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Two-Port Needle-Assisted Pediatric Laparoscopic Herniotomy Using Tuohy Needle: Clinical Experience and Outcomes

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ABSTRACT

Background: The objective of this study is to compare Tuohy Needle-assisted laparoscopic hernia repair with the open repair technique in terms of recovery time, the ability to evaluate and repair contralateral defects, postoperative complications, and overall clinical outcomes.

Methods: This study was conducted over six months from February 2024 to July 2024. Laparoscopic herniotomy was performed using a two-port technique with a 23-G Tuohy needle and 3/0 Prolene for extracorporeal closure. Total operative time was recorded from the initial port placement to skin closure. Analgesia requirements were also recorded using a visual analogue scale. The Length of hospital stay was recorded in days from the day of admission until the patient's discharge.

Results: A total of 60 pediatric patients with an age range of 2 to 12 years and a mean age of 7.1 years were included, with a mean weight of 23.2 kg. It included 47 males (78.3%) and 13 females (21.7%). The majority of pediatric patients had left-sided hernia 35 (58.3%), followed by right-sided 17 (28.3%) and bilateral hernia 8 (13.3%). Only one patient (1.7%) out of 60 presented with a recurrent inguinal hernia. The mean total operative time for laparoscopic needle-assisted herniotomy was 15.8 minutes. The average postoperative analgesia requirement was 1.7 doses, and the mean length of hospital stay was one day.

Conclusion: The two-port laparoscopic needle-assisted herniotomy using a Tuohy needle is a safe, highly effective, and minimally invasive laparoscopic technique for inguinal hernia repair in the pediatric population.

Keywords: Tuohy Needle, Needle-Assisted Repair, Two-Port Technique, Laparoscopic Herniotomy, Operative Time, Analgesia Requirement, Hospital Stay.

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INTRODUCTION

At birth, inguinal hernia is one of the most frequently encountered surgical problems in infants and children, and is six times more commonly seen in males[1]. The incidence is approximately 1–5% in full-term infants[2]. However, premature infants have a greater risk of developing an inguinal hernia, and risk factors include: low birth weight, history of lung disorder, and lung ventilation impairments[3].

The condition occurs due to failure of the closure of the processus vaginalis ring, which allows the abdominal contents to protrude through the inguinal canal and present as an asymptomatic reducible swelling in the groin or scrotal region, and becomes more prominent during physical straining or crying[4]. Open herniotomy has been the standard technique for inguinal hernia repair in infants and children and has yielded excellent operative outcomes, but has limitations[5]. It leaves a visible scar and also limits contralateral exploration of tissue in bilateral hernias[6].

Various laparoscopic techniques, both intracorporeal and extracorporeal suturing methods, have been introduced[7]. Amongst these techniques, Laparoscopic needle-assisted hernotomy using Tuohy needle has gained high popularity due to its minimally invasive nature, reduced operative time and hospital stay, and minimal tissue dissection[8]. Laparoscopic needle-assisted inguinal hernia repair (LNAR) in pediatric patients utilizes a 23-Gauge Tuohy spinal needle to guide the suture circumferentially around the internal inguinal ring[9]. This is a minimally invasive technique, which requires minimal tissue dissection and is often performed through a single or dual-port[10]. It also enables precise and accurate placement of the suture to enable effective complete closure of the defective hernial orifice[11]. The use of the 23-Gauge Tuohy needle in Laparoscopic hernia surgery minimizes tissue trauma, improves surgical accuracy, post-surgical recovery, and cosmetic outcomes in children[12].

Long-term outcomes are not known for laparoscopic needle-assisted hernia repair surgery, as conflicting data exists in previous literature regarding whether laparoscopic techniques differ from open surgery in terms of hernia recurrences[13]. Laparoscopic surgery remains a clinically debated subject for inguinal hernia repair in infants and children and is not routinely carried out by all pediatric surgeons[14]. Despite initial hesitance due to fear of recurrences, it is gradually establishing itself as a routine procedure in several European and American institutes[15]. This study was conducted to evaluate the clinical effectiveness of the two-port Tuohy needle-assisted laparoscopic herniotomy in children, addressing limitations of conventional open repair. It evaluates the operative time, intra-operative analgesia requirements, and hospital stay associated with this technique in the pediatric population, thereby contributing to the growing evidence supporting minimally invasive Laparoscopic needle-assisted pediatric hernia repair.

METHODS

This was a descriptive case series that was conducted in the Department of Surgery, Sharif Medical City Hospital, Lahore, over a period of six months from February 2024 to July 2024. Approval from the "Institutional Ethical Committee" was obtained before the commencement of this research (Letter No: SMDC/SMRC/ 244-22 dated 16-04-22). The study was designed to evaluate perioperative outcomes of a two-port laparoscopic needle-assisted herniotomy with a 23-Gauge Tuohy needle in pediatric patients. This study included a total of 60 pediatric patients, both males and females, who fulfilled the inclusion criteria. The included pediatric patients aged between 2 and 12 years, presenting with clinically and ultrasound confirmed reducible inguinal hernia swelling. Patients with both primary reducible inguinal hernia (unilateral or bilateral) and recurrent hernias following open herniotomy repair were included. Children who presented with strangulated hernias in emergency department and those with severe comorbidities e.g., chronic anemia, marasmus, Kwashiorkor or hematological disorders, were excluded from this study. Children with a history of upper respiratory tract infection, otitis media, or groin rash and infants with fetal growth restriction (EFW or AC below 3rd percentile with deranged Dopplers) were not included. Written informed consent was taken from all children parents. Patient selection was done by non-probability consecutive sampling and a calculated sample size of 60 was based on a 95% confidence level and previous literature showing a mean analgesia dose of 5 ± 1. Pre-operatively, no special preparation was required, but pre-anesthesia assessment for fitness and standard laboratory blood tests were carried out. All laparoscopic procedures were performed under general anesthesia with endotracheal intubation by a pediatric anesthetist. A urinary catheter was inserted to empty the bladder preoperatively.

Pneumo-peritoneum was established using a supra-umbilical Veress needle to maintain an intra-abdominal pressure of 8 mmHg with a flow rate of 2 L/min. A 5 mm optical trocar was placed supra-umbilically for laparoscope insertion. A second 5 mm working port was placed midway between the umbilicus and the anterior superior iliac spine on the contralateral side.

Patients were placed in Trendelenburg position with a 30° tilt opposite to the hernia side. After identifying the hernia defect and confirming intra-abdominal anatomy, a small stab incision was made approximately 1.5–2 cm above and medial to the anterior superior iliac spine.

A 23 Gauge Tuohy needle loaded with 3/0 prolene suture was inserted extra peritoneally from lateral to medial, along the inferior margin of the hernia defect preserving iliac vessels and gonadal. A prolene loop was retrieved using a Maryland grasper. The needle was then reinserted from lateral to medial preserving vas deferens, engaging the loop. One free end of the suture was passed through the needle into the loop, and the loop was withdrawn, delivering the Prolene tail. The knot was tied subcutaneously to ligate the internal ring. Skin was closed using Steri-Strips.

Post-operatively patients received a single dose of intravenous first-generation cephalosporin and were given non-steroidal anti-inflammatory suppositories for analgesia for the first 48 hours. Oral intake was resumed once bowel sounds returned. Patients were discharged when they met clinical criteria, including a pain score <4/10 and tolerance of oral feeding. Operative time was calculated in minutes from skin incision to skin closure. Analgesia requirement was measured by the number of doses administered during hospital stay based on a visual analogue scale. The length of hospital stay (LOHS) was calculated in days, from the day of admission to discharge. A follow-up was done for 6 months to look for any recurrence and testicular atrophy in male subjects.

The data were entered and analyzed using SPSS version 23, and quantitative variables like age, weight, operative time, analgesia doses, and Length of hospital stay were presented as mean ± standard deviation. Qualitative variables, e.g., side of hernia, recurrence of hernia, were mentioned as frequencies and percentages. Post-stratification independent T-tests were utilized to assess associations between groups, with $p \leq 0.05$ considered statistically significant.

RESULTS

A total of 60 pediatric patients diagnosed with reducible inguinal hernia and confirmed on ultrasound were included in this study. There were 47 (78.3%) male children and 13 (21.7%) females. The mean age of the included pediatric patients was 7.12 ± 3.63 years, ranging from 2 to 12 years. The mean weight of the included cohort was 23.23 ± 12.07 kg, with a minimum of 4 kg and a maximum of 52 kg.

In terms of hernia laterality, left-sided inguinal hernia was observed in 35 patients (58.3%), right-sided in 17 patients (28.3%), and bilateral hernia in 8 patients (13.3%). The majority of patients (98.3%, n=59) presented with a primary inguinal hernia, while only one patient (1.7%) had a recurrent case. The mean operative time of Laparoscopic needle-assisted hernia repair surgery was 15.80 ± 3.02 minutes, ranging from 10 to 20 minutes. The number of analgesic doses required post-operatively during hospital stay was one dose in 21 patients (35.0%), two doses in 35 patients (58.3%), and three doses in 4 patients (6.7%). All the children were discharged on the first post-operative day, hence yielding a mean hospital stay duration of 1.0 ± 0.0 days. No recurrence was noticed in the 6-month follow-up.
Subgroup analysis was performed to evaluate the impact of age, weight, and hernia laterality (side of hernia) on operative time (Figure 1). Patients were categorized into two age groups, that is, less than 7 years (n = 32) and more than 7 years (n = 28).

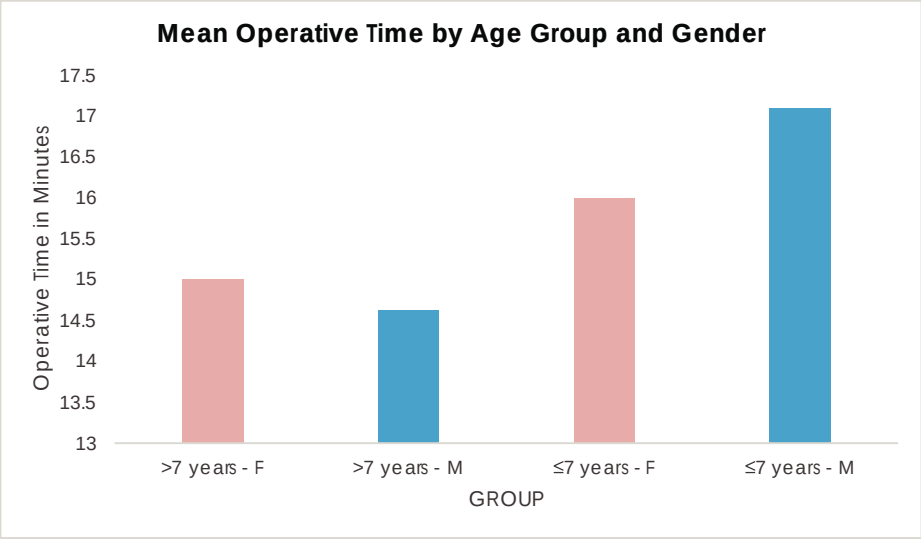

Figure 1: Mean Operative Time by Age Group and Gender

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The mean operative duration was 16.78 ± 2.19 minutes in the younger age group (less than 7 years), compared to 14.68 ± 3.46 minutes in the older group (more than 7 years). This difference was statistically significant (p = 0.006), indicating longer operative duration in younger patients aged less than 7 years.

In this cohort, children weighing less than 25 kg (n = 33) had a mean operative time of 16.42 ± 2.70 minutes, while those weighing more than 25 kg (n = 27) had a mean surgery time of 15.03 ± 3.26 minutes (Figure 2). However, this difference was not statistically significant (p = 0.083).

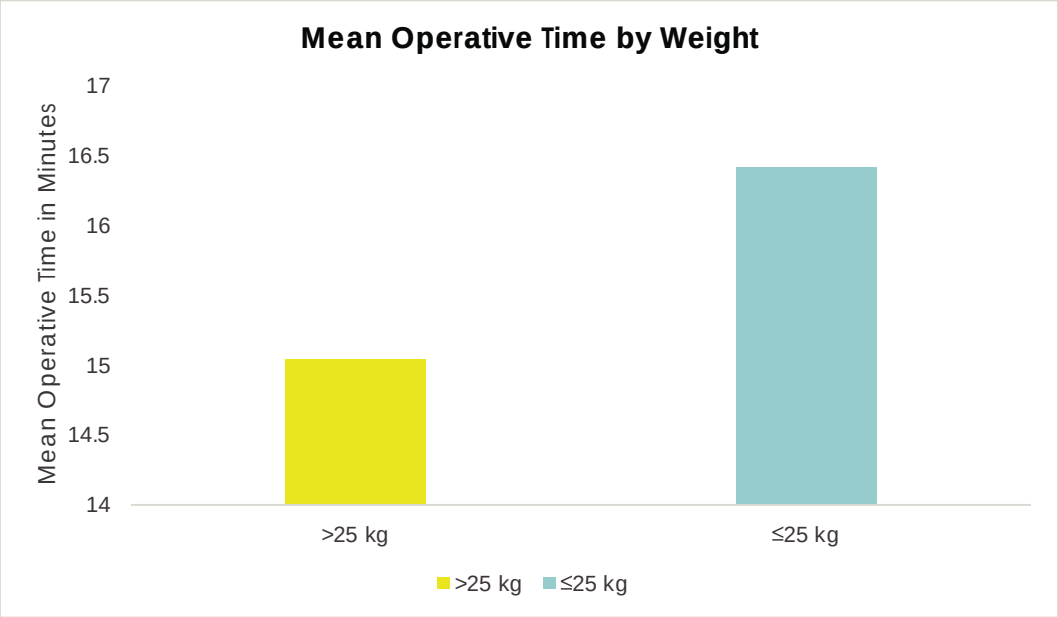

Figure 2: Mean Operative Time by Weight

Regarding hernia laterality (side of hernia), patients with bilateral hernia (n = 8) had a longer mean operative time of 16.87 ± 3.72 minutes as compared to 15.63 ± 2.91 minutes in unilateral hernia patients (n = 52), though this difference was not statistically significant (p = 0.284) **Figure 3**.

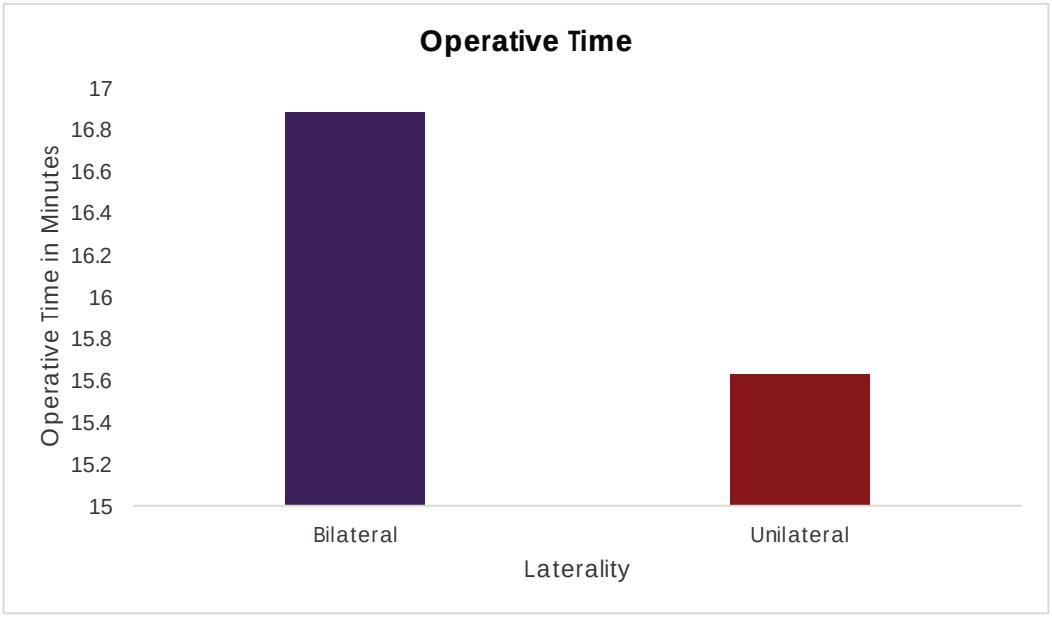

Figure 3: Mean Operative Time by Hernia Laterality

In this study, children aged less than 7 years (n = 32), 9 patients (28.1%) required 1 dose of analgesia, 23 patients (71.9%) required 2 doses, and no patient required 3 doses. In children aged more than 7 years (n = 28), 12 patients (42.9%) needed 1 dose, 12 patients (42.9%) required 2 doses, and 4 patients (14.3%) required 3 analgesia doses, **Figure 4.**

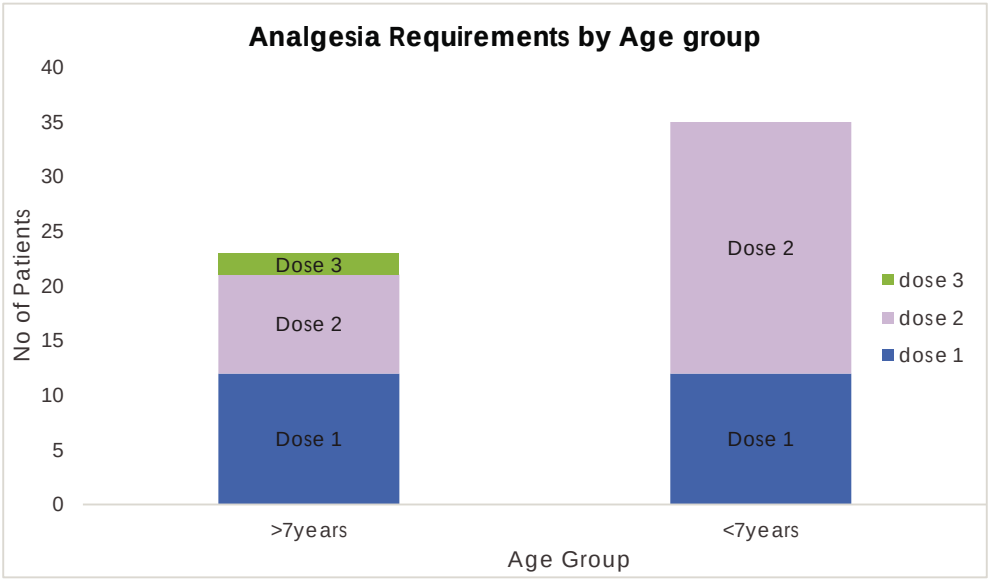

Figure 4: Bars Showing Analgesia Requirement by Age Groups

Among patients weighing less than 25 kg (n = 33), 9 cases (27.3%) required 1 dose, 24 patients (72.7%) required 2 doses, and no patient required 3 doses. Those weighing greater than 25 kg (n = 27), 12 cases (44.4%) required 1 dose, 11 patients (40.7%) required 2 doses, and 4 patients (14.8%) required 3 doses (**Figure 5**). The interpretation is that heavier children exhibited greater variation, with some requiring higher analgesic support. This difference was also not statistically significant (p = 0.877).

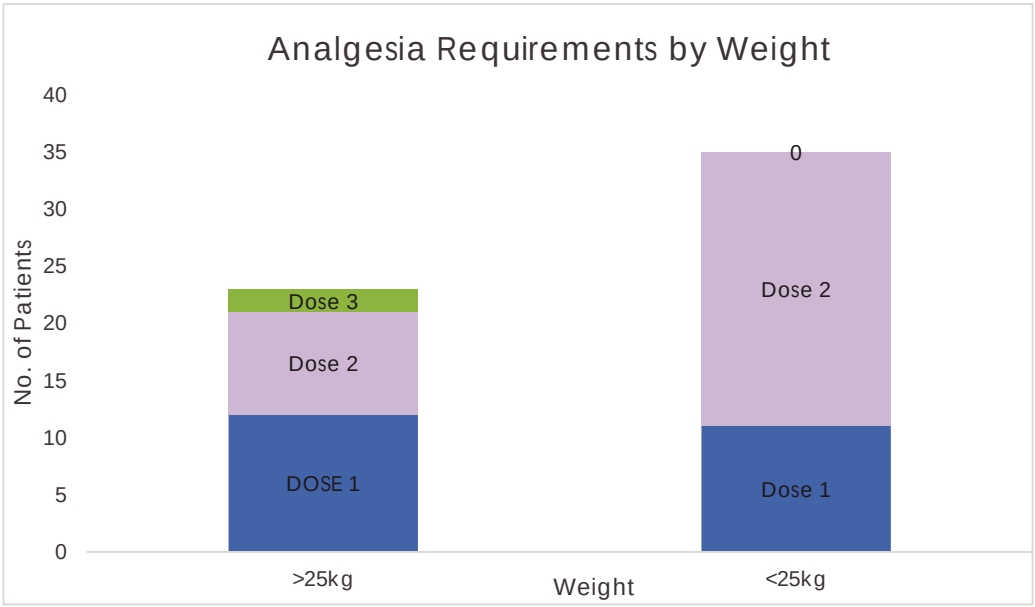

Figure 5: Analgesia Requirement by Weight

Patients with bilateral hernia had a notably higher proportion of patients requiring 3 doses of analgesia post-operatively as compared to unilateral cases, although the difference was not statistically significant (p =

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0.141). Among bilateral cases (n = 8), 2 cases (25.0%) required 1 dose, 4 patients (50.0%) required 2 doses, and 2 (25.0%) required 3 doses. In unilateral hernia cases (n = 52), 19 cases (36.5%) required 1 dose, 31 patients (59.6%) required 2 doses, and only 2 cases (3.8%) required 3 doses (**Figure 6**).

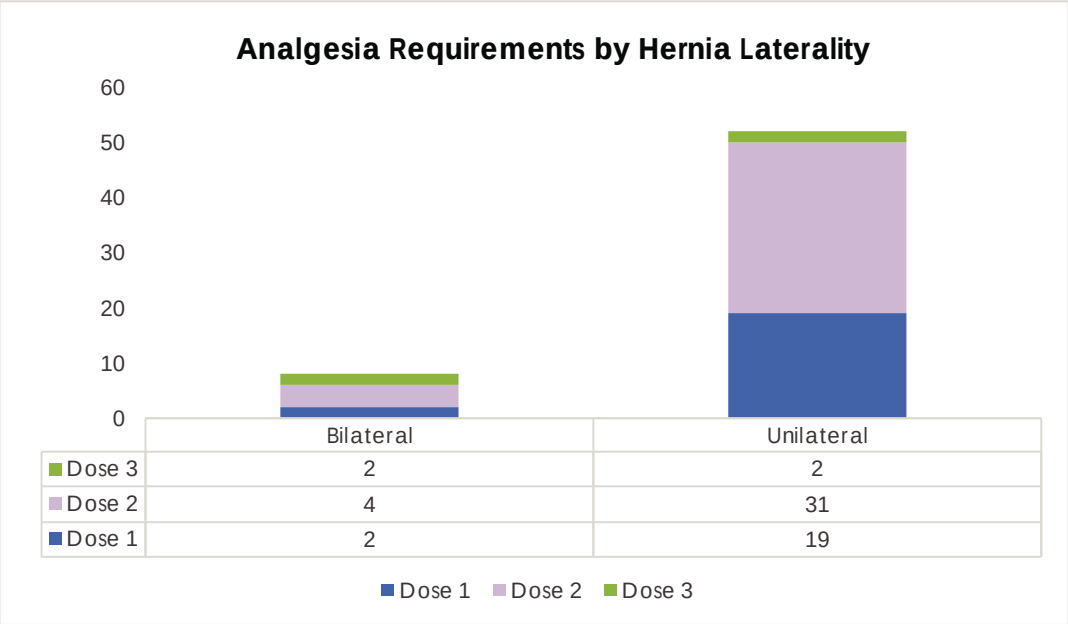

Figure 6: Analgesia Requirement by Hernia Laterality

All patients in this cohort were discharged on the first postoperative day, resulting in a uniform mean length of hospital stay of 1.0 ± 0.0 days, with no variation across age, weight, or laterality subgroups.

DISCUSSION

The adoption of laparoscopic operative methods has significantly expanded in pediatric surgery, and has become the standard of care across many Children Hospitals where it is now employed routinely in place of conventional open surgical methods[16]. The Laparoscopic approach offers several advantages over conventional open repair techniques in pediatric inguinal hernia patients, in that it got improved cosmetic outcomes, decreased postoperative pain, and shorter intra-operative times[17]. It ensures better visualization of the contralateral inguinal region, thus allowing simultaneous detection and repair of a contralateral inguinal hernia when present and also enables inspection of the bowel for ischemia in cases of incarcerated hernias[18].

In this cohort the mean operating time of the pediatric patients undergoing Laparoscopic needle-assisted hernia repair was 15.80±3.02 minutes. One dose analgesia requirement was observed in 21(35%) patients, two doses requirement was found in 35(58.3%) patients, and three doses were observed in 4(6.7%) patients, and the mean length of hospital stay was 1.00 ± 0.00 days.

One of the largest studies conducted on Laparoscopic needle-assisted inguinal hernia repair (LNAR), including 1023 patients with 1457 hernia repairs over a 10-year study period, with a mean follow-up of 5.97 years[19]. It reported a mean operative time of 24.8 ± 0.28 min, with 23.1 min for unilateral repairs and 28.6 min for bilateral hernia surgeries. In our study on 60 cases, the mean operative time was 15.8 ± 3.02 minutes, which is significantly shorter than that reported in the above study, and this difference could be attributed to the smaller sample size in our study and the surgeon's familiarity with the Tuohy needle technique.

In a comparison with another study, a recurrence rate of 0.5% in the Laparoscopic Percutaneous Extraperitoneal Closure (LPEC) group, lower than the 1.3% observed in conventional open repair, and a significantly reduced incidence of contralateral inguinal hernia (metachronous) due to routine laparoscopic inspection[20]. Our data also synchronize with their outcome findings in terms of recurrences, and supports the need to manage opposite patent process us vaginata, prophylactically when identified intra-operatively.

In a study on 100 pediatric patients, there were no recurrences and only one case of wound infection using the LPEC technique with a Tuohy needle[21]. The average mean operative time in their study was

22.08 ± 10.2 min for unilateral inguinal hernias and 27.6 ± 11.47 minutes for bilateral repairs, as compared to 15.80±3.02 min for unilateral and 16.88 ± 1.19 min for bilateral in our study, which is almost comparable[21]. The operative time for bilateral hernias is greater than unilateral cases, as in a few cases, the camera angle and port alignment may need adjustment to access the contralateral internal ring optimally, which can further prolong the procedure. Bilateral hernias also necessitate closure of both internal inguinal rings in a single operative session, hence doubling the steps involved in suture placement, knotting, and careful anatomical confirmation compared to unilateral repairs.

The results of our study strongly aligned with another study, and supported the efficacy, minimal invasiveness, and excellent patient outcomes of laparoscopic needle-assisted hernia repair in the pediatric age group[22]. It reported slightly shorter average operative times of 20.74 minutes for unilateral hernias as compared to 15.80±3.02 minutes in our study. Both studies demonstrated zero recurrence rate, no intra and post-operative complications, shorter hospital stays and no surgical site wound infections, thus reinforcing the safety and reliability of LNAR technique.

Another study demonstrated that single-port laparoscopic herniorrhaphy significantly reduced postoperative pain scores, hospital stay, and complication rates when compared to the conventional two-port approach[23]. It identified an increased postoperative inflammatory marker in its patients and the use of a two-port technique as independent predictors of recurrence, hence highlighted the potential benefit of minimizing laparoscopic port access during hernia repair surgery[23]. Although our study technique utilized two Laparoscopic insertion ports, our no recurrence rates remained comparable to their study, indicating that even in resource-limited settings, two port minimally invasive needle-assisted approaches can yield effective and safe outcomes.

Another study reported valuable insight into the current evolving acceptance of laparoscopic needle-assisted hernia repair in pediatric surgery[24]. The author stated that initially he was resistant to adopting the laparoscopic approach in hernia repairs due to concerns over higher recurrence rates, but later embraced the Tuohy needle-based laparoscopic technique, emphasizing its safety, efficacy, and favorable cosmetic outcomes[24]. He reported a recurrence rate of only 0.3% with an average follow-up period of 2.6 years and hence supported the paradigm shift towards minimally invasive laparoscopic repair as a safe alternative to open repair, thus aligning with the outcomes observed in our cohort[24].

Although the outcomes of our study are promising in terms of efficacy, the number of patients included may not provide adequate statistical power to detect rare complications or recurrence over the long term. Therefore, long-term follow-up studies extending beyond at least 5 years are recommended to assess the delayed complications like testicular atrophy and hernia recurrences.

CONCLUSION

The Tuohy needle-assisted Laparoscopic two-port technique offers advantages of simplicity, minimal tissue dissection and scarring, and reproducibility in resource-limited settings, thus making it a valuable safe alternative to both open and conventional multi-port laparoscopic herniotomy procedures in pediatric inguinal hernia patients.

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CONFLICT OF INTEREST

None

ETHICAL APPROVAL

The ethical approval from the IRB was obtained before the commencement of this research (Letter No: SMDC/SMRC/ 244-22 dated 16-04-22).

AUTHORS' CONTRIBUTION

All participants equally contributed as per ICMJE Policy.

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