

# An open and shut case for early VATS treatment of primary spontaneous pneumothorax in children

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**Background:** Treatment of primary spontaneous pneumothorax (SP) involves thoracostomy tube (TT) drainage, with surgery reserved for persistent or recurrent air leaks. We hypothesized that the advent of video-assisted thoracic surgery (VATS) would change indications and outcomes for surgical treatment of SP in our centre. **Methods:** We performed a retrospective (1993–2003) review of children treated for SP. Patients with persistent or recurrent air leaks underwent either limited axillary thoracotomy (LAT), 1993–2001, or VATS, 2001–2003. We included the following outcomes: preoperative SP episodes, TT days (that is, patient days with TT in situ, before surgery), length of hospital stay (LOS), narcotic use and freedom from recurrence. We evaluated the predictive value of preoperative CT scans in guiding treatment of the contralateral side. **Results:** Among 31 patients with 19 ipsilateral or contralateral recurrences (61%), 11 were managed nonoperatively. Twenty-six surgeries (13 LAT, 13 VATS) were performed in 20 patients, with 9 undergoing bilateral procedures (3 LAT, 6 VATS). VATS patients were treated earlier, had a diminished narcotic requirement postoperatively and had a shorter LOS with an equivalent recurrence rate, compared with LAT patients. The absence of contralateral blebs did not predict freedom from SP on the contralateral side in patients undergoing surgery for ipsilateral SP. **Conclusions:** Compared with LAT, VATS causes less pain, has a shorter LOS and encourages earlier surgical treatment (including prophylactic, contralateral treatment) of SP in children.

**Contexte :** Le traitement du pneumothorax spontané (PS) primaire comporte un drainage au moyen d'un tube de thoracotomie (TT), l'intervention chirurgicale étant réservée aux fuites d'air persistantes ou récidivantes. Nous avons posé en hypothèse que l'avènement de la chirurgie thoracique assistée par vidéo (CTAV) modifierait les indications et les résultats pour le traitement chirurgical du PS à notre centre. **Méthodes :** Nous avons procédé à une étude rétrospective (1993–2003) de cas des enfants traités pour un PS. Les patients qui avaient une fuite d'air persistante ou récidivante ont subi la thoracotomie axillaire limitée (TAL), 1993–2001, ou une CTAV, 2001–2003. Nous avons inclus les résultats suivants : épisodes préopératoires de PS, jours TT (c'est-à-dire jours-patient avec TT in situ, avant l'intervention chirurgicale), durée de l'hospitalisation (DH), utilisation de stupéfiants et absence de récurrence. Nous avons évalué la valeur prédictive des TDM préopératoires pour guider le traitement du côté contralatéral. **Résultats :** Sur les 31 patients qui ont eu 19 récurrences ipsilatérales-contralatérales (61 %), 11 ont été traités de façon non chirurgicale. On a pratiqué 26 interventions chirurgicales (13 TAL, 13 CTAV) chez 20 patients et 9 ont subi une intervention bilatérale (3 TAL, 6 CTAV). Les patients qui ont subi une CTAV ont été traités plus tôt, ont eu besoin de moins de stupéfiants après l'intervention, leur séjour a été plus court et le taux de récurrence a été équivalent comparativement à ceux qui ont subi une TAL. L'absence de bulles contralatérales n'était pas un prédicteur d'absence de PS du côté contralatéral chez les patients qui ont subi une intervention chirurgicale pour un PS ipsilatéral. **Conclusions :** Comparativement à la TAL, la CTAV cause moins de douleur, réduit la durée du séjour et encourage un traitement chirurgical plus rapide (y compris un traitement contralatéral prophylactique) du PS chez les enfants.

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Primary spontaneous pneumothorax (SP) is defined as a pneumothorax occurring in the absence of underlying lung pathology. The incidence in children is estimated at 0.1%, with a male predominance.<sup>1</sup> Treatment consists of thoracostomy tube (TT) drainage, with definitive surgery (bleb resection, pleural abrasion/pleurectomy) reserved for those with a persistent air leak or recurrence. The 2 most widely practised surgical techniques are limited axillary thoracotomy (LAT) and video-assisted thoracic surgery (VATS). The purported advantages of VATS over LAT include decreased postoperative pain, reduced length of hospital stay (LOS) and improved pulmonary function.<sup>2-6</sup> The purpose of this retrospective study was to compare surgical treatment of SP during 2 treatment “eras” to determine whether the transition from LAT to VATS in our hospital has altered outcomes or surgical indications for SP in children.

## Methods

We retrospectively reviewed all children with SP treated at the British Columbia Children’s Hospital in a 10-year span (1993–2003). We received institutional review board approval for the review. Patients were stratified according to the following surgical treatment era: from 1993 to 2001, patients who underwent LAT treatment (of persistent or recurrent SP); and from 2001 to 2003, patients who underwent VATS treatment. Thoracic imaging included plain radiographs and CT scans of select patients. Where thoracic imaging identified contralateral asymptomatic blebs in patients with unilateral SP, treatment (i.e., observation v. prophylactic resection) and outcome were discerned. Treatment outcomes included preoperative chest tube days (TT days), number of SP episodes before intervention, LOS, operative time, postoperative narcotic use, complications, recurrences and duration of clinical follow-up.

We performed group comparisons with a 2-tailed Student *t* test and considered  $p < 0.05$  significant.

## Surgical techniques

LAT was undertaken through a fourth interspace, muscle sparing axillary thoracotomy under general anesthesia without selective lung ventilation. The involved lung parenchyma was excised with a stapler, and an apical parietal pleurectomy was performed.

VATS was performed using 3 thoracoscopic ports. With selective, contralateral lung ventilation achieved by either a double lumen endotracheal tube or a bronchial blocker (depending on patient size), the parenchymal blebs were visualized and excised with an endoscopic stapler. Pleural abrasion, with a cautery “scratch-

pad,” was performed across the parietal pleural surface of the upper-half of the hemithorax.

## Results

There were 31 (24 male [77%], mean age 14.3 yr, range 7–17) patients with 31 initial and 19 “recurrent” (ipsilateral or contralateral [61%]) episodes of SP (Fig. 1). All SP episodes were treated initially by TT, and surgery consisting of either LAT (1993–2001) or VATS (2001–2003) was performed on select patients with persistent or recurrent SP. All of the patients had a clinical follow-up by telephone interview.

Eleven patients with a total of 14 SP episodes were treated exclusively by TT (Table 1). These patients had short duration air leaks (mean 2.9 d) and an LOS that was

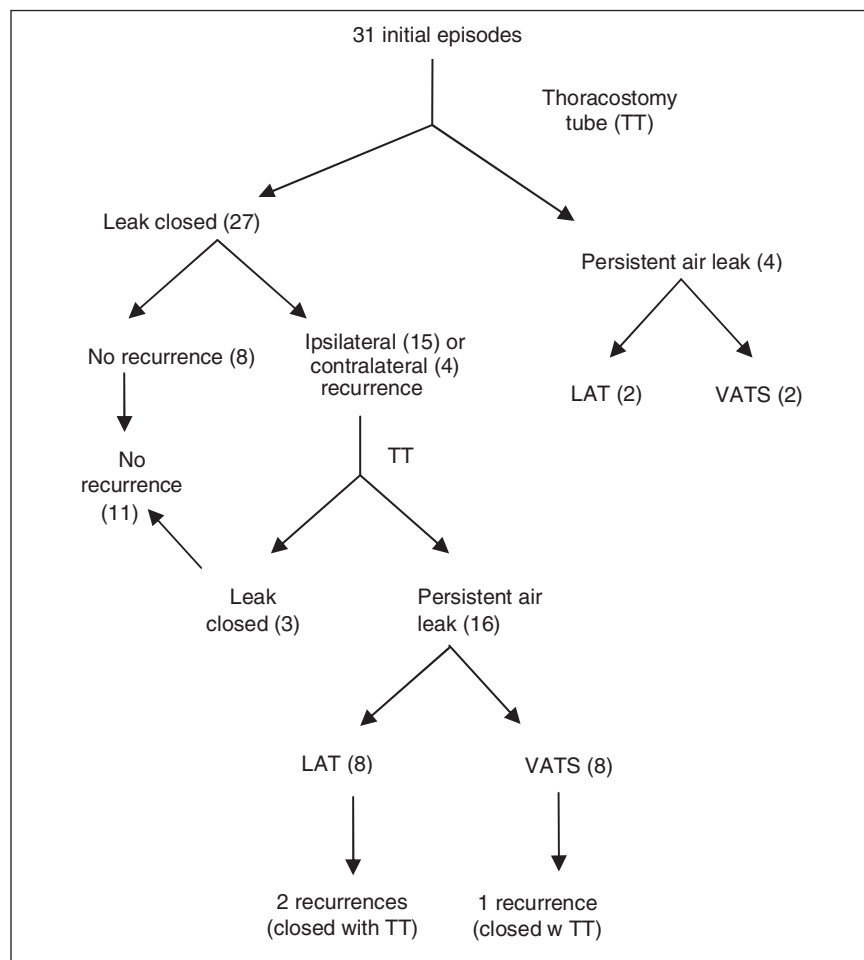


FIG. 1. Course of treatment.

significantly shorter than both surgical groups, despite a 45% recurrence rate for which repeat TT provided definitive treatment. Follow-up in the TT only group averaged 49 months.

A total of 26 operations for persistent or recurrent SP were performed in 20 patients over the entire study period (Table 1). Ten patients underwent 13 operations in both the LAT group and the VATS group. Patients in the LAT group experienced significantly more ipsilateral SP recurrences and TT days before operation than did VATS patients. There was a significantly longer LOS in the LAT group, which was primarily attributable to the delay in surgical treatment. Another significant difference between the 2 surgical groups was a diminished need for narcotics and a shorter follow-up period in the VATS patients.

Bilateral operations were performed in 9 patients, 6 of whom underwent VATS. In 5 patients (3 LAT, 2 VATS), these were “metachronous” operations for sequential, bilateral persistent or recurrent SP. Four patients with unilateral SP requiring surgery and CT scan evidence of con-

tralateral, asymptomatic blebs underwent bilateral synchronous VATS.

CT scans were performed in 16 patients with unilateral SP requiring surgical treatment to characterize the presence or absence of blebs on the contralateral (asymptomatic) side. The outcome of the asymptomatic side (by presence or absence of CT blebs) is summarized in Table 2. Only 3 patients (19%) were found to have contralateral blebs by CT scan, and of these, 2 underwent prophylactic VATS resection. The other patient with asymptomatic contralateral blebs was observed after unilateral LAT and has not developed a contralateral SP at 3-year follow-up. Of 13 patients without contralateral blebs, 4 (31%) developed a contralateral SP.

**Discussion**

Primary SP is thought to arise from rupture of upper lobe apical or lower lobe superior segment subpleural blebs. The incidence is 6–18 per 100 000, with an increased tendency in tall, asthenic males.<sup>7</sup> Our ipsilateral/contralateral recurrence rate of 61% is comparable with other pedi-

atric reports.<sup>8</sup> A consensus statement proposed by the American College of Chest Physicians (ACCP) recommends surgery for adults with air leaks lasting longer than 4 days and for recurrent SP.<sup>9</sup>

VATS is an established technique with both diagnostic and therapeutic application. Its advantages over LAT include improved thoracic cavity visualization, reduced postoperative pain and morbidity and earlier recovery. Our study evaluated the treatment of SP in children over a 10-year period, during which time, there was a transition in surgical approach from thoracotomy to VATS in our centre. We hypothesized that adopting a less-invasive operation would be accompanied by changes in the timing of

**Table 2**

Outcome of asymptomatic side		
Developed contralateral SP	Contralateral CT blebs	
	Absent	Present
Yes	4	0
No	9	3*

SP = spontaneous pneumothorax.  
\*2 patients underwent VATS based on CT findings.

**Table 1**

Group characteristics and outcomes			
Characteristic	TT only 1993–2003	LAT 1993–2001	VATS 2001–2003
No. of patients	11	10	10
Mean age, yr (and range)	15.4 (12–16)	13.6 (7–17)	14.6 (11–17)
No. of operations	NA	13	13
No. of bilateral operations			
Simultaneous*	NA	0	4
Sequential	NA	3	2
Mean no. of ipsilateral SP episodes (before surgery for LAT, VATS)*	1.2 (1–2)	1.9 (1–3)	1.1 (1–2)
Mean duration of TT drainage, d (before surgery for LAT, VATS)*	2.9 (1–11)	18.8 (1–29)	4.7 (1–9)
Operative time, min	NA	75.1 (38–130)	63.5 (42–127)
Mean LOS, d*†	4.4 (2–12)	21.2 (3–31)	6.7 (2–13)
Mean postoperative narcotic use (morphine equivalent mg/kg/d) *	NA	0.58 (0.24–0.89)	0.27 (0.02–.84)
Recurrence after treatment	3‡	2	1
Mean follow-up, mo†	49 (7–121)	69 (12–106)	19 (12–23)

TT = thoracostomy tube; LAT = limited axillary thoracotomy; VATS = video-assisted thoracic surgery; SP = spontaneous pneumothorax; LOS = length of stay.  
\*Significant difference, TT and LAT v. VATS.  
†Significant difference TT v. LAT and VATS.  
‡Recurrences successfully treated with repeat TT.

surgery and approach toward asymptomatic contralateral blebs. This proved to be true with the observation of earlier (significantly fewer pre-operation SP episodes and TT days) intervention leading to shorter LOS in the VATS group, compared with the LAT group. Although our numbers are small, our institutional approach to the treatment of asymptomatic blebs reflects a preference for prophylactic treatment during the VATS era, with 2 of 3 patients with contralateral blebs by CT scan undergoing bilateral VATS under the same anesthetic.

The ability of chest CT scans to guide treatment of the contralateral (asymptomatic) side in patients requiring surgery for persistent or recurrent air leaks is unclear. Observational studies in adults with contralateral, asymptomatic blebs report a contralateral recurrence risk of up to 27% in 5 years<sup>10</sup>; however, there are no comparable data for children. Our own study yielded 4 episodes of contralateral SP among 13 patients in whom CT scans had not identified contralateral blebs. In our view, this predictive uncertainty limits the use of preoperative CT scans in planning treatment of the contralateral side, and perhaps greater weight should be given to individual risk factors including geographical access to medical care and the severity of clinical presentation (i.e., tension SP).

Pediatric SP with persistent or re-

fractory air leaks are best treated surgically. Our own data suggest that air leaks that persist for longer than 3 days are unlikely to close spontaneously and, for these patients, as well as for those with recurrent SP, VATS (compared with LAT) enables earlier and less painful treatment. These findings support the adoption of ACCP recommendations of VATS in children with recurrent or persistent (> 4 days) SP. The ability of CT scans to predict the behaviour of asymptomatic blebs remains unreliable, especially when the CT scan is negative for blebs. Without data on the observational history of contralateral, asymptomatic blebs in children requiring surgery for SP, it is difficult to make recommendations regarding prophylactic treatment, except to note that bilateral VATS can be performed with minimal incremental patient risk and should at least be considered in such patients.

**Competing interests:** None declared.

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