Journal of Pediatric Surgery (2011) **46**, 458–461

ELSEVIER

Journal of Pediatric Surgery

www.elsevier.com/locate/jpedsurg

Does thoracoscopic congenital diaphragmatic hernia repair cause a significant intraoperative acidosis when compared to an open abdominal approach?

Julia R. Fishman*, Simon C. Blackburn, Niall J. Jones, Nicholas Madden, Diane De Caluwe, Munther J. Haddad, Simon A. Clarke

Chelsea and Westminster NHS Foundation Trust, London, UK

Received 29 September 2009; revised 28 July 2010; accepted 30 August 2010

Key words:
Congenital diaphragmatic hernia (CDH);
Thoracoscopic;
Pneumocarbia;
Acidosis

Abstract

Purpose: Thoracoscopic congenital diaphragmatic hernia (CDH) repair is increasingly reported. A significant intraoperative acidosis secondary to the pneumocarbia, as well as an increased recurrence rate, are possible concerns. Our aim was to review our early experience of the technique.

Methods: A prospective and retrospective data collection was carried out on all patients undergoing either an open or thoracoscopic CDH repair for a 4-year period. Preoperative blood gas values were identified at various stages of the operative procedure. A pH of 7.2 was considered to be a significant acidosis. The duration of surgery, complications, and recurrence rates were also recorded. Data were analyzed using the Mann-Whitney *U* test, and a *P* value of .05 or less was considered significant.

Results: Twenty-two patients were included. One death occurred before surgery. Twelve patients underwent thoracoscopic repair (8 neonatal), and 9 underwent open repair (8 neonatal). There were 9 left-sided defects in the thoracoscopic group and 9 in the open group. Operative time was longer in the thoracoscopic group compared to the open group (median, 135 vs 93.5 minutes; $P = .02$). Neonates undergoing thoracoscopic repair were heavier compared to the open group (median, 3.9 vs 2.9 kg; $P = .05$), and their preoperative requirements for ventilation and inotropes were comparable. However, the association between those patients who required preoperative inotropes and those who required a patch repair was statistically significant $P = .03$. Two patients in each group developed an intraoperative acidosis. A further patient in the thoracoscopic group had a severe acidosis present at the beginning of surgery. There was no statistical difference in pH values or recurrence rate between the 2 groups. All recurrences were in patients requiring patch repairs. No postoperative mortality occurred.

Conclusions: We present our early experience of thoracoscopic CDH repair. Our results from thoracoscopic repair appear similar to the open procedure performed over the same period. No clear difference in intraoperative pH or recurrence rate has been demonstrated in our series. There is a need for a multicenter prospective study to establish the longer term outcome of this technique.

In 1946, the first successful congenital diaphragmatic hernia (CDH) repair in a neonate was performed through an open abdominal approach [1]. In recent years, the techniques

* Corresponding author. Department of Paediatric Surgery Chelsea and Westminster Hospital NHS Foundation Trust, SW10 9NH London, UK. Tel.: +44 020 8746 8696.

E-mail address: juliafishman@yahoo.co.uk (J.R. Fishman).

0022-3468/$ – see front matter © 2011 Elsevier Inc. All rights reserved.
doi:10.1016/j.jpedsurg.2010.08.062

for repair have greatly advanced, and with the advent of minimal access surgery, new approaches have been developed [2-11].

Thoracoscopic repair of CDH was first described in 1995 by Silen et al [2]; however, several concerns regarding its use have been raised. In 2005, Yang et al [3] proposed the possibility of neonatal selection criteria to minimize the complications in those patients undergoing a thoracoscopic repair. As well as an increased rate of recurrence compared to the open method [3], there is potential that the intraoperative pneumocarbia associated with thoracoscopic repair may lead to a significant intraoperative acidosis leading to possible neurocognitive dysfunction [12].

1. Purpose

We sought to present our experience of open and thoracoscopic repair of CDH for the last 4 years. Our primary outcome measure was intraoperative pH. Secondary outcome measures included recurrence rate and operative time.

2. Methods

2.1. Study cohort and data

All patients at our institution undergoing repair of a CDH defect, either by the open abdominal (CDH-O) or the thoracoscopic (CDH-T) approach since January 2005, were included in our study. All ages of patients and types of defect were included. This period was used as it coincided with our first thoracoscopic CDH repair. To ensure complete patient capture, patients were identified using operating room databases, surgeons' logs, and clinical coding. Prospective data collection and an individual retrospective note review, including anesthetic and drug charts, were carried out for each patient. Selection for type of repair was based on preference by the lead surgeon, 3 of the 5 surgeons preferring the thoracoscopic approach.

Baseline characteristics and observations recorded included sex, gestational age (weeks) and weight at operation (kg), laterality of defect, patch requirement, preoperative time on ventilator (days), preoperative inotropic support, time to surgery from diagnosis (days), length of postoperative hospital admission (days), and length of follow-up (weeks). Lung-to-head ratio was not measured as it is not routinely carried at our center. Outcome measures included pre, peri, and postoperative pH, base deficit, and end-tidal CO_2 (kPa); recurrence rates; complications; and operative time (minutes). Recurrences and complications associated with the CDH repair were detected during initial hospital admission and at subsequent follow-up in outpatients. Formal investigations, including chest radiographs, were left to the discretion of the surgeon responsible.

2.2. Surgical technique

Thoracoscopic CDH repairs were performed with the patient in the lateral position with the side of the defect uppermost. Port positioning is as described previously by Becmauer et al [10]. Three-millimeter instruments were used in all cases. Initial insufflation pressure varied between 4 and 10 mm Hg depending on the weight of the patient and at a flow rate of 0.5 to 1 L/min. The pneumothorax, together with instrumental manipulation, was used to reduce the herniated abdominal contents into the abdomen. Insufflation was discontinued once visceral reduction was achieved. The diaphragmatic defect was then repaired using 2-0 Ethibond (Ethicon product code W6977). The use of a patch was at the discretion of the operating surgeon. Permacol (Tissue Science Laboratories Inc) was used in all cases. Patches were inserted through one of the working ports.

Open repairs were accomplished using a subcostal incision on the side of the defect. After manual visceral reduction, the defect was repaired using Ethibond, PDS, or Prolene at the discretion of the operating surgeon. The use of a patch was also at the discretion of the operating surgeon. Surgisis (Cook Biotech) (2 patients) and Permacol (2 patients) were both used.

2.3. Statistical analysis

Data were compared using the Mann-Whitney U test, and a P value of .05 or less was considered significant.

2.4. Exclusion criteria

Any patient who died before operative correction was excluded from analysis. There were no other exclusions.

3. Results

Twenty-two patients were admitted to our hospital with a CDH during the study period. There was one preoperative death, and the overall survival rate for patients' with a CDH was 21 (95%) of 22. Twenty-one children underwent diaphragmatic hernia repair; of these, 12 were performed using a thoracoscopic technique. Eight of the thoracoscopic repairs were performed in neonates. Of the open repairs, 8 were performed during the neonatal period. There were 3 patients with significant associated anomalies in the CDH-T group (undiagnosed syndrome with dysmorphism, hypotony, and esophageal atresia), compared to 2 patients in the CDH-O group (cystic periventricular leukomalacia and intersex anomaly).

Neonates undergoing thoracoscopic repair were heavier compared to those in the open group, and the difference was statistically significant (P = .05). The baseline characteristics, including preoperative requirements for ventilation