Thoracoscopic resection of congenital pulmonary malformations in infants: is the feasibility related to the size of the lesion?

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Brief report

Background: **The size of congenital pulmonary malformation (CPM) in infants might interfere with the feasibility of thoracoscopic resection. This study was undertaken to evaluate the impact of the size of CPM on the applicability of video-assisted thoracic surgery (VATS) in infants.**

Methods: **Twenty-two infants were operated on for CPM from November 2000 to June 2009. The intra- and postoperative course was analyzed retrospectively from patient charts. Preoperative scans were evaluated blindly by a radiologist to calculate the relation between the maximum size of the lesion and the thoracic diameter in VATS and open procedures.**

Results: **VATS was performed in 14 (64%) of the 22 patients and thoracotomy in 8. VATS was successfully performed in 11 (79%) of the 14 patients, whereas VATS was converted to thoracotomy due to lack of overview in 3 (21%). The mean relative size of CPM at preoperative imaging was 0.34 ± 0.05 (range: 0.3-0.4) in patients who received successful VATS, 0.57 ± 0.06 (range: 0.5-0.6) in converted cases, and 0.68 ± 0.10 (range: 0.5-0.8) in infants who underwent thoracotomy. The relative CPM size was significantly lower in successful VATS than in cases of conversion (P<0.01) and thoracotomy (P<0.01).**

Conclusions: **The relative size of CPM at preoperative imaging might be useful information for a decision-making on the use of VATS in infants. A relative CPM size below 0.5, which is less than half of the thoracic diameter, indicates a good feasibility for thoracoscopic resection of CPM. A larger size may indicate that VATS might be technically difficult.**

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Introduction

Since the early 1990s, video-assisted thoracoscopic surgery (VATS) has gained wide acceptance for resection of congenital pulmonary malformation (CPM) in infants and children.[1-5] The size of the lesion may limit the feasibility of VATS due to problems with visibility and exposition, which may result in thoracotomy.[1,6] However, information about the limitations of VATS in children is lacking and the impact of the size of CPM on the feasibility of VATS remains to be investigated. This study was conducted to analyze the decision-making of an interdisciplinary board on the use of a conventional or thoracoscopic approach for resection of CPM in infants. In addition, the feasibility with regard to the relative size of CPM on preoperative CT or MRI imaging was investigated.

Methods

All patients aged below 18 months who underwent a resection of CPM from November 2000 to June 2009 were included in this study. Retrospectively collected data included patient characteristics, operative approaches, operation duration, intraoperative events, conversion rate of VATS, and site and histopathological changes of the lesion shown by Stocker's classification.[7] The decision to schedule CPM patients for VATS or open surgical procedures was made by an interdisciplinary

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board of pediatric surgeons, pediatric radiologists and pediatric pulmonologists according to the anticipated suitability of VATS in each patient. A defined cut-off point of CPM size was not given.

A standardized VATS technique was used.[5] Briefly, the patient was placed in a lateral position and the operation was carried out using 3 to 4 ports. Three or 5 mm instruments were used. Carbon dioxide was insufflated with a pressure of up to 8 mmHg. Decompression was routinely performed by needle aspiration to create more intrathoracic spaces in a large cystic CPM. CPM resections were performed using a monopolar hook, an Endoligasure™ sealing device (Valleylab, Boulder, USA), an Endo GIA™ stapler (Auto Suture, Norwalk, CT, USA), and/or intracorporal suturing. An anatomic resection was made in all patients who underwent lobectomy. All specimens were extracted from the chest cavity through a port site and a chest drain was placed at the end of all procedures.

The maximum size of CPM and the maximum thoracic diameter were calculated blindly from preoperative CT or MRI scans by an independent radiologist from another hospital. The maximum size of the lesion was divided by the maximum thoracic diameter (Fig.). The relative size of CPM was calculated for the groups of infants, who underwent primary conventional thoracic resection, successful VATS and converted VATS.

Statistical analysis was performed with Student's *t* test using SPSS statistical software (SPSS GmbH, Munich, Germany). The results were presented as means ± SD. A *P* value ≤0.01 was considered statistically significant.

Results

Twenty-two patients aged below 18 months who had undergone preoperative CT or MRI scans were operated on during the study period. The interdisciplinary board recommended that VATS should not be performed in 8 (36%) of the 22 patients because of the size and/or localization of the lesion, whereas VATS was done in 14 (64%). Eleven infants had congenital cystic adenomatoid malformation (CCAM), 7 had pulmonary sequestration (PS), and 4 had congenital lobar emphysema (LE).

VATS was successfully performed in 11 (79%) of the 14 infants, of whom 4 underwent resections of CCAMs (types II and IV) and 7 underwent resections of PS. Conversion to a lateral thoracotomy was required in 3 VATS procedures (21%) because of lack of overview. All converted cases had CCAMs (2 type I, 1 type II).

Mean body weight, age and operation duration were not significantly different between the groups of infants who had resection via thoracotomy versus VATS with or without conversion (open resection: 4.8 ± 2.3 kg, 3.1 ± 4.2 months, 103 ± 42 minutes; VATS: 6.6 ± 3.4 kg, 5.6 ± 5.4 months, 101 ± 39 minutes).

The relative size of CPM was inversely correlated with the successful use of VATS. The mean relative size of CPM at preoperative imaging in the 11 cases of successful VATS was 0.34 ± 0.05 (range: 0.3-0.4), in 3 converted cases was 0.57 ± 0.06 (range: 0.5-0.6), whereas in 8 cases that received primary thoracotomy was 0.68 ± 0.10 (range: 0.5-0.8) (successful VATS versus converted VATS and thoracotomy: *P*<0.001, Table).

Table. Comparison of the relative size of congenital cystic lung lesions of 22 patients who underwent successful VATS, VATS with need of conversion or thoracotomy

Types of surgery	Age (mon)	Weight (kg)	Relative CPM size
VATS (*n* = 11)	5.6 ± 5.4	6.6 ± 3.4	0.34 ± 0.05
Converted VATS (*n* = 3)	2.1 ± 3.6	5.1 ± 3.3	0.57 ± 0.06*
Thoracotomy (*n* = 8)	3.5 ± 4.6	4.7 ± 2.1	0.68 ± 0.10†

Data are given as mean values ± standard deviation. VATS: video-assisted thoracoscopic surgery; CPM: congenital cystic lung malformation. *: VATS *vs.* converted VATS, *P*<0.001; †: VATS *vs.* Thoracotomy, *P*<0.001.

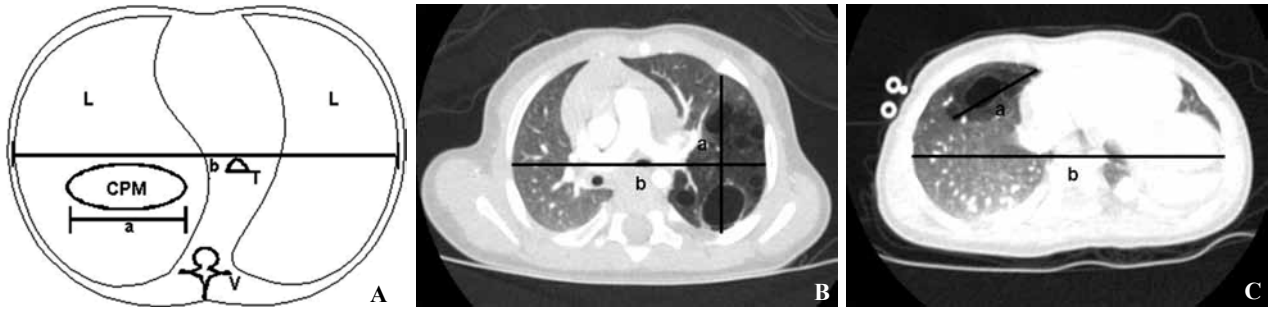

Fig. A: Evaluated parameter: maximal size of the lesion (a) relative to the maximal thorax diameter (b): a/b. L: lung; CPM: congenital pulmonary malformation; T: trachea; V: vertebra. **B:** Patient with CCAM type II, scheduled for thoracotomy (relative size 0.6, a/b). **C:** Patient with CCAM type II, scheduled for VATS (relative size 0.3, a/b). CCAM: congenital cystic adenomatoid malformation; VATS: video-assisted thoracoscopy.

Discussion

VATS is increasingly applied in infants and children due to its excellent feasibility.[2-6,8-12] Numerous advantages of the thoracoscopic approach compared to thoracotomy have been postulated, and we have recently confirmed that VATS is associated with improved cosmesis and a lower incidence of scoliosis.[13] However, a large CPM may interfere with the feasibility of VATS. This has been reported from a series of children in whom inadequate visibility and exposition are the main causes for conversion to thoracotomy.[6]

The impact of the size of organs or tumors on the feasibility of minimally invasive techniques is mainly investigated in laparoscopy.[14-16] But systematic assessments of thoracoscopy in children are lacking. Albanese et al[12] reported 144 thoracoscopic lobectomies in children and adolescents aged up to 18 years, of whom patients with lesions extending more than 25% of the thoracic diameter were excluded from VATS because of anticipated intraoperative complications. However, the cut-off point has not yet been established.

In our study, the relative size of a CPM was inversely correlated with the feasibility of VATS. VATS was feasible in all infants with a relative size of CPM less than half of the diameter of the thorax. In infants with a larger malformation, VATS was not performed or it was converted due to problems with visibility or exposition.

The main drawback of this study is that the decision-making of the interdisciplinary board on the use of thoracotomy or VATS in each patient was not based on a given cut-off point or other parameters. In addition, the patient number of this analysis is small, which limits the validity of the conclusions drawn from this study.

A substantial proportion of our patients were operated on because of CCAM. The indication for a resection of CCAM is still under debate.[17] However, recent evidence is more likely to suggest ablative procedure in cases of CCAM because of risk of malignant transformation.[18]

To our knowledge, this is the first study on the impact of the size of CPM on the feasibility of VATS in infants. We conclude that the feasibility of VATS may be limited in infants with a relative size of CPM of more than 0.5. However, this threshold remains to be confirmed by a study using a larger series of infants in whom VATS is primarily used for all sizes of CPM.

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