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SIMPLIFYING LAPAROSCOPIC HERNIOTOMY IN CHILDREN - A PROSPECTIVE COMPARATIVE STUDY OF CONVENTIONAL LAPAROSCOPY AND INSTRUMENTATION WITH STAB INCISION

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ABSTRACT

Introduction: Paediatric inguinal hernias (IHs) are common. The first paediatric laparoscopic hernia repair was described by El-Gohary and colleagues in the United Arab Emirates in 1993. Inguinal hernias (IHs) are common in the paediatric population with a reported incidence ranging from 3 to 5% in term infants and up to 13% in infants born before 33 weeks of gestation. In India, inguinal hernia repair is a frequently performed surgical procedure due to its high occurrence rate and the availability of various effective treatment methods.

Aim and Objective: A study insimplifying laparoscopic herniotomy in children - a prospective comparative study of conventional laparoscopy with trocar cannulas and instrumentation with stab incision without trocar cannulas to study feasibility of performing laparoscopic procedures without using cannulas for introducing instruments.

Material and Methods: This was a prospective comparative study carried out in the Department of Pediatrics Surgery for a period of 18 months i.e, January 2023 to July 2024, where the first 30 laparoscopic herniotomies were done using 3 port technique. Next 30 laparoscopic herniotomies are done using simple stab incisions to introduce laparoscopic instruments into abdomen. 5 mm Camera port with 30 degree laparoscope is introduced transumbilically in both groups. We conducted the study in lap herniotomy because this condition is common and procedure is short for measuring the variables. We routinely note the surgical time in all procedures as protocol, which we copied from our OT register for comparison. We compared all the complications as outcomes.

Results: In our study, stab incision demonstrated a slightly faster performance compared toconventional cannula, with a time of 26.37 minutes versus 31.68 minutes. In the present study among a total 60 patients , maximum numbers of patients were male than female respectively. In our study three individuals experienced scrotal edema in one group other two individual in another group. Temporary hydroceles, lasting few days, were found in one individual in each group. Operative time is short and analgesic requirement is minimal in stab incision group.

Conclusion: Laparoscopic procedures can be performed effectively and safely with stab incisions for instrument access. There is significant cost savings related to the elimination of utilisation of

cannulas. We believe that use of stab incisions for instrument access is equivalent to the traditional cannula approach and should be considered whenever possible.

Keywords: Stab incisions, Conventional cannulas, Laparoscopy, Herniotomies, Hydroceles

INTRODUCTION

The term "hernia" originates from the Latin word "rupture." A hernia is characterized as an anomalous bulging of an organ or tissue through a structural flaw in its enclosing walls. Hernias can arise in several locations across the body, but they most frequently affect the abdominal wall, specifically the inguinal region. In India, inguinal hernia repair is a frequently performed surgical procedure due to its high occurrence rate and the availability of various effective treatment methods. Paediatric inguinal hernias (IHs) are common. The first paediatric laparoscopic hernia repair was described by El-Gohary and colleagues in the United Arab Emirates in 1993. Inguinal hernias (IHs) are common in the paediatric population with a reported incidence ranging from 3 to 5% in term infants and up to 13% in infants born before 33 weeks of gestation [1, 2]. The majority of these are indirect, arising due to failure of the processus vaginalis to close [3]. Due to the risk of incarceration and gonadal infarction, timely surgical repair is essential [4].

The aim of surgery is to close the patent processus vaginalis (PPV) at the level of the deep ring without damaging the spermatic cord structures con trained within the inguinal canal. Traditionally, this has been performed by an open approach, utilising a groin incision through which the hernia sac is dissected free from the spermatic cord and suture ligated at the deep ring [5]. However, open inguinal herniotomy is not without disadvantages. These include wound related complications, hernia recurrence and damage to the vas deferens or the testicular blood supply [6, 7].

The advent of laparoscopic surgery has offered many advantages over conventional open surgery [8] Laparoscopic inguinal hernia repair (LIHR) may identify a sub clinical contralateral PPV, which will allow for simultaneous repair, preventing later contralateral IH development and thus obviating the need for subsequent surgery [9]. Laparoscopy also identifies incidental genital anomalies which may go unnoticed in open repairs. Minimally invasive surgery is particularly advantageous in the premature population where prolonged general anaesthesia carries a higher risk of post-operative apnoea and need for post-operative ventilation as a result of reduced lung compliance secondary to bronchopulmonary dysplasia typical in this patient cohort.

The traditional approach for access to the abdominal cavity in laparoscopic operations utilizes cannulas or ports through which the instruments are inserted. The use of cannulas has proven to be effective and safe for the multitude of laparoscopic procedures now being performed throughout the surgical community. In the fall of 1999, we began using a new technique whereby select operative instruments are introduced directly through abdominal wall stab incisions (SI), reducing the number of cannulas required for any given procedure and ultimately leading to a cost reduction in operative charges as well as a superior cosmetic result. This study details our experience to date with this technique. Therefore the present study was undertaken in simplifying laparoscopic herniotomy in children - a prospective comparative study of conventional laparoscopy and instrumentation with stab incision.

MATERIAL AND METHODS

This was a prospective comparative study where the first 30 laparoscopic herniotomies are done using 3 port technique. Next 30 laparoscopic herniotomies were done using simple stab incisions to introduce laparoscopic instruments into abdomen. We have chosen lap herniotomy because the condition was common and procedure was short for measuring the variables. Single surgeon operated on all patients. We routinely note the time of introduction and end time of surgical procedures as protocol. We compared operative time, analgesia requirement, cosmesis, hospital stay, needle introduction and complications as outcomes for this comparison.

A comprehensive inquiry was conducted to gather pertinent information, and a thorough examination was carried out to determine their suitability for anesthesia. Each of these patients was scheduled for surgery. The laparoscopic operation was conducted using the conventional method of three 5mm ports, while maintaining an intra-abdominal pressure of 8-10mm Hg. In the second group where trocar cannulas are not used the left and right hand instruments are introduced after incising the abdominal wall with 11 number blade. In both groups the camera port required a 5 mm trocar cannula introduced transumbilically. The sac is completely separated using diathermy hook at internal ring and the peritoneum is sutured using Ethibond 3-0 or 4-0 suture. If the contralateral side was determined to be open, a similar surgery was carried out. All surgeries required written informed consents from the guardians of all patients.

Statistical analysis:
Data recorded on the case report from and structured proforma were subsequently entered into a spreadsheet. Data management and analysis were performed using Microsoft Excel.

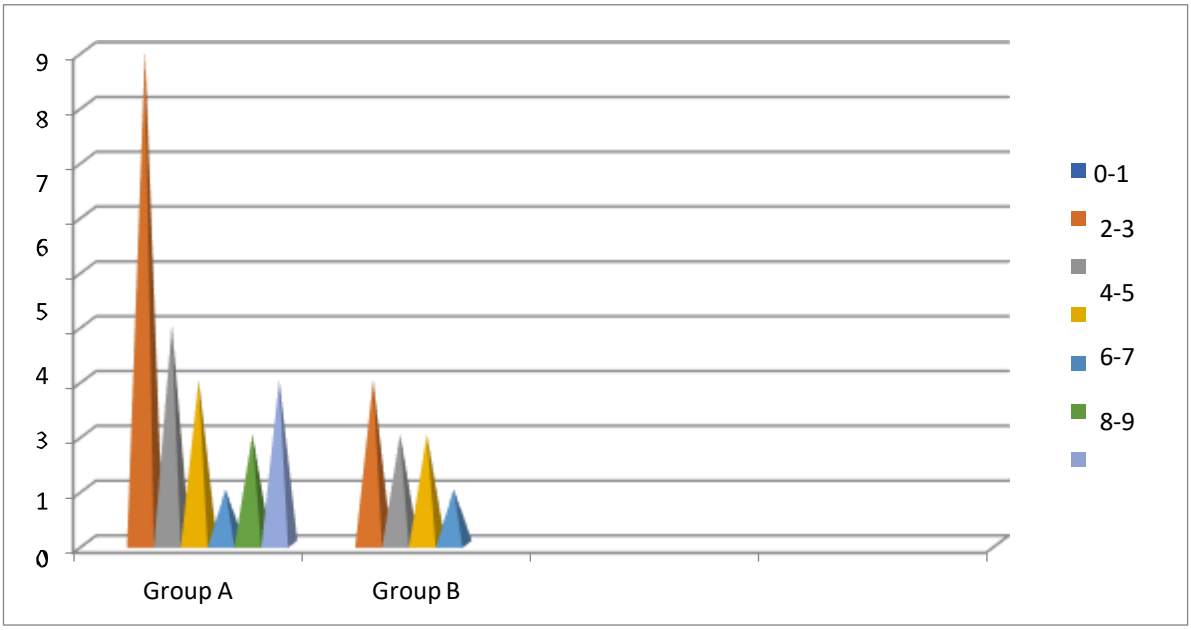
Ethical clearance:
The ethical committee clearance certificate was duly obtained before starting of study by Institutional Medical Ethical Committee.

RESULTS
A prospective study was carried out in the Paediatric Surgery Unit at a tertiary care hospital.In this study, we found that the maximum number of patients were present in the age group 2-3 yrs of age followed by the age group 4-5 yrs respectively as shown in Table no.1 and Table no.2.
The weight range is 2.8-16 kgs.

Figure 1: Stab Incision for Instrument access

Table no. 1 Age wise Distribution of the study according to Conventional cannula.

Age (in Years)	Group A (Lap)	Group B (Herniotomy)
	No.	No.
0-1		
2-3	9	3
4-5	4	2
6-7	3	2
8-9	1	1
10-11	2	
>11	3	
Total	22	8

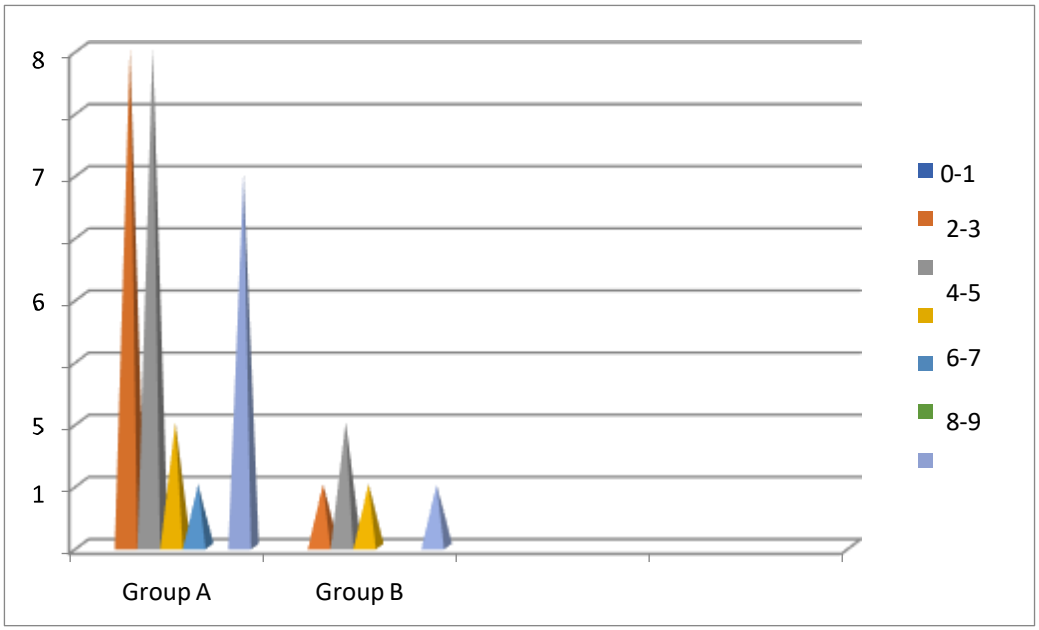


Graph No. 1: Graphical Representation of Age wise Distribution of the study according to Conventional cannula.

Table no. 2 Age wise Distribution of the study according to Stab incision.

Age (in Years)	Group A (Lap)	Group B (Herniotomy)	P value
	No.	No.	
0-1			
2-3	8	1	
4-5	8	2	
6-7	2	1	0.01
8-9	1		
10-11			
>11	6	1	
Total	25	5	

P value: 0.01 - Significant



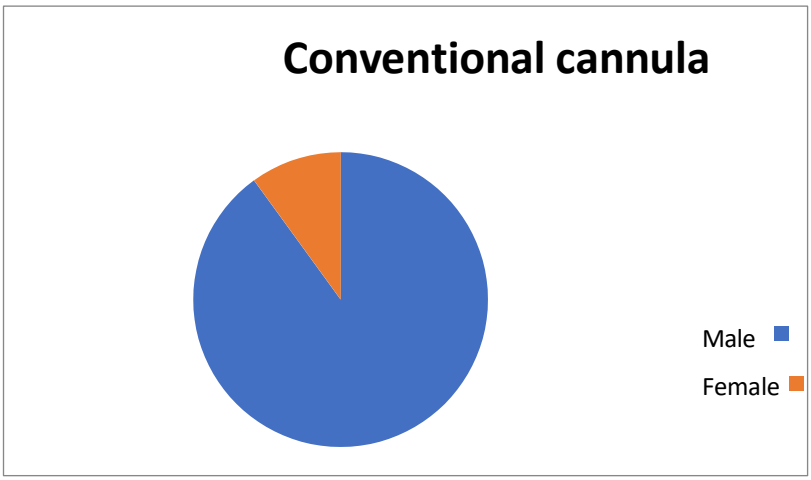
Graph No. 2: Graphical Representation of Age wise Distribution of the study according to Stab incision.

In the present study among a total 60 patients , maximum numbers of patients were male than female as shown in Table no.3.The aesthetic appearance in the right side was better than in the left side as shown in Table no. 4.

Table no. 3 Gender wise Distribution of patients.

Gender	Conventional cannula	Stab incision	P value
Male	27	22	0.07
Female	3	8	
Total	30	30	

P value: 0.07- Insignificant

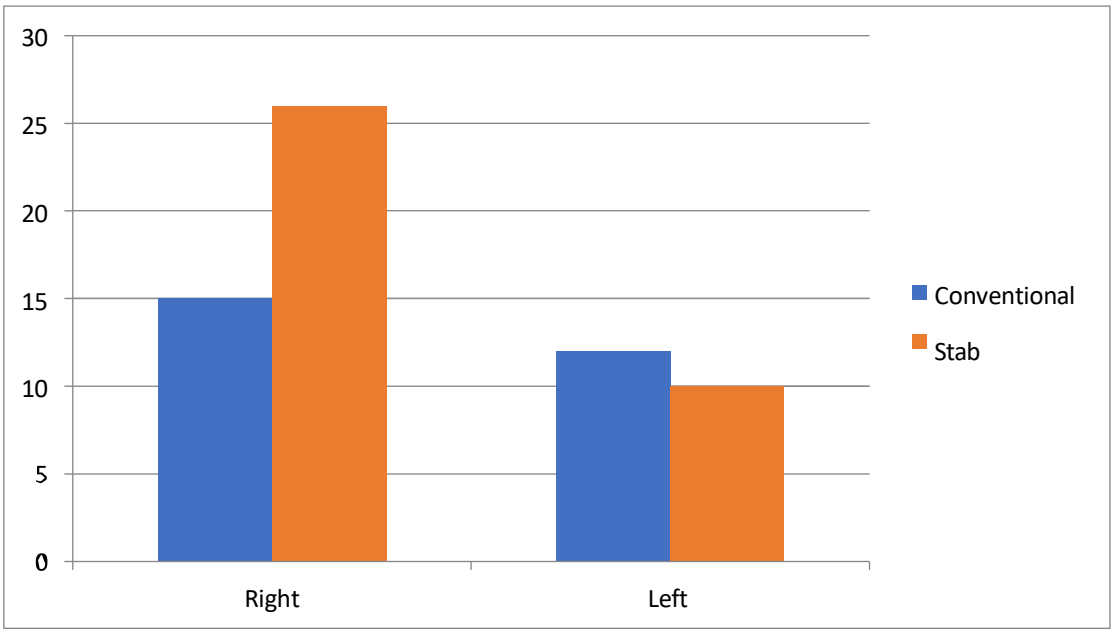


Graph No. 3: Graphical Representation of Gender wise Distribution of patients.

Table no.4 Side of Hernia

Side	Conventional (n-30)	Stab (n-30)	P value
Right	15	26	0.02
Left	12	10	

P value: 0.02- Significant



Graph No. 4: Graphical Representation of Side of Hernia

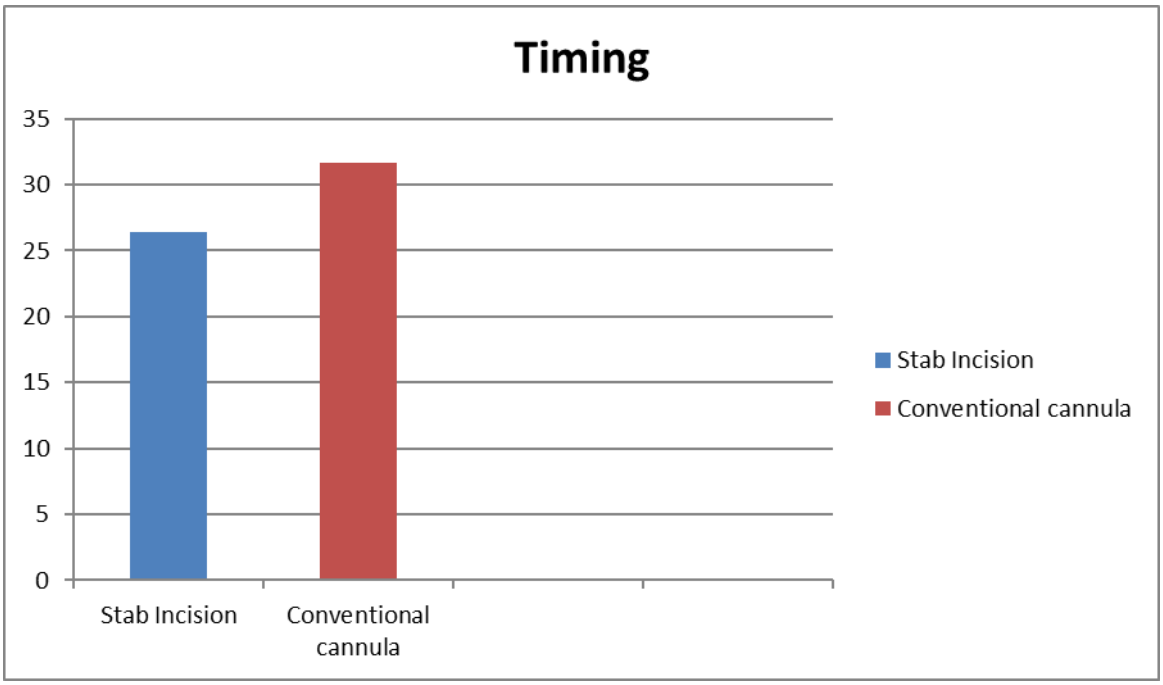


Chart A showing timing between both groups

In our study, stab incision demonstrated a slightly faster performance compared toconventional cannula, with a time of 26.37 minutes versus 31.68 minutes (chart A). The stab incision group also required less frequent dosage of paracetamol. The disparity in painperception between both groups was negligible.A higher percentage of children who underwent stab incision experienced a delay in immediate postoperative recovery (less than 3 hours) compared to other procedures.However, the length of hospital stay was not significantly different between the two groups.All patients, with the exception of one individual in the stab incision group, were discharged within a 24-hour timeframe following the surgical procedure. In the conventional cannula group, nearly all individuals, except for four, were discharged within a comparable timeframe.

Needle introduction in conventional cannula group is through abdominal wall in all those patients where we used a 3 mm cannula. In addition the retrieval of needles is along with cannula removal,

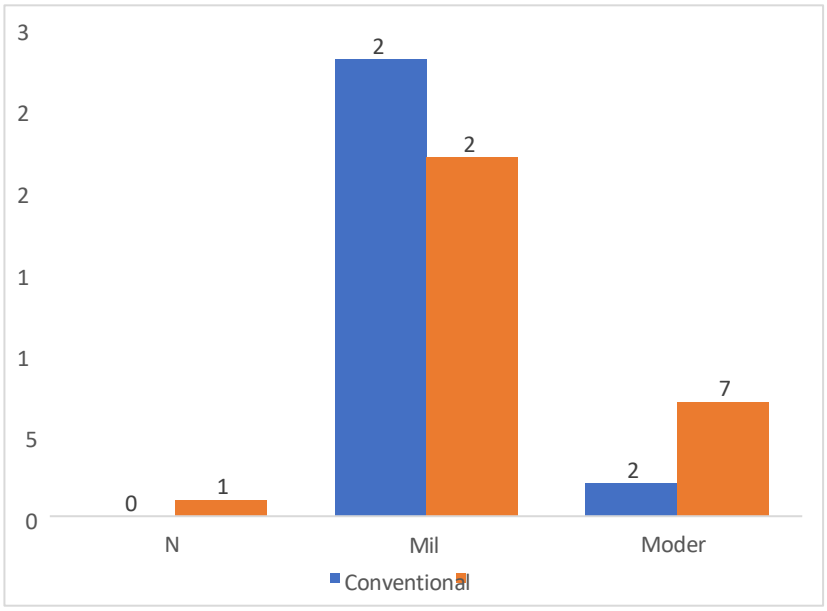
which we find cumbersome. In stab incision group the needle introduction and retrieval is directly through abdominal wall and is very simple.
Cosmetically both group parents are satisfied with the scar appearance.

CONVENTIONAL (N-30) STAB (N-30)

Table no.5 Comparison of the complication between groups.

1.TIME (in minutes)	31.68	± 11.35	26.37	± 15.05
2.PAIN				
Nil	0	1		
Mild	28	22		
Moderate	2	7		
3.RECOVERY				
<3HRS	21	27		
>3HRS	9	3		
4.DISCHARGE				
<10HRS	26	29		
24HRS	4	1		
5.COMPLICATION	5	3		
Scrotal edema	1	0		
Hydrocele	1	1		
Peritoneal bleed	0	0		
Erythema	3	2		
Recurrence	0	0		
6.COSMESIS				
Excellent	0	30		
Good	30	0		
P value: 0.002		P value: 0.3		

From the table no. 5 it was observed that for Conventional method p value was found to be 0.002, which was significant whereas observed to be most complicated as compared to the Stab method where p value was observed to be 0.3, which showed Insignificant, thus was observed to be negligible complications.



Graph No. 5: Distribution of pain in both groups.

In our study, the rates of complications were comparable. Three individuals that experienced erythema in one group other two individual in another group. Temporary hydroceles, lasting only a few days, were found in one individual in each group. Table no.5.

Table no. 6 Comparing the time duration between stab incision and conventional cannula.

Parameter	Stab Incision	Conventional Cannula
Number of Patients	30	30
Mean Procedure Time (min)	20	35
Standard Deviation (min)	4	6
Median Procedure Time (min)	19	34
Range of Procedure Time (min)	15 - 30	25 - 50
Time for Procedure Setup (min)	5	10
Standard Deviation (min)	1	2
Recovery Time (min)	15	25
Standard Deviation (min)	3	4
Total Time (min)	35	60
Standard Deviation (min)	5	7
Percentage of Total Time	36.4% (Procedure) / 63.6% (Recovery)	58.3% (Procedure) / 41.7% (Recovery)
Complications Rate (%)	5	10

Table no. 7 Comparing paracetamol usage between both groups.

Parameter	Cannula Group (n=30)	Stab Incision Group (n=30)
Average Number of Doses	5 doses	3 doses
Duration of Use (days)	3 days	2 days
Average Pain Score (VAS)	6/10	4/10
Patients Requiring Additional Analgesia (%)	20%	10%

In this comparison, the cannula group (30 patients) received a higher average total dose of paracetamol postoperatively (3500 mg) compared to the stab incision group (30 patients), who

received 1800 mg. The cannula group also required more frequent doses, averaging 5 doses per patient, while the stab incision group averaged 3 doses.
The duration of paracetamol usage was longer in the cannula group (3 days) versus 2 days in the stab incision group. Pain scores, recorded using a visual analogue scale (VAS), were higher in the cannula group, averaging 6/10, while the stab incision group reported lower pain scores, averaging 4/10.
Finally, 20% of patients in the cannula group required additional analgesics beyond paracetamol, compared to only 10% in the stab incision group, suggesting that patients with stab incisions experienced less postoperative discomfort and required fewer pain medications.
This table no. 7 and analysis indicate that patients who had stab incisions generally experienced less pain and required lower doses and shorter durations of paracetamol compared to those with conventional cannula insertion.

DISCUSSION

Inguinal hernia is a prevalent issue in children, and herniotomy is the established therapeutic method against which all other treatment options are assessed. It is acknowledged for its simplicity in execution, high rate of success, and minimal incidence of complications. However, in line with the boom in minimally invasive surgery across all surgical disciplines, laparoscopy is also becoming increasingly popular for pediatric surgery. Nevertheless, there is disagreement regarding its broader acceptance as the preferred technique.

This study explores the use of stab incisions as an alternative to the conventional trocar-cannula system in pediatric laparoscopic surgery. Hence we conducted a trial study if stab incision method is possible and beneficial. Laparoscopic inguinal herniotomy is our chosen study which is a very common issue in children. While herniotomy is the traditional, widely accepted treatment for inguinal hernias due to its simplicity, effectiveness, and low complication rates, the rise of minimally invasive laparoscopic techniques has spurred interest in alternatives. Laparoscopy offers advantages such as a clear, magnified view of anatomy, which allows precise, minimally invasive procedures with minimal bleeding. However, the suturing required within the peritoneal cavity can be technically challenging and time-consuming, necessitating high hand-eye coordination, especially around sensitive areas like the inferior epigastric veins.

The stab incision technique, originally introduced by Ostlie and Holcomb in 2003, is a straightforward and cost-effective method that avoids some of the complications associated with the traditional trocar-cannula system. In another observation by Sandesh V Parelkar et al in 2013, Laparoscopic pyloromyotomy can be safely performed by using laparoscopic trocarless instruments [21]. Daniel J Ostlie reported the authors' experience using minimal access (MA) stab incisions, rather than cannulas, for insertion of laparoscopic instruments into the peritoneal cavity [19]. Gregory R Hanson observed that there were no complications associated with the use of stab incisions [20]. The laparoscopic instruments- Maryland forceps, needle driver, suction cannula, blunt dissectors, scissors and sutures for transport can be passed across into abdomen with stab incision method except perhaps the endoloop.
The following side effects are associated with the use of sharp trocar and cannula systems-particularly in pediatric surgeries. One of the main issues observed is instrument misfit, where hand instruments do not properly align with the trocar, potentially affecting the surgeon’s control and precision. Another problem is the occurrence of gas leaks around the cannula or broken rubber washers, which can compromise the controlled environment within the abdomen required for minimally invasive procedures. Additionally, in smaller children with thinner abdominal walls, the cannula can dislodge more easily, which can lead to interruptions and pose risks during surgery. Needle entrapment is also noted as a complication, where needles may become stuck in the cannula during insertion or retrieval, causing delays and requiring extra handling that could increase the risk

of tissue damage. Given these drawbacks, the suitable alternative seems to be the stab incision method in pediatric age groups.

The stab incision method in the present study demonstrated advantage in speed (average procedure time: 26.37 minutes vs. 31.68 minutes for trocar-cannula) and requirement of only oral pain medication, while the conventional group needed intravenous paracetamol. Although some children in the stab incision group experienced minor delays in immediate postoperative recovery (less than 3 hours), this delay was not clinically significant. Minor, self-limiting complications, such as temporary erythema and hydroceles, were observed and resolved without intervention.

Despite initial concerns about potential complications—such as gas leaks, false track creation, bleeding, and surgical emphysema—the study found that these issues did not arise with the stab incision method. In our study, three individuals experienced erythema. Temporary hydroceles, lasting few days, were found in one individual. This finding is in accordance with Shyam Sharvari [10]et al, Jeong Min Lim [11] et al and Zeng C. [15] et al.

The method was most effective in newborns and children under 20 kg with thinner abdominal walls, it was unsuitable for heavier children or those with fatty abdominal walls, where the trocar-cannula system may still be necessary. Though the above study is done in laparoscopic herniotomy, the authors also conducted various other pediatric laparoscopic surgeries (e.g., urological, hepatobiliary, gastrointestinal) using stab incision method and found this method acceptable.

However, the study's limitations include its small sample size and lack of diverse patient demographics and surgical types. To verify these findings, further research with larger, more varied groups is recommended. This would provide a more comprehensive understanding of outcomes and the suitability of stab incisions across different patient populations and surgeries.

In conclusion, the study suggests that stab incisions are a viable, cost-effective alternative to the traditional trocar-cannula system for pediatric laparoscopic procedures, especially in smaller children. The authors recommend the stab incision method in appropriate cases, as it could simplify procedures, reduce costs, and maintain safety and effectiveness.

CONCLUSION

In conclusion, this study suggests that pediatric laparoscopic procedures can be performed safely and effectively using stab incisions for instrument access. This technique offers notable cost savings by eliminating the need for cannulas. The authors believe that stab incisions provide an access method comparable to the traditional cannula approach and recommend its use whenever feasible in suitable pediatric cases.

Declarations:

Conflicts of interest: There is not any conflict of interest associated with this studyConsent to participate: There is consent to participate.

Consent for publication: There is consent for the publication of this paper.

Authors' contributions: Author equally contributed the work.

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