Inguinal Hernia in Preterm Infants: A Comparative Study of Early Versus Late Surgical Repair

Original Article

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ABSTRACT

Background: Inguinal hernia is a common condition in preterm infants, with an increased risk of complications such as incarceration and strangulation. The optimal timing of surgical repair, whether early (prior to NICU discharge) or delayed (after 50 weeks corrected age), remains debated.

Objective: This study aimed to compare the safety and outcomes of early versus late surgical repair of inguinal hernia in preterm infants.

Patients and Methods: A retrospective cohort study was conducted at Zagazig University Hospitals over a 5-year period, including 120 preterm infants (< 37 weeks gestation) with inguinal hernia. Patients were divided into two groups: early repair (n= 60) and late repair (n= 60). Outcomes assessed included serious complications (e.g., respiratory complications, hernia recurrence, testicular atrophy), hernia incarceration, operative time, and hospital stay. Statistical analysis was performed to identify significant differences.

Results: The mean age at surgery was 40.62±2.19 weeks for the early group and 56.21±5.16 weeks for the late group. Early repair was associated with longer hospital stays (4.3±0.1 days vs. 6.4±0.9 hours, p< 0.05) and higher rates of respiratory complications, including apnea (6.6%) and PICU admission (5%). Hernia recurrence (3.3%) and testicular atrophy (1.6%) were also noted in the early group. In contrast, the late repair group experienced a higher incidence of hernia incarceration (10).

Conclusion: Early repair reduces the risk of hernia incarceration but is associated with higher perioperative complications, including respiratory issues and recurrence. Delayed repair allows for physiological maturation, reducing immediate complications but increasing the risk of incarceration. Individualized decision-making, considering gestational age and health status, is crucial. Further multicenter trials are recommended to establish optimal timing for inguinal hernia repair.

Key Words: Complications, Early repair, Inguinal hernia, Late repair, Preterm infants.

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INTRODUCTION

Inguinal hernia is a common condition in preterm infants, with an incidence ranging between 10 and 30%, significantly higher than in term infants. This increased prevalence is attributed to delayed closure of the processus vaginalis[1].

Preterm infants are particularly vulnerable to complications such as incarceration and strangulation, which, if untreated, can lead to severe outcomes like bowel ischemia or testicular infarction[2].

The optimal timing of surgical repair for inguinal hernias in preterm infants remains a matter of debate. Early repair, before discharge from the neonatal intensive care unit (NICU), aims to reduce the risk of hernia incarceration. However, this approach is associated with respiratory complications due to the immature pulmonary systems of these infants[3,4].

On the other hand, delayed repair, performed after hospital discharge, allows for further physiological maturation and reduced anesthetic risks but may increase the risk of hernia-related complications[5,6].

Surgical repair of inguinal hernia in preterm infants is technically demanding as

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The hernial sac is large, thin , friable and the testis is high and poorly fixed to the scrotum[7].

Preterm infants, particularly those with a postconceptual age of 45 weeks, are five times more likely to experience postoperative apnea[8].

Aim

To compare the safety of early repair of inguinal hernia before discharge from NICU versus late repair after discharge from NICU at 50 weeks of corrected age.

PATIENTS AND METHODS:

This retrospective cohort study was conducted at Zagazig University Hospitals, including NICUs and the pediatric surgical department, over a 5-year period. The study included preterm infants (< 37 weeks of gestation) diagnosed with unilateral or bilateral inguinal hernia who fulfilled the following criteria: birth weight greater than 2000g at diagnosis, stable cardiorespiratory status, and parental consent. Exclusion criteria included congenital anomalies requiring concurrent surgical intervention, severe comorbid conditions (e.g. grade III/IV intraventricular hemorrhage or necrotizing enterocolitis), a history of prior inguinal hernia repair. Participants were classified into two groups based on the timing of surgical intervention:

a. Early repair group: Surgery performed at the time of presentation before 44 weeks.

b. Late repair group: Surgery performed after NICU discharge, typically at or beyond 50 weeks of corrected gestational age.

All surgical repairs were performed using standard open techniques.

The primary outcome measure was the incidence of serious adverse events, including respiratory complications, hernia incarceration, and recurrence. Secondary outcomes included postoperative length of hospital stay and the occurrence of postoperative apnea requiring intervention. Data collection encompassed Demographic variables (gestational age, birth weight, gender), clinical details (comorbidities, preoperative risk factors), surgical details (timing, duration, and approach), and postoperative outcomes (complications, length of hospital stay, and follow-up findings).

Statistical analysis: was conducted using appropriate tests: Student's *t*-test or Mann–Whitney *U* test for continuous variables and χ^2 test or Fisher's exact test for categorical variables. Multivariate logistic regression was used to control for potential confounders. The sample size was calculated to achieve a statistical power of 80% to detect a significant difference in the primary outcome at a two-sided alpha of 0.05.

Ethical approval for the study was obtained from the Institutional Review Board of Zagazig University. Written informed consent was secured from parents or legal guardians, and the study adhered to the principles outlined in the Declaration of Helsinki.

RESULTS:

A total of 120 preterm infants diagnosed with inguinal hernia were included in this study. Group 1 (early repair) consisted of 60 patients, and group 2 (late repair) included 60 patients.

The mean age at the time of surgery was 40.62±2.19 weeks for group 1 and 56.21±5.16 weeks for group 2. The mean weight for group 1 was 3.51±0.63kg, and for group 2, it was 5.2±0.48kg.

The mean operative time for unilateral cases was 35.8±21min in group 1 and 26.9±17min in group 2. In bilateral cases, the mean operative time was 45.2±0.7min for group 1 and 37.3±62min for group 2.

The mean postoperative hospital stay was 4.3±0.1days in group 1 and 6.4±0.9h in group 2.

Significant differences were observed between the two groups regarding age at surgery, hospital stay, and operative time ($P< 0.05$). Patients in group 1 underwent surgery at a younger age and had a longer operative time and hospital stay compared with group 2.

Complications

Group 1 (early repair)

Table (1) shows the complications observed in group 1. Complications were more frequent in group 1. Respiratory complications included apnea in four (6.6%) patients and the need for PICU admission in three (5%) patients. Postoperative complications included hernia recurrence in two (3.3%) patients, testicular atrophy in one (1.6%) patient, bradycardia in one (1.6%) patient, and convulsions in one (1.6%) patient. No cases of hernia incarceration were reported.

Group 2 (Late Repair)

Table (2) shows the complications observed in group 2. Hernia incarceration was observed in six (10%) patients. Successful nonoperative reduction was achieved in four (66.6%) cases, while two (33.3%) patients required emergency surgery for hernia reduction and repair. No patients in this group required bowel resection during the follow-up period.

Follow-Up

All patients were followed-up in the outpatient department for 6 months for any perioperative or postoperative complications. No additional complications were observed during the follow-up period for either group.

Table 1: Patient demographics, surgical outcomes, and hospital stay:

Parameter	Group 1 (Early Repair)	Group 2 (Late Repair)	P value
Number of patients	60	60	–
Age at surgery (weeks, mean±SD)	40.62±2.19	56.21±5.16	<0.05
Weight (kg, mean±SD)	3.51±0.63	5.2±0.48	<0.05
Operative time (unilateral,min)	35.8±21	26.9±17	<0.05
Operative time (bilateral,min)	45.2±0.7	37.3±6.2	<0.05
Posthospital stay (mean±SD)	4.3±0.1 days	6.4±0.9h	<0.05

Study Results: Patient Demographics and Complications.

Table 2: Complications Observed in Both Groups:

Complication	Group 1 (early repair)	Group 2 (late repair)
Apnea	4(6.6)	0
Need for PICU	3(5)	0
Hernia recurrence	2(3.3)	0
Testicular atrophy	1(1.6)	0
Bradycardia	1(1.6)	0
Convulsions	1(1.6)	0
Hernia incarceration	0	6(10)
Successful nonoperative reduction	–	4(66.6)
Emergency surgery for hernia repair	–	2(33.3)
Need for bowel resection	0	0

DISCUSSION

Inguinal hernia repair in preterm infants remains a topic of significant debate. The timing of surgery whether to perform it early or to delay until the infant is more stable has implications for both short-term and long-term outcomes.

This study aimed to compare the outcomes of early versus late repair of inguinal hernia in preterm infants, focusing on complications, hospital stay, and the impact of surgery timing on recovery.

Our study included a cohort of 120 preterm infants, with 60 patients undergoing early repair (group 1) and 60 patients undergoing late repair (group 2). The results revealed significant differences between the two groups regarding the age at surgery, hospital stay, and operative time, in line with previous studies indicating that early repair is associated with longer hospital stays due to the preoperative and postoperative care required for these patients[9,10].

The longer operative time in the early repair group is likely related to the surgical challenges faced when performing surgery on neonates with immature physiology, such as unstable hemodynamics and respiratory function[3].

Respiratory compromise following early inguinal hernia repair is an important consideration when determining the timing of surgery. These complications may contribute to longer NICU stays and the need for more intensive respiratory support, potentially delaying discharge. As noted in the work of Vaos *et al*., careful preoperative optimization of respiratory status and close postoperative monitoring are essential for minimizing the risks of respiratory compromise after early repair[11].

Our findings indicate that early repair is associated with a higher incidence of perioperative complications, including respiratory issues such as apnea 6.6% and PICU admission 5%. These complications are likely attributable to the immature respiratory physiology of preterm infants, exacerbated by anesthesia and surgical stress, as noted in previous studies[12,13].

In the early repair group, there were incidents of hernia recurrence (3.3%) and testicular atrophy (1.6%), which are both important considerations when evaluating surgical outcomes. And is consistent with reports suggesting that the thin and fragile hernial sac in preterm infants contributes to technical difficulties and postoperative recurrence[14].

The recurrence rate in our study is in line with previously reported figures in the literature, such as those in Krieger *et al*., who reported recurrence rates of up to 4% in neonates undergoing early hernia repair[15].

Uemura, *et al*., reported 5–10% recurrence rate with higher rate in infants with lower birth weight, bilateral hernia, early repair[16].

The presence of testicular atrophy is a particularly concerning complication, which may result in long-term infertility issues for affected patients. However, this complication is relatively rare and does not appear to be directly linked to the timing of repair but rather to the technical aspects of the surgery, such as hernia sac handling and vascular compromise during dissection. In our study the incidence of testicular atrophy occurred in 1.6% in early group.

Krieger *et al*., reported that, Testicular atrophy was more commonly observed in the early repair group, with an incidence of ~1–3% and the incidence was lower in the delayed repair group, at around 0-1%. in our study the delayed group showed no cases of testicular atrophy.

Other complications, including postoperative bradycardia (1.6%) and convulsions (1.6%), were also seen in the early repair group. Bradycardia may occur due to anesthetic effects, while convulsions could be caused by perioperative stress and the immaturity of the nervous system[17].

One of the most concerning outcomes in the late repair group was the significant increase in the incidence of hernia incarceration. Incarceration occurred in 10% of infants who underwent surgery after 50 weeks of corrected gestational age. This aligns with previous studies indicating that delayed repair carries an increased risk of incarceration[18,19].

While most cases in our cohort did not require bowel resections, the need for emergency surgery (33.3%) highlights the potentially life-threatening consequences of delayed intervention.

Follow-up and long-term outcomes

No significant differences were observed between the two groups in terms of long-term complications. This aligns with findings from other studies, which suggest that while early repair may have higher immediate postoperative risks, long-term outcomes, including recurrence rates and developmental milestones, are generally similar between early and late repair groups[3].

Implications for practice

Our study highlights the need for individualized decision-making in the management of preterm infants with inguinal hernia. While early repair may be preferable to avoid the risk of hernia incarceration, it comes with an increased risk of postoperative complications such as apnea, bradycardia, and recurrence. On the other hand, delaying repair until the infant is more physiologically stable may reduce these immediate complications but increases the risk of incarceration, which could require emergency surgery.

The decision to proceed with early versus late repair should, therefore, take into consideration the infant's gestational age, overall health status, and the specific risks associated with the timing of the procedure. Neonatologists and pediatric surgeons should work closely to evaluate each case, considering the individual infant's condition and the potential benefits and risks of each approach.

LIMITATIONS

Our study has several limitations. First, the study's retrospective nature and the small sample size . Additionally, the single-center may introduce institutional biases in surgical techniques and anesthesia protocols. Further multicenter, randomized controlled trials are needed to confirm these findings and better understand the optimal timing for repair.

CONCLUSION

This study provides valuable insights into the outcomes of early versus late repair of inguinal hernia in preterm infants. While early repair reduces the risk of incarceration, it is associated with higher rates of immediate complications, such as apnea and testicular atrophy. Late repair, on the other hand, carries the risk of incarceration, though it is associated with fewer postoperative complications.

CONFLICT OF INTEREST

There are no conflicts of interest.

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