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The challenges of the management of the incisional hernia in children and infants: a retrospective experience of a tertiary hospital

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Abstract

Background: Incisional hernia in children and infants represents a major complication following exploration. The condition is associated with prolonged hospital stay, readmission, and the need for another operation to treat the resulting incisional hernia. The incidence is variable worldwide. The leading causes are still indeterminate as well as the management strategy. We aimed at studying incisional hernia in children and infants at a tertiary level hospital as regards presenting symptoms, methods of management, and its impact on the quality of life of patients.

Results: A retrospective study included all infants and children presented with incisional hernia. Patients were categorized in to two groups according to the age of presentation, group A patients younger than 2 years of age and group B patients older than 2 years. All data related to the first operation in addition to data related to repair of the incisional hernia were collected in special charts. The study included 67 patients. the median age in group A was 6.5 months vs 10.5 years in group B. Urgent presentation was found in 35.4% of cases in group A vs 19.44% of cases in group B. Tissue repair was used as the definitive management in 64.5% of cases in group A and in 52.7% of cases in group B.

Conclusion: Incisional hernia in infants and children is a major complication. The management is associated with prolonged hospital stay, financial burden, and deep impact on the quality of life. It is to some extent difficult to predict its onset.

Keywords: Incisional hernia, Infants, Children, Tissue repair, Wound complications

Background

Incisional hernia is a serious morbidity following laparotomy, and its incidence among the children and the infants is not clearly established [1, 2]. Some studies reported that the incidence of an incisional hernia in the children and the infants (IHCI) ranged from 1 to 3% of all operated patients. The limitation of these reports was their spotting on some neonatal diseases such as necrotizing enterocolitis (NEC) and infantile hypertrophic pyloric stenosis (IHPS). Moreover, the presence of a stoma was found to be significantly associated with an increased incidence of IHCI [3].

The factors attributed to the development of incisional hernia were extensively analyzed in the adults; however, they were not clarified in the pediatric patients [4]. Therefore, we aimed to assess the challenges associated with the occurrence, management, and the prognosis of the IHCI patients who were treated at our tertiary level hospital.

Methods

This is a retrospective study including all the children and the infants who were subjected to either an elective or an urgent laparotomy and presented with an incisional hernia during the period from January 2007

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to July 2021. Ethical committee review report was obtained (approval code: 34687/5/21). The neonates who were presented with congenital abdominal wall defects or the patients with missed records and/or follow-up were excluded. Additionally, we excluded the cases with wound dehiscence as its pathogeneses and management are different.

According to the age, the patients were categorized into two groups; group A included the infants that had incisional hernia at the age of $\leq$ 2 years, and group B that included the children older than 2 years. The presenting symptoms were a swelling at the site of the incision, a recurrent colicky abdominal pain, or the clinical picture of a complicated hernia. The analyzed variables were the age at primary operation, the gender, the prematurity, the indication of surgery, the general condition of the patients, the nutritional status, the presence of a surgical site infection, the onset of incisional hernia, the presenting symptoms, the size of the defect, the type of the repair, the mean duration of postoperative ventilation if needed, the occurrence of any complications, the mean hospital stay, and the onset of the recurrence.

The collected data were statistically analyzed using SPSS version 19 (Statistical Package for Social Studies) created by IBM, Chicago, IL, USA. For numerical values the range, the mean, and the standard deviations were calculated. Regarding categorical variables, the number and percentage were estimated and the differences between subcategories were assessed using chi-square ($\chi 2$) test. If chi square was not appropriate, we used Fisher's exact test, or Monte Carlo exact test. For the risk estimation of infection, we calculated the odds ratio (OR) and 95% confidence interval. The level of significance was assigned at $p < 0.05$.

Results

This retrospective study included 67 patients in both groups who presented with an incisional hernia. The demographic data, the indications of exploration, and the postoperative criteria of cases before the management of the incisional hernia in both groups were summarized in Table 1.

An urgent presentation of IHCI (intestinal obstruction, strangulated hernia, or irreducible hernia) was

Table 1 The demographic data, indications of exploration, and postoperative data of cases before repair of incisional hernia in both groups

	Group A ($N = 31$)	Group B ($N = 36$)	*P* value
Gender			
Males	19 (61.3%)	23 (63.9%)	0.352
Females	12 (38.7%)	13 (36.1%)	
Median age at first operation	6.5 (0–20) months	10 (2.5–18 years)	N/A
Indications for surgery			
Urgent	19 (61.3%)	19 (52.7%)	0.435
Elective	12 (38.7%)	17 (47.22%)	0.034*
History of immaturity	12 (38.7%)	10 (27.77%)	0.542
Nutritional status			
Good	20 (64.5%)	23 (63.88%)	0.183
Fair	11 (35.48%)	13 (36.1%)	0.137
Postoperative stoma	5 (16.12%)	4 (11.11%)	0.435
Postoperative wound infection	11 (35.4%)	10 (27.77%)	0.542
Total numbers of surgeries			
One operation	28 (90.3)	30 (83.3%)	0.743
More than one	3 (9.6%)	6 (16.7%)	0.362
Incision site			
Transverse subcostal	24 (77.41%)	0 cases	
Periumbilical	7 (22.58%)	0 cases	N/A
Midline	0 cases	36 (100%)	
Closure technique			
Closure in layers	19 (61.3%)	24 (66.6%)	0.392
Mass closure	12 (38.7%)	12 (33.3%)	0.243

*Significant

N/A not applicable

encountered in 11 patients (35.4%) in group A, while it occurred in 7 cases (19.44%) in group B. Swelling at the incision site was the presenting symptom in 11cases (35.4%) and 15 cases (41.6%) in group A and group B, respectively. A recurrent abdominal pain was the chief complaint in 9 cases (29.03%) in group A and in 14 cases (38.8%) within group B. The size of the defect was less than in 2 cm in 13 cases (41.9%) in group A and 9 cases (25%), ranged from 2 to 4 cm in 7 cases (22.5%) in group A versus 10 cases (27.7%) in group B, and was more than 4 cm in 11 cases (35.4%) and 17 cases (47.44%) in group A and group B, respectively. The relation between the size of the defect and the site of the incision was statistically significant (Fig. 1).

The preoperative, operative, and postoperative data of cases at the management were listed in Table 2.

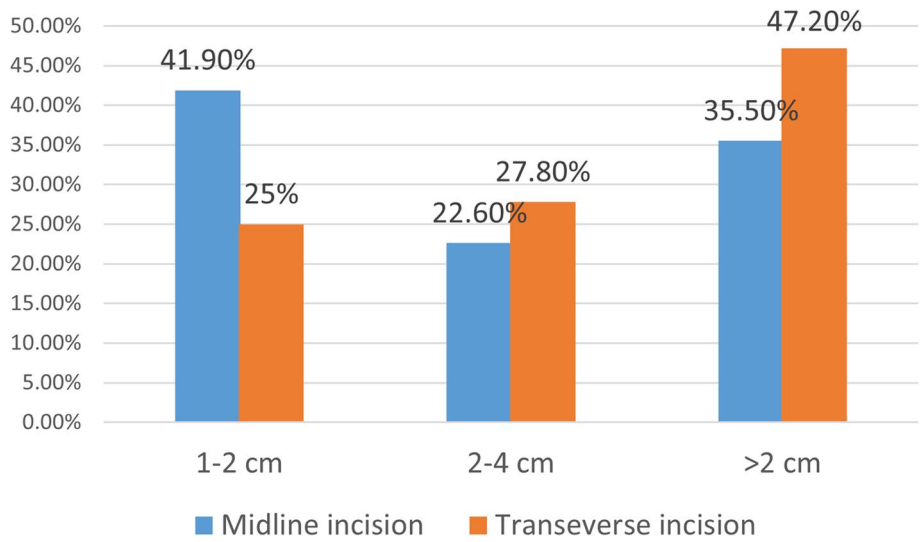

Fig. 1 Relation between the site of incision and the size of the defect in both groups

Table 2 The preoperative, operative, and postoperative data of the cases of the incisional hernia at the management in both groups

	Group A ($N = 31$)	Group B ($N = 36$)	*P* value
Presentation			
Urgent	11 (35.4%)	7 (19.44%)	0.324
Swelling	11 (35.4%)	15 (41.6%)	0.436
Colicky pain	9 (29.03%)	14 (38.8%)	0.732
Size of defect			
<2 cm	13 (41.9%)	9 (25%)	0.321
2–4 cm	7 (22.5%)	10 (27.7)	0.415
> 4 cm	11 (35.4%)	17 (47.44%)	0.039*
Technique of repair			
Tissue repair	20 (64.5%)	19 (52.7%)	0.421
Mesh repair	11 (35.4%)	17 (47.3%)	0.05*
Cases needed postoperative ventilation	14 (45.1%)	24 (66.6%)	0.257
Postoperative ventilation period (days) (median and range)	1.5 days (0.5–2 days)	2.5 days (1.5–4 days)	0.045*
Hospital stay (median and range)	6 (3–8)	8 (4–12).	0.05*
Post repair complications**			
Grade I	11	13	0.346
Grade II	3	4	
Grade III	3	3	
Recurrence	2 (6.4%)	2 (5.5%)	0.132

There was a significant difference between the size of the defect and the clinical presentation. The smaller size of the defect was associated with a more urgent clinical presentation and vice versa as documented in Table 3.

The tissue repair was the definitive management in 20 cases (64.5%) in group A and in 19 cases (52.7%) in group B. A mesh hernioplasty was the treatment of choice in 11 cases (35.4%) in group A and in 17 cases (47.2%) in group B. This was due to the large size of the defect that might lead to the repair under tension if tissue repair was planned.

The median duration of hospital stay in group A was 6 days versus 8 days in group B. This was statistically significant as showed in Fig. 2. Fourteen cases (45.1%) in group A needed postoperative ventilatory support versus 24 patients (66.6%) in group B. The duration of postoperative ventilation was significantly shorter 1.5 days (range: 0.5–2 days) in group A than 2.5 days (range: 1.5–4 days) in group B.

Table 3 The relation between the size of the defect and the clinical presentation of IHCI in both groups

Presentation	Groups	Size of defect			*P* value
		< 2 cm	2–4 cm	> 4 cm	
Urgent	A ($n = 11$)	9	1	1	0.002*
	B ($n = 7$)	0	6	1	
swelling	A ($n = 11$)	4	4	3	0.049*
	B ($n = 15$)	1	3	11	
Recurrent abdominal colicky pain	A ($n = 9$)	0	2	7	0.019*
	B ($n = 14$)	8	1	5	

According to the Clavien-Dindo classification of postoperative surgical complications [5], the complications that developed in both groups were summarized in Table 2.

Discussion

This study highlighted our experience in the management of IHCI at a tertiary-level hospital. Few reports were concerned with such problem in the pediatrics. It is an upsetting and challenging situation for the parents, the patients and the pediatric surgeons. Several factors play crucial roles in the rising of this challenge. One of them is the incidence of IHCI. The determination of the incidence is quite difficult due to two reasons. The first is due to the increase in the incidence of IHCI with the prolongation of the follow-up period. The second is due to a probability of a spontaneous resolution and closure of the defect with follow-up. A spontaneous disappearance occurred in one of every seven cases of IHCI and usually happened in patients who had their initial operation during neonatal life [1, 6]. Fink et al. reported an increase of the incidence of the incisional hernia in the patients with an elective midline exploration from 12.6 to 22.4% if the follow-up period was extended up to 3 years [7].

We excluded the cases of gastroschisis and omphalocele. The abdominal wall has an already inborn deficiency in certain regions and different pathology that may require a delayed, or a reconstruction of the anterior abdominal wall. While the cases of IHCI have a different pathophysiological process of the abdominal wall which was completely normal before the leading exploration. We emphasized that the inclusion of infants and children

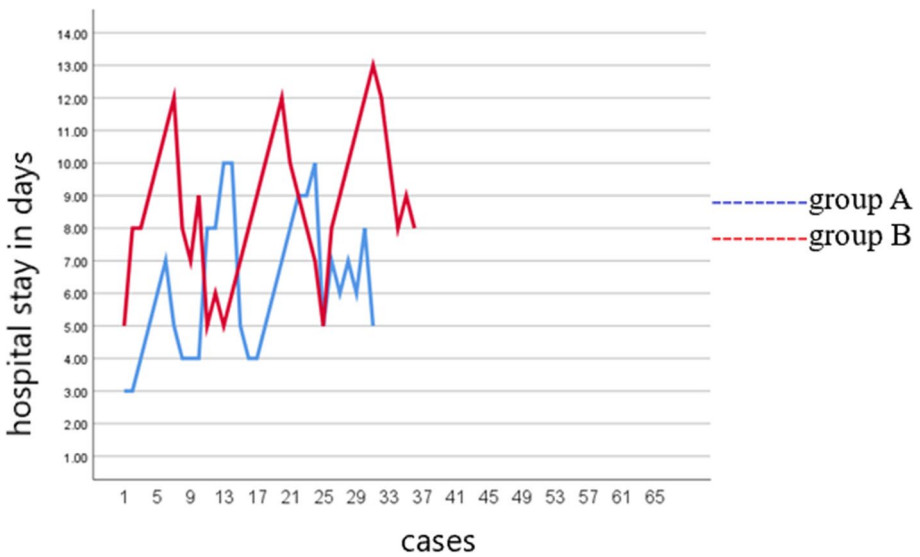

Fig. 2 The duration of the hospital stay per patient in both groups

with the congenital defects of their abdominal wall might falsely increase the magnitude of the problem. However, some studies considered these congenital abdominal wall defects as a risk factor of developing IHCI [6].

The indications of explorations (leading to the development of IHCI) showed a wide range of diseases. Broadly, they were classified into either urgent or elective. This range of the diseases was affected by the age of the patient. We included all cases of NEC, IHPS, congenital diaphragmatic hernia, neonatal intestinal obstruction, intussusception, biliary atresia, infantile abdominal tumors, peritonitis, traumatic exploration, childhood abdominal tumors, and open fundoplication.

Some authors included only the infants up to 3 years of age in their cohort studies. This was reflected by an increasing incidence of the incisional hernia due to certain diseases. As IHPS is a common condition in early neonatal life, it is more likely to have a higher incidence of occurrence of the incisional hernia. The incidence may be increased when using the periumbilical approach for pyloromyotomy. Moreover, some studies considered that IHPS of its accord, a strong risk factor of developing the incisional hernia which may be due to the poor nutritional status of infants [8, 9]. Our data reported 7 cases (22.5%) diagnosed as IHPS in group A presented with an incisional hernia. They all had been managed through a periumbilical approach.

Wound infection was an important cause of the development of IHCI during our study. Twenty-one cases out of 67 (31.4%) had postoperative wound infection, although these patients were under coverage of antibiotics. The infection competed with the normal healing process at the site of the incision and ended with the development of IHCI.

Walming and his colleagues reported that 19% of cases of the incisional hernia developed wound infection. Despite being a study of adults' cohort, it matches our conclusion [10]. Shah reached a conclusion that an umbrella of the antibiotics during both the preoperative and the postoperative periods affected the incidence of the development of IHCI by reducing the chance of wound infection [11].

According to the protocol in our institution, we usually use the transverse upper abdominal incision for all cases requiring exploration in patients ≤ 2 years. This approach is more exploratory in this group of patients. In children older than 2 years, we performed midline incisions during explorations. Waldhausen et al. reported the use of the transverse incision in any infant younger than 1 year of age. They explained that the infant's abdomen is barrel-shaped and transverse incision would be more exploratory than vertical incision [12]. There is still a great debate of what type of the incision that will have a lower incidence of a breakdown and a development incisional hernia. Some authors considered the transverse incisions or para-midline incisions having a less chance to develop an incisional hernia when compared to the midline incisions. They assumed that these incisions could accommodate the increased intraabdominal pressure without giving up in contrary to the midline incisions which are relatively weaker [13].

In the same context, Swenson et al. documented a less incidence of the incisional hernia in the patients having transverse incisions. However, they included the gridiron incision of the appendectomy in their series. These gridiron incisions are rarely complicated by an incisional hernia and may not reflect the actual occurrence of IHCI among their cohort [14].

Mullassery noticed that the site of incision, the closure technique (mass or layer-by-layer in layer closure), the suture material used (monofilament vs multifilament or delayed absorbable vs nonabsorbable) and the mode of the suturing had no effect on the development of IHCI. Interestingly, these factors have a great effect on the development of the incisional hernia in adults [2].

We found that the way of suturing, the suture material, the mass, or the layer-by-layer closure did not affect the development of IHCI. However, we recommended further randomized control trials to study the effects these variables on the development of IHCI.

In their retrospective review, Schattenkerk et al. concluded that the site of the incision, the suture material, the technique of the closure, or the technique of the suturing had no significant impact on the development of the incisional hernia in the infants. This met our conclusion. However, our study extended to include both the infants and the children [6].

One of the most important prognostic factors during the management of IHCI is the clinical presentation. While the cases presented with a swelling or a recurrent abdominal pain can be treated on an elective base, the cases presented with an urgent condition as the intestinal obstruction, or the strangulation required an urgent intervention. The urgent cases of IHCI have a prolonged postoperative period on the ventilation as well as a prolonged hospital stay. We found that the smaller the size of the defect whether the incision was a midline or an upper abdominal transverse, the more liability of urgent presentation. So, we recommended early management of IHCI once the condition had been diagnosed. This may help reduction of the rate of an urgent admission, the need of postoperative ventilatory support and the reduction of the length of hospital stay.

Schattenkerk et al. reported that the main presentation in their cohort was swelling at the site of the incision (68%) of cases. Recurrent abdominal pain was present in

Table 4 The current and previous studies of incisional hernia in children and infants

	Total no. of cases	Site of incision	Including congenital abdominal wall defects	Indications for first laparotomy	Method of repair
Current study (2021)	67 cases (infants and children	- Transverse (No = 24) - Periumbilical (No = 7) - Midline (No = 36)	Not included	- Urgent (No = 38) - Elective (No = 29	- Tissue repair (No = 39 - Mesh repair (No = 28)
Schattenkerk et al. [6] (2021)	2066 (infants)	- Transverse - Laparoscopic ports - Periumbilical	Included	- NEC - Pyloric stenosis - Intestinal atresia - Gastroschisis - Omphalocele	Not applicable
Tanaka et al. [1] (2018)	14 children	- Transverse - Laparoscopic	Not included	- Fundoplication - Inguinal hernia - Pyloric stenosis - Splenectomy	Tissue repair using absorbable sutures.
Mullassery et al. [2] (2016)	21 (children)	- Transverse - Periumbilical	Not included	- NEC - Pyloric stenosis - Malrotation - Diaphragmatic hernia	- Tissue repair with absorbable suture materials

NEC necrotizing enterocolitis

16% of cases and incarceration was diagnosed in 15% of cases. However, they did not correlate these clinical pictures to either the site of the incision or the size of the defect [6].

The repair of incisional hernia was well established in adults. Mesh hernioplasty constituted the standard management. Also, mesh hernioplasty has good results if compared to the tissue repair when recurrence rate is addressed. Even there is an advantage of detecting patients that may at risk of developing the incisional hernia and hence a reinforcement of the abdominal wall with a mesh as a prophylaxis takes place during the setting of initial operation [15–17].

Unfortunately, these principles cannot be applied in scenarios of IHCI. The anterior abdominal wall in infants and children has deferent physiological and anatomical considerations. It is a growing unit, and the intra-abdominal viscera are growing also. During our study, we performed a mesh repair when the defects were larger than 4 cm in maximum width. We found that the tissue repair in these cases was accompanied by an increase in the intrabdominal pressure as detected by change in the ventilatory measures. Also, the repair was under tension that threatened the repair and increased incidence of failure.

Mullassery and his colleagues reported the repair of IHCI using sutures. They found that repair was sufficient with success rate approaching about 90%. However, most of these cases were operated in the same session while restoring of gastrointestinal continuity after stoma. They did not comment on the site or the size of defect. Also, they did not report the causes and the management of recurrent cases [2].

According to the available data most of the pediatric surgeons support the tissue repair by sutures in cases of IHCI. They keep mesh use for cases complicated by recurrence. We believe the recurrence rate in most series was either due to large defect beyond 4 cm in width or the repair is under tension.

We studied the postoperative data of infants and children following repair of the incisional hernia. In addition to the readmission for repair of IHCI, there were some patients who required postoperative ventilatory support before the weaning and transferring to the ward. The median duration of postoperative ventilation support and hospital stay in group A were significantly shorter than in group B. Although we did not have any mortality among patients of both groups, we reported the occurrence of postoperative complications in both groups. These complications increased the financial burden on both parents and the facility. Also, there was a great psychological effect on both the patients and their parents. The main limitations of our study were being a retrospective study and single tertiary center experience.

We included and summarized the experience of other authors who studied the same problem in Table 4.

Conclusions

Incisional hernia represents a complex complication, and it is associated with a wide range of presentations. The management is individually tailored to every patient. A mesh repair is recommended if the defect is larger than 4 cm in the maximum width. These children and infants have prolonged periods of hospital stay and may

need ventilatory support during the early postoperative periods.

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Authors' contributions
All authors equally contributed to the manuscript design, operating patients, writing. and approval of the manuscript.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Approval was obtained from the Research Ethics committee at our faculty of medicine with approval code 34687/5/21. Parents of each patient were informed about all steps in the procedure. A written consent was obtained from study participants.

Consent for publication
The authors agree to publish the manuscript.

Competing interests
All authors declare that they have no competing interests.

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