Comparison between balloon dissection and conventional dissection for extrapleural approach in tracheoesophageal fistula repair

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Received 10 June 2015
Accepted 28 June 2015

The Egyptian Journal of Surgery
2015, 34:261–263

Objective
The extrapleural approach for tracheoesophageal fistula is preferred by most of the pediatric surgeons. The traditional method is based on combined blunt and sharp dissection. We compared this with dissection using Foley's catheter balloon.

Patients and methods
This study included two groups: the conventional dissection group, which included 30 cases, and the balloon group, which included 22 cases.

Results
The mean time for pleural dissection in the conventional group was 10 min, with a range of 8–15 min, whereas the mean in the balloon group was 4.5 min, with a range of 2–6 min. Minor pleural tears occurred in six cases (20%) in the conventional group versus four (18%) in the balloon group. Four major pleural tears were encountered in the conventional group (13.3%), which were managed with repair and intercostal tube insertion, whereas none of the balloon group cases showed major tears. Six anastomotic leaks occurred in the conventional group versus four in the balloon group, which were managed conservatively. Three mild anastomotic strictures (10%) occurred in the conventional group versus two in the balloon group (9%), and all were managed conservatively.

Conclusion
Balloon dissection is an efficient, rapid, and safe method for pleural dissection in the extrapleural approach for repair of tracheoesophageal fistula.

Keywords:
extrapleural, Foley's catheter, tracheoesophageal fistula

Egyptian J Surgery 34:261–263

1110-1121

Introduction

Esophageal atresia is an anomaly in which there is a blind-ending upper esophagus with common tracheoesophageal fistula [1]. It is a relatively common congenital anomaly that is recorded in 1 : 4000 live births [2–4]. Familial cases represent less than 1% of cases, whereas the majority of them are sporadic [5]. Surgery is indicated as urgently as possible to avoid aspiration and pulmonary complications. Operative intervention is usually carried out in the first few days of life after echocardiography for ruling out associated cardiac anomalies. The operative interference entails fistula ligation and esophageal anastomosis [6]. The classic approach involves the right posterolateral, thoracotomy in the fourth intercostal space [2,7]. The extrapleural approach is preferred by most of the surgeons because if any leak occurs it will result in an esophagocutaneous fistula, which usually closes in 1–2 weeks [8]. However, the problem with this approach is the tedious time-consuming pleural separation with multiple tears that may require repair and intercostal tube application [7]. This study aimed at comparing the traditional method for combined blunt and sharp pleural dissection with a newly introduced method using Foley's catheter balloon dissection as regards efficacy, time consumed, and the incidence of significant pleural tears.

Patients and methods

This prospective study was conducted from August 2013 to March 2015 and included a total of 55 patients who were diagnosed with esophageal atresia and distal tracheoesophageal fistula (by history of chocking and regurgitation with failure to pass a 10-Fr nasogastric tube that was confirmed by radiograph showing a kinked tube in the blind pouch). Cases were randomly allocated into two groups regardless the age, sex, or associated anomalies: the first group, in which pleural dissection was achieved with the conventional method using the combined blunt and sharp technique, and the second

 DOI: 10.4103/1110-1121.167388

group, in which pleural separation was accomplished by using the balloon of Foley's catheter No. 10 Fr. All patients were subjected to the usual screening for associated anomalies. Cases were investigated routinely. Care as regards respiration, guarding against infection, and preparation for packed red blood cell was taken preoperatively. A posterolateral thoracotomy through the fourth space was performed (Fig. 1). The intercostal muscles were divided and the pleura was separated using the traditional method in the first group. Inflation the second group, the tip of a Foley's catheter No. 10 Fr was introduced between the pleura and the rib cage, with inflation of the balloon with 10 cm saline (Fig. 2). The balloon was deflated and redissection was carried out using Foley's No. 12 Fr and 14 Fr inflated with 20 and 30 cm saline, respectively, until the pleura was separated from the ribs with complete visualization of the azygos vein (Fig. 2). The rest of the operative task was completed as usual and a tube catheter No. 16 Fr was inserted in the extrapleural space as a drain. The time used for pleural dissection was calculated in both groups starting just after muscle separation until visualization of azygos vein. Intraoperative recording of the pleural tears was carried out. Patients were followed up with regular chest examination and plain chest radiography for complications.

Results

A total of 55 patients (33 male and 19 female) with tracheoesophageal fistula/esophageal atresia were enrolled into this study. The first group (traditional) included 30 cases, whereas the second one (balloon) included 22 cases. The mean age was similar in both groups (4 days) with a range of 2–7 in the first group and 2–8 in the second. There were associated anomalies in 12 (40%) cases of the first group and in nine (41%) cases of the second (Table 1), with cardiac anomalies being the most common as they were reported in eight cases of the first group (27%) and in five cases (23%) of the second. Pleural dissection was accomplished within a mean of 10 min in the first group (range of 8–15 min) versus a mean of 4.5 min (a range of 2–6 min) in the second one. Six minor tears (≤2 cm) and four major ones (>2 cm) that required repair and intercostal tube insertion were recorded in the first group, whereas only four minor tears were recorded in the second group; one of them was repaired with vicryl 5/0 suture without intercostal tube insertion. However, in the other three, separate minor tears occurred in the pleura and they were left to heal spontaneously. No pleural effusion, empyema, or pneumothorax were recorded in any case. Anastomotic leak occurred in six cases in the first group (20%) and in four cases in the second one (18%). All developed esophagocutaneous fistulas, which were managed conservatively and closed in 7–10 days. Anastomotic stricture occurred in three cases of the first group (10%) and in two cases in the second one (9%), and all were managed successfully with dilatation.

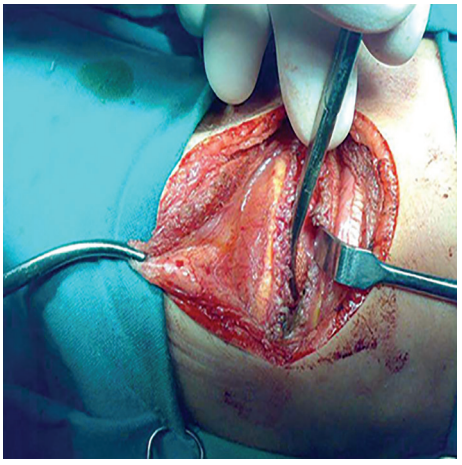
Discussion

Currently, the survival has become better and the morbidity has improved with the recent surgical

Table 1 Patient characteristics

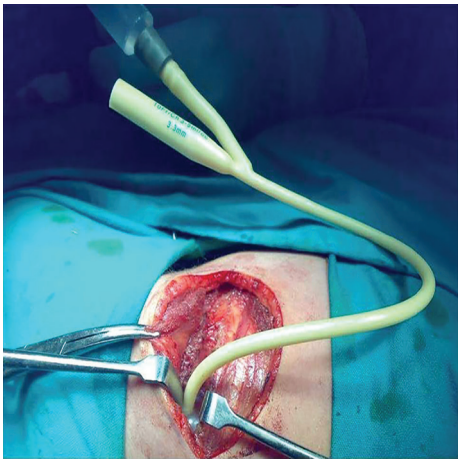
Type of pleural dissection	Conventional method		Balloon method	
	Number/ mean	Range/ percentage	Number/ mean	Range/ percentage
Sex				
Male	20	66.7%	13	59%
Female	10	33.3%	9	41%
Age (days)	4	2–7	4	2–8
Associated anomalies	12	40%	9	41%

Figure 1



Intercostal muscle division.

Figure 2



Technique of balloon dissection method.

trends in the management of esophageal atresia and tracheoesophageal fistula [9]. Associated anomalies occur in 40% of infants with esophageal atresia [10]. Cardiac anomalies were detected in 27 and 23% of cases in the first group and second group, respectively. This is in agreement with the findings of Chittmitrappap *et al.* [11], who reported an incidence of 29% for cardiac malformations. The ideal time for management is when the child becomes fit for general anesthesia [12]. Hosie and Short [1] suggested that the patient could be stabilized and planned for surgery within the first 48 h. In the present study, the mean age at the time of operation was 4 days. Nowadays, the extrapleural approach is preferred by most of the pediatric surgeons. However, if performed traditionally, it is time consuming and carries a tedious dissection [8]. In this study, we compared the traditional method of dissection with a simpler one using the balloon of Foley's catheter. The required time for balloon dissection ranged from 2 to 6 min with a mean time of 4.5 min. Thus, this method of dissection overcomes the disadvantage of the lengthy traditional extrapleural dissection. Moreover, there were no major pleural tears with subsequent intercostal tube usage after dissection using the balloon method. The incidence of anastomotic leaks was nearly similar in both groups and to other studies [8,13–15]. McKinnon and Kosloske [14] reported that the route of repair (transpleural or retropleural) did not affect the incidence of anastomotic complications. Moreover, Bishop *et al.* [13] used the transpleural approach and reported an incidence of 20% for anastomotic leak. They found that leak-related mortality reduced from 88% during the period between 1951 and 1963 to 0% during the period between 1974 and 1983. This is obviously related to the development of better technical issues. However, with the transpleural approach, the anastomotic leaks may be complicated by empyema or tension pneumothorax [8], which add to the morbidity of the patient and to the hospital cost using more aggressive antibiotic regimens. In contrast, with extrapleural approach and a patent mediastinal drain, up to 95% of anastomotic leaks close spontaneously [16]. Nowadays, in the era of endoscopic surgery, the thoracoscopic approach is acquiring popularity [17], but in many centers with limited surgical expertise, the open technique still predominates and we recommend our newly introduced technique (Table 2).

Table 2 Operative outcome

Method of pleural dissection	Conventional method		Balloon method	
	Number/ mean	Range/ percentage	Number/ mean	Range/ percentage
Pleural dissection time (min)	10	8–15	4.5	2–6
Pleural tears				
Minor	6	20%	4	18%
Major	4	13.3%	0	0
Use of intercostal tube	4	13.3%	0	0
Anastomotic leak	6	20%	4	18%
Anastomotic stricture	3	10%	2	9%

Conclusion

The extrapleural approach for repair of esophageal atresia and tracheoesophageal fistula is more desirable. Balloon dissection is a newly introduced method for faster and safer pleural dissection with nearly 0% incidence of significant pleural tears.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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