

Research Article

Thoracoscopic versus Open Diaphragmatic Plication for Diaphragmatic Eventration in Pediatric Patients at Saidu Group of Teaching Hospitals: A Retrospective Cohort Study

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ABSTRACT

Objectives: To compare the surgical outcomes of thoracoscopic versus open diaphragmatic plication for the management of diaphragmatic eventration in pediatric patients at Saidu Group of Teaching Hospitals using a retrospective cohort design.

Materials and Methods: After obtaining approval from CPSP and the Ethical Review Committee of Saidu Group of Teaching Hospitals, medical records of eligible pediatric patients who underwent thoracoscopic or open diaphragmatic plication during the study period were reviewed. Demographic, clinical, operative, and postoperative data were extracted from hospital records. Patients were categorized into Group A (thoracoscopic plication) and Group B (open plication) according to the documented surgical approach. Patient confidentiality was maintained throughout the study, and the data were analyzed using SPSS version 26.

Results: A total of 46 pediatric patients (23 per group) were included. Thoracoscopic diaphragmatic plication was associated with significantly less blood loss, shorter chest tube duration, reduced mechanical ventilation, and a shorter hospital stay than open plication (all $p < 0.001$), while postoperative complications, recurrence, follow-up duration, and mortality were comparable between the two groups.

Conclusion: It was concluded that thoracoscopic diaphragmatic plication is a safe and preferred treatment for symptomatic diaphragmatic eventration in children, offering less surgical trauma, faster recovery, and recurrence rates comparable to those of open surgery when appropriate surgical expertise is available.

Keywords: Thoracoscopic Diaphragmatic Plication, Open Diaphragmatic Plication, Diaphragmatic Eventration.

INTRODUCTION

Diaphragmatic eventration (DE) is defined by aberrant elevation of the diaphragm as a result of either phrenic nerve injury-induced paralysis or a congenital deficit of diaphragmatic muscle fibers.(1, 2) It can also happen as an iatrogenic consequence after mediastinal surgery or phrenic nerve traction associated to delivery.(3) The preferred course of treatment for those with symptoms is surgical plication. Diaphragmatic plication has historically been carried out with an open posterolateral thoracotomy, a tried-and-true technique with good results and a low rate of

complications.(4) However, thoracoscopic diaphragmatic plication has become a safe and successful substitute thanks to advancements in minimally invasive surgical procedures.(5, 6) It offers the advantages of less surgical trauma, quicker recovery, and better postoperative outcomes even in newborns and young children.(7)

Incomplete growth of the diaphragmatic muscle fibers or injury to the phrenic nerve are the main causes of diaphragmatic eventration, which results in diaphragmatic weakening or paralysis.(8) As a result, the abdominal organs move into the thoracic

cavity, squeezing lung tissue and impairing breathing.(9) While some older children may be asymptomatic and only found by accident during imaging tests, newborns and young children may exhibit respiratory distress, recurring respiratory infections, feeding issues, and growth retardation.

A rare disorder in children, diaphragmatic eventration frequently necessitates surgical plication to restore lung function and alleviate respiratory symptoms. Open diaphragmatic plication is still often used, especially in areas with low resources, even though thoracoscopic diaphragmatic plication has become more popular due to its minimally invasive nature. There is little data comparing the results of these two surgical techniques in the local pediatric population. In order to compare the perioperative and postoperative results of thoracoscopic versus open diaphragmatic plication in pediatric patients receiving care at Saidu Group of Teaching Hospitals, a retrospective cohort study was conducted. The results may assist determine the safest and most efficient method for treating diaphragmatic eventration in children and will offer local evidence to inform surgical decision-making.

Objective: To compare the surgical outcomes of thoracoscopic versus open diaphragmatic plication for the management of diaphragmatic eventration in pediatric patients at Saidu Group of Teaching Hospitals.

MATERIALS AND METHODS

Study Design: Retrospective cohort design

Study Setting: Department of pediatric surgery.

Duration of the study: The study was conducted from Jan 2019 to Dec 2025.

Sampling Technique: Non-probability Consecutive sampling

Selection criteria

Inclusion criteria:

- Pediatric patients of 0 to 10 years of age.
- Patients who underwent thoracoscopic or open diaphragmatic plication at the Saidu Group of Teaching Hospitals.
- Both genders.

Exclusion criteria:

- Patients with congenital diaphragmatic hernia.
- Patients who underwent other major thoracic or abdominal surgeries concurrently.

- Patients who underwent revision surgery following previous diaphragmatic plication.
- Patients with neuromuscular diseases.

Methods: Approval from the CPSP and the hospital ethical review committee of Saidu Group of Teaching Hospitals was obtained prior to the commencement of the study. The hospital information system and patient files were used to identify the medical records of all pediatric patients who had thoracoscopic or open diaphragmatic plication for diaphragmatic eventration throughout the specified study period. Demographic information (age, gender, and weight), clinical information (side of eventration, presenting symptoms, and comorbidities), preoperative examination results, surgical procedure type (thoracoscopic or open diaphragmatic plication), length of surgery (minutes), intraoperative complications, length of postoperative mechanical ventilation (if necessary), length of chest drain placement (days), length of hospital stay, postoperative complications (including wound infection, pneumothorax, atelectasis, and pleural effusion), recurrence of diaphragmatic eventration during follow-up, and postoperative mortality, if any.

Based on the documented surgical approach, patients were categorized into two cohorts: Group A, comprising those who underwent thoracoscopic diaphragmatic plication, and Group B, comprising those who underwent open diaphragmatic plication. Patient confidentiality was strictly maintained throughout the study. For Statistical analysis data were analyzed by using SPSS version 26.

RESULTS

A total of 46 pediatric patients were included, with 23 patients each in the thoracoscopic and open diaphragmatic plication groups. The mean age was 2.47 ± 6.75 years in the thoracoscopic group and 2.85 ± 1.39 years in the open group, while the mean weight was 11.6 ± 3.4 kg and 12.0 ± 3.8 kg, respectively. In the thoracoscopic group, 14 (60.9%) patients were male and 9 (39.1%) were female, whereas in the open group 15 (65.2%) were male and 8 (34.8%) were female. Right-sided diaphragmatic eventration was observed in 15 (65.2%) patients in the thoracoscopic group and 8 (34.8%) in the open group, while left-sided eventration was present in 14 (60.9%) and 9 (39.1%) patients, respectively (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics (N=46)

Variables	Groups	
	Thoracoscopic (N=23)	Open (N=23)
Age (Years)	2.47±6.75	2.85±1.39
Gender		
Male	14(60.9%)	9(39.1%)
Female	15(65.2%)	8(34.8%)
Weight (Kg)	11.6 ± 3.4	12.0 ± 3.8
Sides		
Right-Sided Eventration	15(65.2%)	8(34.8%)
Left-Sided Eventration	14(60.9%)	9(39.1%)

The mean operative time was significantly different between the thoracoscopic and open diaphragmatic plication groups (2.47 ± 6.75 vs. 2.85 ± 1.39 , $p<0.001$). Patients who underwent thoracoscopic plication had significantly lower intraoperative blood loss (18.5 ± 9.6 mL vs. 47.2 ± 18.8 mL), shorter

duration of chest tube placement (2.5 ± 0.8 vs. 4.0 ± 1.3 days), shorter duration of postoperative mechanical ventilation (0.7 ± 0.9 vs. 1.6 ± 1.4 days), and reduced hospital stay (4.9 ± 1.5 vs. 7.3 ± 2.0 days) compared with the open plication group (all $p<0.001$) (Table 2).

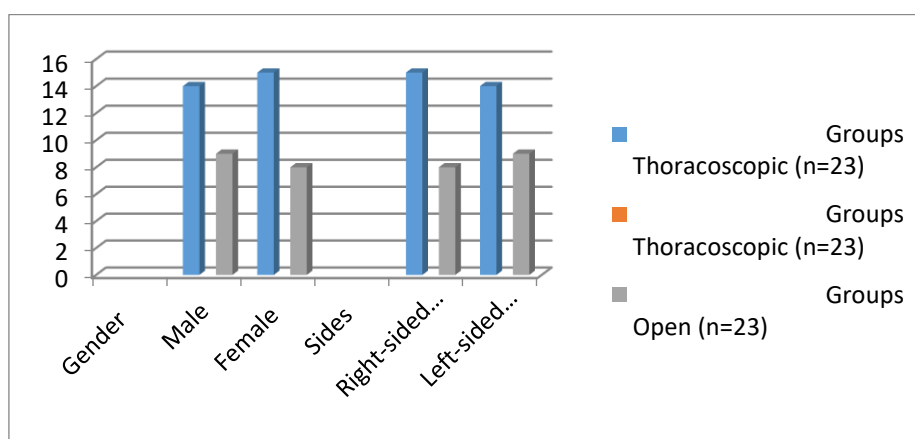


Fig 1: Baseline Demographic Characteristics of Patients

Table 2: Comparison of Post-Operative Outcomes (N=46)

Variables	Groups		P-Value
	Thoracoscopic (N=23)	Open (N=23)	
Operative Time (Minutes)	2.47±6.75	2.85±1.39	0.00
Blood Loss (ML)	18.5 ± 9.6	47.2 ± 18.8	0.00
Duration Of Chest Tube (Days)	2.5±0.8	4.0±1.3	0.00
Mechanical Ventilation (Days)	0.7±0.9	1.6±1.4	0.00
Hospital Stay (Days)	4.9±1.5	7.3±2.0	0.00

Postoperative wound infection occurred in 1 (4.3%) patient in the thoracoscopic group and 5 (21.7%) patients in the open group ($p=0.08$). Pneumothorax was observed in 1 (4.3%) and 3 (13.0%) patients, respectively ($p=0.29$), while pleural effusion occurred in 1 (4.3%) patient in the thoracoscopic group and

2 (8.7%) patients in the open group ($p=0.55$). Reoperation was required in 1 (4.3%) patient in the open group but in none of the thoracoscopic cases ($p=0.32$). No postoperative mortality was observed in either group (Table 3).

Table 3: Comparison of Postoperative Complications between Thoracoscopic and Open Diaphragmatic Plication in Pediatric Patients with Diaphragmatic Eventration

Variables	Groups
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	Thoracoscopic (N=23)	Open (N=23)	P-Value
Wound Infection	1(4.3%)	5(21.7%)	0.08
Pneumothorax	1(4.3%)	3(13.0%)	0.29
Pleural Effusion	1(4.3%)	2(8.7%)	0.55
Reoperation	0 (0.0)	1(4.3%)	0.32
Mortality	0 (0.0)	0 (0.0)	0.00

During follow-up, recurrence of diaphragmatic eventration was observed in 1 (4.3%) patient in the thoracoscopic group and 2 (8.7%) patients in the open group, with no statistically significant difference between the groups

($p=0.55$). The mean follow-up duration was 11.2 ± 3.6 months for the thoracoscopic group and 10.8 ± 3.9 months for the open group, which was also not significantly different ($p=0.65$) (Table 4).

Table 4: Comparison of Recurrence and Follow-Up Duration between the Thoracoscopic and Open Plication Groups

Variables	Groups		P-Value
	Thoracoscopic (N=23)	Open (N=23)	
Recurrence	1(4.3%)	2(9.7%)	0.55
Follow-Up Duration (Months)	11.2 ± 3.6	10.8 ± 3.9	0.65

DISCUSSION

Diaphragmatic eventration is a rare clinical problem in children.(10) The present retrospective cohort study investigated the outcomes of thoracoscopic versus open diaphragmatic plication in pediatric patients with diaphragmatic eversion. This study stated that the thoracoscopic approach was linked to significantly shorter hospital stays, shorter chest drain times, shorter postoperative breathing times, and less intraoperative blood loss. However, there were no significant differences between the two methods in terms of follow-up time or recurrence rate. Because thoracoscopic diaphragmatic plication is minimally invasive, it has various advantages over the traditional open method as stated in a previous literature.(11) Because the treatment is carried out through tiny incisions, there is minimal tissue damage, intraoperative blood loss, and postoperative pain. The diaphragm can be precisely plicated while causing the least amount of damage to nearby buildings because to improved vision of the operating field. As a result, patients had shorter postoperative mechanical ventilation stays, earlier chest drain removal, quicker respiratory function recovery, shorter hospital stays, better cosmetic results, and an earlier return to regular daily activities. Thoracoscopic plication is a safe, efficient, and increasingly popular surgical alternative for pediatric patients with diaphragmatic eventration because studies have shown that it produces recurrence rates and long-term surgical outcomes comparable to those of the open

technique. Another study conducted by Go Miyano et al.(12) also support our study finding. Thoracoscopic plication is a minimally invasive, safe, and effective method for treating symptomatic diaphragmatic eventration, according to a study by Tsubasa Takahashi et al. The authors stated that this strategy should be regarded as a preferred treatment option, even in neonates, when sufficient surgical skill is available, after demonstrating satisfactory surgical outcomes with minimum problems.

In comparison to open surgery, thoracoscopic diaphragmatic plication demonstrated noticeably improved perioperative and postoperative results in this study. The thoracoscopic group experienced considerably less intraoperative blood loss (18.5 ± 9.6 ml vs. 47.2 ± 18.8 ml; $p<0.001$), which is probably because the less invasive treatment caused less tissue damage and is in line with earlier research findings. In a similar vein, the thoracoscopic group experienced a significantly shorter duration of chest drainage (2.5 ± 0.8 vs. 4.0 ± 1.3 days; $p<0.001$), postoperative ventilation (0.7 ± 0.9 vs. 1.6 ± 1.4 days; $p<0.001$), and length of hospital stay (4.9 ± 1.5 vs. 7.3 ± 2.0 days; $p<0.001$). In terms of postoperative complications, the thoracoscopic group experienced fewer wound infections, pneumothorax, and pleural effusions; however, because of the small sample size, the differences were not statistically significant. Only the open surgery group needed reoperations, and neither group experienced any postoperative mortality,

demonstrating the safety of both techniques. Long-term results were likewise similar: neither the follow-up length (11.2 ± 3.6 vs. 10.8 ± 3.9 months; $p=0.65$) nor the recurrence rate (4.3% vs. 8.7%; $p=0.55$) differed substantially between the thoracoscopic and open surgery groups. These findings are in line with reports by Kim et al.(13) and St. Peter et al.(14) showing that thoracoscopic diaphragmatic plication is a less invasive and equally effective substitute for open surgery, allowing for a quicker recovery with similar long-term results.

CONCLUSION

It was concluded that thoracoscopic diaphragmatic plication should be considered the preferred procedure for treating symptomatic diaphragmatic eversion in children, provided the necessary surgical expertise is available, due to the reduced surgical trauma, faster postoperative recovery, and comparable recurrence rates.

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