

Evaluation of Congenital Diaphragmatic Hernia Repair with Thoracoscope in Neonates

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Abstract

Introduction: congenital diaphragmatic hernia (CDH) is one of the most common congenital anomalies with significant morbidity and mortality. The most common form of CDH is Bochdaleck type of the anomaly, with the defect located in poster lateral part of the diaphragm. The aim of this retrospective study was to compare the outcome of open repair (OR) with thoracoscopic repair (TR) for Bochdaleck CDH at Mofid Children Hospital.

Materials and Methods: neonates with Bochdaleck CDH at Mofid Children Hospital from 2015 to 2018 were studied. After meeting the criteria, the information during and after surgery was recorded in the questionnaire. We compared the data with independent T- test and Chi-square.

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Keywords

- Congenital diaphragmatic hernia
- Bochdaleck diaphragmatic hernia
- Bochdaleck diaphragmatic hernia

Results: a total number of 18 patients were included, of whom 9 underwent thoracoscopic repair and 9 underwent open repair. Mean age at the operation was 5.3 days in TR group vs. 3.89days in OR group ($P= 0.9$). In TRgroup 37.5% of the patients were female and 62.5% male, versus OR group with 22.2% female and 77.8% male ($P= 0.62$). Gestational age at birth in TR group was 37.2 weeks vs 37.89 weeks in OR group ($P= 0.85$). Birth weight in TR group was 2904.22 g vs. 2988.88g in OR group ($P= 0.96$). Delivery type in TR group was NVD in 22.2% and C/S in 77.8%;vs. 33.3% NVD and 66.7% C/S in OR group ($P = 1$). In TR group none had prenatal diagnosis, while in OR group 11.1% had and 88.9% didn't have prenatal diagnosis ($P= 1$). Entrance status to Mofid Children Hospital: all of them were nonintubated, with no family history of CDH. CPR Hx: TR one vs. OR none ($P= 1$), recurrence: TR 0vs. 1 OR ($P= 0.3$), Echo abnormal results: TR 44.4 % vs. OR 66.7 ($P=0.63$), brain abnormal US: TR 0 vs. OR 1 ($P= 0.38$), skeletal anomaly: 1in TR ($P= 1$), post-op admission: TR 18d vs. OR 25d ($P= 0.04$), commencement of enteral feeding: TR 8.7d vs. OR 5.7d ($P= 0.78$), complications: 1 in OR ($P =0.3$), survival: 1 death in TR & 1 in OR ($P= 1$), death age: TR at 270d vs. OR 81d ($P= 1$).

Conclusion: thoracoscopic repair appears to be as effective as open repair for treating cardiopulmonary stable patients. Thoracoscopic repair is in some way much better than open repair such as wound cosmetic and hospital stay.

Introduction

One of the relatively common neonatal abnormalities is congenital diaphragmatic hernia (CDH).¹ It can be associated with significant mortality and morbidity. Determining the factors involved in prognosis and selecting appropriate surgical method can play an important role

for increasing the chances of survival in these patients.

Mofid Children Hospital, as a referral center from different parts of the country, accepts a significant number of patients annually who undergo reconstructive surgery. In this study, the effective factors

in choosing the type of surgery by thoracoscopic and open methods were investigated in order to reduce morbidity and mortality. This study is a retrospective one that has been evaluated and reviewed on the files of the hospital. Our study is a comparison of the treatment outcomes of Bucholadalek diaphragmatic hernia, referred to Mofid Children Hospital, with both open and thoracoscopic methods. During this study, the effects of various factors on the results were investigated. The specific purpose of this study is to identify appropriate preoperative criteria to increase the chances of success of one of these two methods.

Materials and Methods

In this study, cases of congenital diaphragmatic hernia admitted to neonatal Intensive Care Unit in 2015 until 2018 were included. Hemodynamically stable, non-intubated patients were chosen for study after explaining both types of thoracoscopic and open surgery and the possible benefits and complications of each technique for the parents and obtaining written consent from them, then they were randomly operated on by thoracoscopic or open surgery. The process of carrying out the study has been approved by the ethics committee of Shahid Beheshti University of Medical Sciences.

In the study, demographic information, information about the disease and type of hernia, length of hospital stay, number of surgical cases, postoperative complications (such as recurrence,

mortality, incisional hernia, and wound infection), duration of antibiotic treatment, duration of chest tube in place, duration of ventilator dependency, and need for readmission were assessed.

Input criteria: All stable and non-intubated patients who were diagnosed with congenital diaphragmatic hernia referred to Mofid Children Hospital in Tehran, with the desire and consent of their parents for each of these two surgical methods were included in the study.

Output criteria:

1. Dissatisfaction of the patient's parents to participate in the project
2. Patients who did not stay in the study until the end of the study

After selecting the patients to enter the study, during and after treatment, the information was entered into a questionnaire. The information was entered in the SPSS statistical software version 17 and the two treatment groups were compared using statistical analysis.

Quantitative data were described by means and variance and compared with t-test.

Qualitative data were compared with Chi-square test with frequency and percentage of description.

Ethical considerations: Sufficient explanation was given to the patient's parents about both types of surgery and the possible benefits and complications of each technique. Written consent was obtained from the patients and no additional costs were imposed on the patients.

Results

Among the 18 neonates studied in this study, 22% were male and 77% were female in the open surgery group; and 37.5% were female and 62.5% were male in the thoracoscopic group. There was no significant difference between sex and type of surgery ($P=0.62$).

The mean gestational age of neonates born in the open surgery group was 37.89 weeks, and in the thoracoscopic group was 37.2 weeks. In terms of treatment results, there was no significant difference between gestational age and type of surgery ($P=0.85$).

The mean age of surgery in the open surgery group was 3.89 days, and in the thoracoscopic group was 5.3 days. There was no significant difference between the age of surgery and the type of surgery ($P=0.9$).

Birth weight was 2988 g in open surgery group and 2904 g in thoracoscopic group. There was no significant difference between birth weight and type of surgery in terms of treatment results ($P=0.96$).

Regarding the type of delivery in the open surgery group, 33.3% were vaginal delivery and 66.7% were Cesarean Section. In thoracoscopy, they were 22.2% and 77.8%, respectively. In terms of treatment results, there was no significant difference between the type of delivery and the surgical method ($P=1.0$).

In terms of prenatal diagnosis in the open surgery group, 11.9% were diagnosed prenatally and in the thoracoscopic surgery group, all cases were diagnosed after birth. There was no significant difference between prenatal diagnosis and

type of surgery in terms of treatment results ($P=1.0$).

In terms of onset conditions, all 18 cases were non-intubated, of which 9 neonates were in open group and 9 cases in thoracoscopic group.

There was no family history of hernias in either groups.

Regarding the history of consanguineous marriage, in the open surgery group, 44.4% were unattached and 55.6% were attributed. In the thoracoscopic surgery group, 77.8% were unassigned and 22.2% were attributed. In terms of treatment results, there was no significant difference between the history of consanguineous marriage and the type of surgery ($P=0.335$).

In open surgery group, 16.7% were born in the Capital and 83.3% in some other cities. In the thoracoscopic group, it was 22.2% and 77.8%, respectively. In terms of treatment results, there was no significant difference between the place of birth and the type of surgery ($P=1.0$).

66.7% of patients who underwent open surgery and 44.4% of patients who underwent thoracoscopy had abnormal echocardiographic results. There was no significant difference between surgical method and echocardiographic results ($P=0.63$).

In the study for other anomalies, 2 patients had accompanying other anomalies; who underwent open surgery. There was no significant difference between other anomalies and surgical method in terms of treatment results ($P=0.47$).

In terms of type of organ in the thorax; there was small intestine in 12 people,

large intestine in 13, and stomach in 4, and spleen in 5. In terms of treatment results, there was no significant difference between the organ in the thorax and the type of surgery ($P=0.15$).

None of the patients had any gastrointestinal abnormalities during the operation. Patients' Characteristics are showed in **Table 1**.

Table 1. Patients' Characteristics (n = 18)	Open Group (9 cases)	Thoracoscopic group	P value
Gender (female)	77%	37.5%	0.62
mean gestational age (weeks)	37.89	37.2	0.85
mean age of surgery (days)	3.89	5.3	0.9
Birth weight(g)	2988	2904	0.96
type of delivery (cesarean)	66.7%	77.8%	1
prenatal diagnosis	11.9%	0%	1
consanguineous marriage (attributed)	55.6%	22.2%	0.335
Cardiac abnormality	66.7%	44.4%	0.63

Hernia's side in all cases was on the left. One patient in open group recurred. There was no significant difference between surgery and recurrence ($P=0.47$). The mean duration of postoperative hospitalization was 25 days in the open group and 18 days in the thoracoscopic group. In terms of treatment results, there was significant difference between the

duration of hospitalization and surgery ($P=0.04$).

The mean period of postoperative feeding was 8.7 days in the open group and 5.7 days in the thoracoscopic group. There was no significant difference between the surgical method and the age of onset of feeding ($P=0.78$).

Postoperative complications were seen only in one patient with open surgery. In terms of treatment results, there was no significant difference between postoperative recurrence and surgical procedure ($P=0.3$).

For survival, one died in the surgical open group and one died in thoracoscopy. In terms of treatment results, there is no

significant difference between survival and surgical method ($P=1$).

The age of death was 81 days in open surgery and 270 days in thoracoscopy group. There was no significant relationship between age of death and surgical method in terms of treatment results ($P=1$). Post operative results are shown in **Table 2**.

Table 2: Postoperative results

Postoperative data	Open Group	Thoracoscopic group	P value
-Hernia's side(left)	100%	100%	
-recurrence	11%(1)	0%	0.47
-mean duration of postoperative hospitalization(days)	25	18	0.04
-mean of postoperative feeding(days)	8.7	5.7	0.78
Mortality(N)	1(81 days)	1(270 days)	1

Discussion

Considering that Mofid Children Hospital is a referral center for surgery of newborns with diaphragmatic hernia and due to the high prevalence of this anomaly, this study is used to compare thoracoscopic and open methods for repair and also to evaluate the effective factors in choosing the method. In one study, most of the infants were male and the sex of the infant had no effect on determining the outcome of treatment.

In terms of birth weight, Apgar score, type of delivery by natural methods or

Cesarean Section, prenatal diagnosis, conditions of the birthplace of the infants, type of organ in the thorax, echocardiography and brain sonography results, there were no significant correlations between the two methods.

Gourley² and colleagues performed study on congenital diaphragmatic hernia on neonates. They reported successful thoracoscopic surgery is expected in infants with good pulmonary condition (the more stable the baby was). In this study the mean age of surgery was 3.89 days in the open group and 5.7 days in the

thoracoscopic group, and all cases were in good condition.

Gander JW³ et al. reported thoracoscopy is associated with lower morbidity and faster recovery but has an increase in recurrence or complications compared to the open surgery. They concluded that early recurrence in thoracoscopic method is more than open surgery. In unstable patients, thoracoscopic repair is not recommended due to further recurrence. In this study, there was no significant difference between recurrence and surgical method.

Costerus S⁴ studied on 108 neonates with appropriate criteria for repair of CDH, 75 neonates underwent thoracoscopy and 34 neonates underwent open surgery. The results of thoracoscopic and open repair were almost similar, but the recurrence rate was just higher in the thoracoscopic group. In the current study, postoperative complications were seen only in one patient in open surgery group. In terms of treatment results, there is no significant difference between postoperative recurrence and surgical procedure (P value= 0.3).

Gomes Ferreira⁵, performed thoracoscopy in 40 neonates. Significant statistical differences were found between results of repair secondary to postnatal PaCO₂ >60 mmHg, intrathoracic position of the stomach, signs of pulmonary hypertension on the postnatal cardiac ultrasound, and preoperative O₂ saturation. They reported that an oxygenation index >3.0 was the only suggested accompanying factor of conversion to open surgery, and considered it as a main post-operative

complication of thoracoscopic surgery. Congenital diaphragmatic hernia is able to be repaired securely in the neonates by thoracoscopic surgery. The limiting factor for repair by the thoracoscope is persistent pulmonary hypertension of the newborn. The best preoperative indicator for persistent pulmonary hypertension of the newborn is oxygenation index. Prospective studies are essential to show the efficiency of these risk factors for use as assistant criteria for planning type of surgical protocols in neonates with CDH. In the current study, stable non-intubated patients were chosen for study after explaining both types of thoracoscopic and open surgery details to the parents.

Takaki Tanaka⁶ studied on 24 neonates with congenital diaphragmatic hernia, identified prenatally or within 6 h after birth, in a 10-year-period with mild pulmonary hypertension and without the use of inhaled nitric oxide. Open operation was performed routinely until 2006 (n = 14) and thoracoscopic repair became routine in 2007 (n = 10). They concluded that thoracoscopic repair seems to be as effective as OR for management of carefully chosen cases of CDH in neonates, with superior wound cosmesis.

Schneider A et al.⁷ reported that thoracoscopy can be successfully used for the operation of CDH in selected cases; but pulmonary hypoplasia is a major restrictive factor. Some cases should be omitted secondary to higher probable requirement for patch repair because of technical difficulties and prolonged operative duration. The success is related

to close teamwork activity among pediatric surgeon, neonatologist and pediatric anesthetist.

The essential problem during repair of diaphragmatic hernia is presence of intraoperative acidosis and hypercapnia unrelated to the method used. Nevertheless, this would be extremely severe during thoracoscopic repair.⁸⁻¹⁰ The consequence of intraoperative hypercapnia and acidosis on the neonate's neuro developmental status is unidentified. So, selection criteria for the cases of thoracoscopic repair are obligatory.^{11,12,13}

Putnam LRetal¹⁴ reviewed a total of 3,067 congenital diaphragmatic hernia patients who underwent open (n = 2,579; 84%) or minimally invasive surgery (n = 488; 16%). Neonates experiencing open approach were more probable to be identified prenatally, be premature, had lower 5-minute Apgar scores, and had main cardiac anomalies. After risk assessment of CDH patients, an MIS method was autonomously accompanying with diminished interval of hospital stay and adhesive small bowel obstruction, but more recurrence rates.

Conclusion

In conclusion, diaphragmatic hernia is one of the most common anomalies in infancy. The study on the effective factors determining the appropriate surgical method and the results of these methods can have a significant impact on the better outcome of these infants. The thoracoscopic method seems to be as effective as the traditional open surgery in neonates with stable cardio-respiratory system, and this method can be used in patients with stable condition, with aesthetically much better results.

Ethical Consideration

This study was approved by Research Ethics Committees of Shahid Beheshti University of Medical Sciences with code number IR.SBMU.RETECH.REC.1396.174.

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Conflict of interests

There is no conflict of interest.

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