, O'Neill (Jr) JA, Fonkalsrud EW, Coran AG (eds). Pediatric Surgery Vol 2, 6th edn. Philadelphia: Mosby Elsevier, 2006; 1172-1192.
17. Al-Ansari K, Sulowski C, Ratnapalan S. Analgesia and sedation practices for incarcerated inguinal hernias in children. Clin Pediatr 2008; 47: 766-769.
18. Gahukamble DB, Khamage AS. Early versus delayed repair of reduced incarcerated inguinal hernias in the pediatric population. J Paed Surg 1996; 31: 1218-1220.