Original Article

Outcome Comparison between Video Assisted Thoracoscopic Surgery and Open Thoracotomy on Primary Spontaneous Pneumothorax in a Tertiary Hospital in Thailand

Sira Laohathai MD[1]

[1] Cardiothoracic Surgery Unit, Department of Surgery, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand

Objective: To assess recurrence, complication after surgery, hospital stay, and cost-effective in primary spontaneous pneumothorax (PSP) patients of Thai urban population that underwent video assisted thoracoscopic surgery (VATS) and open thoracotomy (OT).

Materials and Methods: The present study was a retrospective cohort between 2006 and 2019. Seventy-five patients were diagnosed as PSP. All medical records were collected from Vajira Hospital. All various factors were analyzed to evaluate an outcome between the two groups.

Results: Fifty-four patients were treated by VATS, whereas 21 patients were treated by OT. The mean follow-up time was 26 months. There was no difference in term of gender, indication of surgery, and cost during hospital stay between the two groups. Length of hospital stay were shorter in VATS groups (9.5 days versus 15 days, p=0.006). The operative time was longer and more blood loss in OT groups compared to VATS groups (180 minutes versus 70 minutes, p<0.001 and 100 mL versus 30 mL, p<0.001). In post-operative outcome, there was no difference in terms of recurrence, pneumonia, and re-operation.

Conclusion: VATS is associated with shorter length of hospital stay and less blood loss with no difference of cost effective, recurrence, and post-operative outcome in PSP patients.

Keywords: Video assisted thoracoscopic surgery, Pneumothorax, Open thoracotomy

Received 10 June 2020 | Revised 3 August 2020 | Accepted 17 August 2020

J Med Assoc Thai 2021;104(1):100-4

Website: http://www.jmatonline.com

Primary spontaneous pneumothorax (PSP) is a common disease that affects young healthy patients, particularly in smoker with an incidence of 5 to 10 per 100,000. The British thoracic society (BTS) established the practice guideline for spontaneous pneumothorax. It describe that open thoracotomy (OT) with pleurectomy is the gold standard of treatment[1]. However, since 1992, the video assisted thoracic surgery (VATS) had been widely developed and is a safe procedure in many thoracic diseases including PSP[2-4].

Correspondence to:

Laohathai S.

Cardiothoracic Surgery Unit, Department of Surgery, Faculty of Medicine, Vajira Hospital, Navamindradhiraj University, 681 Thanon Samsen, Khwaeng Wachira Phayaban, Khet Dusit, Bangkok 10300, Thailand.

Phone: +66-94-5645647

Email: sira_l@hotmail.com

How to cite this article:

Laohathai S. Outcome Comparison between Video Assisted Thoracoscopic Surgery and Open Thoracotomy on Primary Spontaneous Pneumothorax in a Tertiary Hospital in Thailand. J Med Assoc Thai 2021;104:100-4.

doi.org/10.35755/jmedassocthai.2021.01.11510

However, there is still limited data about an outcome especially cost between VATS and OT in Thailand. Therefore, the objective of the present study was to compare an outcome between both groups.

Materials and Methods

The present study was a retrospective cohort between 2006 and 2019. Seventy-five patients underwent surgery for PSP in Cardiothoracic surgery unit, Department of Surgery, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand. Patient demographics and clinical parameters were retrospectively extracted from medical recording system, included age, gender, smoking status, laterality, reason for surgery, and surgical approaches. Chest radiographs and computed tomography were obtained in all patients. Patients with secondary spontaneous pneumothorax such as diffuse emphysema, catamenial pneumothorax, or pulmonary lymphangioleiomyomatosis were excluded in the present study. The intraoperative parameters and postoperative outcomes were monitored to assess the progress and outcomes of the

patients such as duration of tube drainage, duration of hospital stay, intraoperative blood loss, postoperative complications including recurrence rate, postoperative pain using the analogue visual scale with a 1 to 10 range, performed every 24 hours up to the three day. Cost of treatment in each method were recorded. The primary outcomes were postoperative complications including recurrence rate. The present study was approved by the Local Institutional Review Board/ Ethics Committee (037/62).

Indications for surgical treatment

Surgical intervention is indicated in PSP patients with a persistent air leak for more than five days, after recurrent ipsilateral or contralateral pneumothorax in cases of bilateral or tension pneumothorax. It is also required in first episode of pneumothorax in high-risk occupation such as airline pilots or where medical attention is inaccessible.

Surgical technique

All procedures were performed with general anesthesia using lung isolation technique with a double-lumen endotracheal tube or bronchial blocker. Surgical operations were performed by board-certified cardiovascular thoracic surgeons whether VATs or OT. Principle of the operation are 1) to identify the part of the lung responsible for the air leak and to deal with it appropriately, and 2) to prevent collapse of the lung in the future by promoting adhesions between the lung and chest wall such as pleurectomy, mechanical pleurodesis, or absorbable mesh coverage. For OT, standard technique of posterolateral thoracotomy, axillary thoracotomy or muscle sparing thoracotomy with rib spreading was used. For VATS, the number of ports depended on the surgeon techniques. The author routinely performed uniportal VATS with 3 cm incision at the fourth ICS, at anterior axillary line for utility port, and then for exploration of the thoracic cavity.

During exploration, the present study institution usually ventilates both lungs using low tidal volume to find small lung bleb. Any circumscribed pulmonary leaks or blebs were located, grasped, and resected with an endo-stapling device or resected and sutured using absorbable suture. In case that could not identify lung bleb, apical lung will be wedged. For pleurodesis, mechanical pleural abrasion or pleurectomy or absorbable mesh spread over the entire apical surface of the parietal pleura were done depending on surgeon preference. Single small chest tubes (24-French or 28-French) were inserted through at incision site placed under endoscopic vision in superior and posterior chest wall, respectively. Patients were normally extubated immediately after the operation. Chest X-ray was done within 8 to 12 hours postoperatively. Routine postoperative cares included adequate pain control, pulmonary toilet exercise, and early mobilization. Chest drain was removed if the content drainage was clear with no fresh blood or pus, was less than 200 mL/day, and there was no air leakage. All patients were followed with chest X-ray and evaluated for clinical symptoms at the cardiovascular thoracic clinic two weeks after discharged.

Statistical analysis

Categorical variables were presented as frequency and percentage. Continuous variables were presented as Median with interquartile range. Chi-square test was used to compare categorical variables and Mann-Whitney U Test was use compare continuous variables. A p-value of less than 0.05 was considered statistically significant. All statistically analyses were performed using PASW Statistics for Windows, version 18.0 (SPSS Inc., Chicago, IL, USA).

Results

Between 2006 and 2016, 75 PSP patients underwent either VATS or OT surgery at Vajira Hospital. Fifty-four patients were performed by VATS approach and 21 patients were performed by OT. The mean follow-up time was 26 months. Indication of surgery were recurrent pneumothorax (57.3%), followed by persistent air leak (32%) and bilateral pneumothorax (4%). There were no differences in term of gender, indication of surgery, and cost during hospital stay between the two groups. However, mean average of age at the time of surgery in VATS groups were slightly younger than OT groups (38 years versus 48 years, p=0.038). Patient's demographic data are shown in detail in Table 1.

Peri-operative results

In operative data, the operative time was longer in OT groups compared to VATS groups (180 minutes versus 70 minutes, p<0.001), and more intra-operative blood loss (100 mL versus 30 mL, p<0.001). Length of hospital stay, and tube duration were significant shorter in VATS groups (9.5 days versus 15 days, p=0.008; 3 days versus 6 days, p=0.027). In post-operative outcome, there was no difference in terms of recurrence, pneumonia, and re-operation. For the post-operative pain score, there was significant less

Table 1. Patient demographic data between VATS and OT in primary spontaneous pneumothorax patients

Patient demographic data	Total (n=75); n (%)	VATS group (n=54); n (%)	OT group (n=21); n (%)	p-value
Sex				0.074
Male	53 (70.7)	35 (64.8)	18 (85.7)	
Female	22 (29.3)	19 (35.2)	3 (14.5)	
Age (year); median (P_{25}, P_{75})	40 (28, 48)	38 (26, 43)	48 (31.5, 62)	0.038
Smoker				0.004
Non smoker	51 (68.0)	42 (77.8)	9 (42.9)	
Smoker	24 (32.0)	12 (22.8)	12 (57.1)	
Indication for surgery				0.131
Recurrent pneumothorax	43 (57.3)	34 (63.0)	9 (42.9)	
Persistent air leak	24 (32.0)	15 (27.8)	9 (42.9)	
Bilateral pneumothorax	3 (4.0)	1 (1.9)	2 (9.5)	
Occupational high-risk	1 (1.3)	1 (1.9)	0 (0.0)	
Large lung bleb	1 (1.3)	0 (0.0)	1 (4.8)	
Other	3 (4.0)	3 (5.6)	0 (0.0)	
Additional procedure				<0.001
Pleurectomy	17 (22.7)	10 (18.5)	7 (33.3)	
Mechanical pleurodesis	29 (38.7)	15 (27.8)	14 (66.7)	
Mesh coverage	28 (37.3)	28 (51.9)	0 (0.0)	
Other, talc pleurodesis	1 (1.3)	1 (1.9)	0 (0.0)	
Cost during hospital stay (bath); median (P_{25}, P_{75})	89,899 (65,779, 124,195)	95,142 (64,078, 126,119)	83,165.50 (67,861.7, 101,616.5)	0.619

VATS=video assisted thoracoscopic surgery; OT=open thoracotomy

Table 2. Intra- and post-operative data between VATS and OT in primary spontaneous pneumothorax patients

Peri-operative data	Total (n=75); n (%)	VATS group (n=54); n (%)	OT group (n=21); n (%)	p-value
Operative time (minutes); median (P_{25}, P_{75})	100 (60, 180)	70 (60, 125)	180 (150, 230)	<0.001
Intra-operative blood loss (mL); median (P_{25}, P_{75})	50 (16.2, 100)	30 (10, 100)	100 (50, 350)	0.001
Length of hospital stay (days); median (P_{25}, P_{75})	11 (6, 19)	9.5 (6, 16)	15 (11, 26.5)	0.006
Length of tube duration drainage (days); median (P_{25}, P_{75})	4 (3, 6)	3 (2, 6)	6 (3, 10.5)	0.027
Recurrence	3 (4)	3 (6.6)	0 (0.0)	0.270
Pneumonia	3 (4)	2 (3.7)	1 (4.8)	0.834
Reoperation	3 (4)	2 (3.7)	1 (4.8)	0.834
Overall post-operative complication	10 (13.3)	7 (13)	3 (14.3)	0.880
Pain score; median (P_{25}, P_{75})				
Day1	4 (2, 6)	3 (2, 5)	7 (6, 8.5)	<0.001
Day2	3 (0, 3)	2 (0, 2)	4 (2.5, 6.5)	<0.001
Day3	2 (0, 2)	1 (0, 1)	1 (1.5, 4.5)	<0.001

VATS=video assisted thoracoscopic surgery; OT=open thoracotomy

pain in post-operative day 1, 2, 3 in VATS groups compared to OT groups (3 versus 7, p<0.001; 2 versus 4, p<0.001; 1 versus 1, p<0.001) as shown in Table 2.

Discussion

PSP is a very common problem. Management of PSP varies greatly from observation, needle aspiration, tube thoracostomy, video-assisted thoracic surgery (VATS), or thoracotomy, which usually based on patient's clinical history and the size of the pneumothorax.

OT and VATS were proved to be useful methods

Table 3. Results of studies comparing VATS with OT in treatment of primary spontaneous pneumothorax

Authors	Operative time (minutes)		Chest tube duration (days)		Hospital stays (days)		Recurrence (%)	
	VATS	OT	VATS	OT	VATS	OT	VATS	OT
Waller, et al.[11]	45	37.5	2	2	4	5	6.6	3.3
Kim, et al.[12]	91.2	86.3	5	4.3	-	-	11	0
Ayed, et al.[7]	77.5	95	4	5	6.5	10.7	10	0
Bertrand, et al.[2]	-	-	4.4	5.6	6.9	10.3	3.6	1.1
Present study	94.9	199.5	4.9	7.2	12.1	19.1	5.6	0

VATS=video assisted thoracoscopic surgery; OT=open thoracotomy

for PSP surgery. Both techniques aimed to resect a pathology lung lesion such as lung bleb and create an adhesion between the parenchymal and pleural to help prevent recurrence.

In 1956, Gaensler reported the first successful series of patients with recurrent pneumothorax that underwent parietal pleurectomy[5]. Since then, OT became a gold standard for treatment of PSP. However, to reduce thoracotomy-related morbidities, a successful VATS in PSP were reported by Levi et al in 1990[6]. This method has changed the way of treatment in PSP.

In this era, VATS approach had become standard and performed worldwide in many diseases including PSP. The benefits of VATS were reported by many authors in term of less postoperative pain, complication after surgery, and shorter length of hospital stay comparing with OT groups[3,4,7]. The present study data have shown a statistically significant reduction in intra-operative bleeding, shorten length of post-operative stay, and hospital stay with no difference in cost of hospital stay in VATS compare to OT. Ayed and Al-Din summarized the outcome between VATS and OT in PSP[7] (Table 3).

Despite the benefit of VATS, the British Thoracic Society guidelines on management of pneumothorax in 2010 claimed that the incidence of recurrence were higher in VATS than OT (5% versus 1%)(1). Other studies by Barker et al also reported a meta-analysis that VATs had a significant higher recurrence rates in pneumothorax patients compared to OT[8]. The present study also had higher recurrence rates in VATS groups compared to OT groups. However, there was no statistical difference. The author believes that exposure during OT made it easier to find a subpleural bleb than in VATS.

Another issue to be address is a cost of VATS, especially in developing country. Miller reported higher costs associated with VATS than OT[9]. However, many authors also suggested that VATS actually save on costs after shorten length of hospital stay and fewer complications[10]. The present study demonstrated that there was no difference in term of cost between VATS and OT.

Conclusion

The present study reported a benefit of VATS procedure in PSP patients in term of shorten length of post-operative and hospital stay, lesser operative time and intra-operative blood loss with no difference of recurrence rates and cost of hospital stay.

However, there were several limitations such as small sample size, retrospective data, and limited long-term outcome. A large national registry or randomized control trial may help to identify the benefit of VATS approach.

What is already known on this topic?

VATS had become a standard procedure for thoracic surgery especially pneumothorax disease due to the benefits of less peri-operation, hospital stays, and complications. This study confirmed that VATS had a better outcome than open procedure in pneumothorax surgery.

What this study adds?

This study claimed to be a first report to compare an outcome between VATS and open thoracotomy in pneumothorax surgery of Thailand. This study showed comparable cost of each surgery with benefits of less hospital stay and blood loss in the VATS group.

Acknowledgement

The authors would like to thank to Miss Jeeranan Bantad and Anucha Kumsom for statistical analysis and thank you for the Navamindradhiraj University Research Fund for financial support.

Conflicts of interest

The authors declare no conflict of interest.

References

1. MacDuff A, Arnold A, Harvey J. Management of spontaneous pneumothorax: British Thoracic Society Pleural Disease Guideline 2010. Thorax 2010;65 Suppl 2:ii18-31.
2. Bertrand PC, Regnard JF, Spaggiari L, Levi JF, Magdeleinat P, Guibert L, et al. Immediate and long-term results after surgical treatment of primary spontaneous pneumothorax by VATS. Ann Thorac Surg 1996;61:1641-5.
3. Liu HP, Lin PJ, Hsieh MJ, Chang JP, Chang CH. Thoracoscopic surgery as a routine procedure for spontaneous pneumothorax. Results from 82 patients. Chest 1995;107:559-62.
4. Treasure T. Minimally invasive surgery for pneumothorax: the evidence, changing practice and current opinion. J R Soc Med 2007;100:419-22.
5. Gaensler EA. Parietal pleurectomy for recurrent spontaneous pneumothorax. Surg Gynecol Obstet 1956;102:293-308.
6. Levi JF, Kleinmann P, Riquet M, Debesse B. Percutaneous parietal pleurectomy for recurrent spontaneous pneumothorax. Lancet 1990;336:1577-8.
7. Ayed AK, Al-Din HJ. The results of thoracoscopic surgery for primary spontaneous pneumothorax. Chest 2000;118:235-8.
8. Barker A, Maratos EC, Edmonds L, Lim E. Recurrence rates of video-assisted thoracoscopic versus open surgery in the prevention of recurrent pneumothoraces: a systematic review of randomised and non-randomised trials. Lancet 2007;370:329-35.
9. Miller JD, Simone C, Kahnamoui K, Thomas J, Bennett WF, Young JE, et al. Comparison of videothoracoscopy and axillary thoracotomy for the treatment of spontaneous pneumothorax. Am Surg 2000;66:1014-5.
10. Sedrakyan A, van der Meulen J, Lewsey J, Treasure T. Video assisted thoracic surgery for treatment of pneumothorax and lung resections: systematic review of randomised clinical trials. BMJ 2004;329:1008.
11. Waller DA, Forty J, Morritt GN. Video-assisted thoracoscopic surgery versus thoracotomy for spontaneous pneumothorax. Ann Thorac Surg 1994;58:372-6; discussion 6-7.
12. Kim KH, Kim HK, Han JY, Kim JT, Won YS, Choi SS. Transaxillary minithoracotomy versus video-assisted thoracic surgery for spontaneous pneumothorax. Ann Thorac Surg 1996;61:1510-2.