Open Access

Original Article

Comparison of Outcomes of Uniportal versus Triportal VATS for Primary Spontaneous Pneumothorax

Raheel Khan, Asif Asghar, Bilal Umair, Aaishah Riaz, Muhammad Omar Farooq, Muhammad Imtiaz Khan

Department of Thoracic Surgery, Combined Military Hospital/National University of Medical Sciences (NUMS), Rawalpindi Pakistan

ABSTRACT

Objective: To compare outcomes of uniportal versus triportal video assisted thoracoscopic surgery for management of primary spontaneous pneumothorax.

Study Design: Quasi-Experimental study.

Place and Duration of Study: Department of Thoracic Surgery, Combined Military Hospital, Rawalpindi Pakistan, from Jan 2019 to Jul 2020.

Methodology: Patients who are diagnosed as cases of primary spontaneous pneumothorax and indicated to undergo apical stapling and pleural abrasion were divided randomly into two groups, Group A & Group B had 45 patients in each group. Group A was subjected to Uniportal VATS technique for apical stapling and pleural abrasion while Group B was subjected to same procedure using Triportal VATS technique. Variables which were studied included Operative time, need of additional port, intensity and duration of post operative pain, chest tube duration, length of hospital stay, surgical site infection (SSI), neuralgia and recurrence.

Results: Uniportal VATS when compared to triportal VATS resulted in significant reduction in pain (*p*-value 0.02), duration of chest tube drainage (*p*-value 0.02), Length of hospital stay (*p*-value 0.038) and development of neuralgia (*p*-value 0.02).

Conclusion: Uniportal VATS technique is effective in treatment of primary spontaneous pneumothorax specifically in regards to reducing post-operative pain, neuralgia and length of hospital stay.

Keywords: Primary Spontaneous Pneumothorax (PSP), Surgical Site Infection (SSI), Uniportal Video Assisted Thoracoscopic Surgery (U-VATS), Video Assisted Thoracoscopic Surgery (VATS), Wound Infection (WI).

How to Cite This Article: *Khan R, Asghar A, Umair B, Riaz A, Farooq MO, Khan MI. Comparison of Outcomes of Uniportal versus Triportal VATS for Primary Spontaneous Pneumothorax. Pak Armed Forces Med J 2025; 75(Suppl-5): S656-S660. DOI: https://doi.org/10.51253/pafmj.v75iSUPPL-5.6702*

INTRODUCTION

Pneumothorax is an accumulation of air in the pleural space and is routinely divided as per etiology into spontaneous and traumatic pneumothorax. Spontaneous pneumothorax is further divided into primary, when there is no detectible underlying disorder of the lung, and secondary, when there is an underlying lung disease.[1] By definition Primary spontaneous pneumothorax (PSP) is not associated with any underlying lung disease but that does not mean that there is no underlying pathological process contributing for its occurence.[2] The pathophysiology of primary spontaneous pneumothorax (PSP) has been a subject of debate but Blebs and emphysema-like changes (ELC) are believed to contribute to the pathogenesis of PSP but cannot be an explanation to causes of all cases developing PSP. Some authors found a relationship between smoking, PSP and concomitant development of bronchiolitis, which could be the initial pathological process that later on leads to development of ELC.[3] As per British Society of Thoracic Surgeons (BTS) guidelines of 2010 for managing PSP, surgical treatment by bullectomy and pleurodesis must be advised after the patient presents with recurrence of an episode of PSP.[4] Among the surgeons throughout the world, there is a difference of opinion in regards to optimal surgical management of pneumothorax, but they all use video-assisted thoracoscopic surgery(VATS) as the intervention of choice for pneumothorax surgery.[5] VATS now has gained a well reputed recognition worldwide and has become the standard modality for management of PSP owing to less postperative pain, having lesser invasiveness, a shorter hospital stay and an early return to daily routine.[6] Conventionally, triportal technique of VATS is being used routinely for bullectomy and pleurodesis. First single-incision thoracoscopic surgery (SITS) for bullectomy/blebectomy was reported by Yamamoto *et al.*, in 1998.[7] In recent past years, some reports evaluated the efficacy of Uniportal VATS (U-VATS) for treating PSP; most of them being either retrospective or unfocused or monocentric works which often yielded conflicting results.[8] Recently,

Correspondence: Dr Raheel Khan, Department of Thoracic Surgery, Combined Military Hospital, Rawalpindi Pakistan

Received: 06 May 2021; revision received: 31 Jan 2022; accepted: 01 Feb 2022

prospectively collected data of post-operative outcomes was reviewed retrospectively at two university hospitals which revealed U-VATS to be feasible, safe and being a less invasive alternative to triportal VATS for surgically treating PSP as it was associated with reduced postoperative pain, paresthesia, hospital stay and had improved cosmetic results.[9] In our department, both triportal and U-VATS were being carried out and we planned to compare both techniques in terms of outcomes including postoperative pain, neuralgia, surgical site infection (SSI), operative time, necessity of other access, chest tube duration, length of hospital stay and recurrence.

METHODOLOGY

This quasi experimental study has been conducted at CMH Rawalpindi. Size of the sample was calculated with the help of WHO Sample size calculator taking confidence interval 95 %, margin of error 5 %, mean post-op pain duration of 15 days in triportal VATS versus 2 days in uniportal VATS).[8] Sample size came out to be 93. Sampling technique used was non-probability consecutive sampling. A total of 90 patients were included in our study. Clearance from institutional ethical committee was obtained and an informed written consent was taken from every individual.

Inclusion Criteria: Patients of both genders with age ranging from 18 to 35 years, presenting to our department with primary spontaneous pneumothorax and indicated to undergo VATS apical stapling were included in the study.

Exclusion Criteria: Patients with known diabetes mellitus, chronic liver disease and patients who were using steroids were excluded from our study

Patients assigned to group A were subjected to surgery using U-VATS technique while group B individuals were subjected to conventional triportal VATS technique. Both groups received prophylactic dose of intravenous ceftriaxone. All patients were subjected to double lumen intubation for one lung ventilation purpose. For the surgery. Patient positioning was lateral decubitus with arms were kept flexed and stretched above their heads. In all selected cases apical stapling / bullectomy with pleural abrasion to achieve effective pleurodesis. After stapling, a "bubble test" was conducted to exclude air leak in all cases.Parietal pleural abrasion from the pleural dome to 6th rib was performed.

In patients operated with Uniportal VATS approach, Surgeon and camera assistant stand on ventral side of patient one next to each other while the second assistant stands at the opposite side of the operating table, looking at the same screen. 4-5cm incision is made along 4-5th intercostal space on anterior axillary line. For previously chest intubated patients, incision included the previous drain placement site if feasible. A wound protector of size 5cm was always placed for preventing soiling of camera which is preferably positioned in the upper portion of incision. At the end of the procedure, percutaneous intercostal nerve blockade was performed injecting Lignocaine and Bupivacaine from 4-6th intercostal spaces including the one of the incision. A 24–28 Fr chest tube was inserted and was fixed on the posterior end of the incision.

In triportal VATS approach, Both surgeon and camera assistant stand on the dorsal side of patient. A 1cm incision was made over the 7-8th intercostal space along mid-axillary line for camera-port. Two 5mm incisions were made on fourth intercostal space along anterior axillary line and along 4-5th intercostal space on the posterior axillary line. Stapler insertion port was later extended to 1cm size. Percutaneous Intercostal nerve block (with Lignocaine and Bupivacaine) was performed for 4th to 8th intercostals nerves. 24 or 28 Fr chest tube was passed through lower access/port.

Skin was closed in both groups using skin staplers. Dressing protocol and other techniques for all patients remained same (Mepore dressing was opened 72 hrs post-operatively and onwards it was changed every 24 hrly). Injectable paracetamol 1gm 8 hrly alongwith Ketorolac 30mg 12 hrly was administered for first 24 hrs. Skin staples of all patients were removed on 14th day of surgery. All U-VATS surgeries were performed by same team while all Triportal by the other team. All patients were followed up in ward and even after discharge till 90 days post-operatively to look for development of recurrence. Contact numbers of all recruited individuals were obtained and all the collected data was filled in data collection performa. Both Mean and standard deviation was calculated for quantitative variables that included age, operative time, length of hospital stay, days of chest tube duration, pain at first post-operative day (VAS Scale). The categorical or Qualitative variables like SSI, neuralgias, necessity of other access and recurrence were all presented in the terms of percentages and

frequencies. All data that was collected was analysed using Statistical Package for Social Sciences (SPSS) version 14. Both groups were compared for all outcomes mentioned earlier using Chi square test. *P*-value of <0.05 was considered statisctically significant.

RESULTS

A total of 90 patients undergoing Apical stapling have been recruited and all individuals were randomly divided into two equal groups of 45 each. The distribution of age among the individuals ranged from 18-35 years in our study. Minimum age of the recruited individual was 18 years (n=1) while maximum age that was observed in the study was35 years (n=1) with Mean age of 27.11+3.88. Mean age in Group A was 27.67±3.85 while mean age in Group B was 26.56±3.87(*p*-value 0.709). Pre-operative risk stratification of smoking, bronchial asthma and hypertension was done in both groups and remained insignificant (0.13, 0.23 & 0.55 respectively) (Table-I). Among 127 male individuals, 6 were observed to develop Surgical site infection. Compared to females; 7 out of 93 females developed SSI with an insignificant p-value of 0.384. Development of Surgical Site infection (SSI) was monitored till 30th post op day. Group A revealed 3(3.3%) individuals to have SSI as compared to Group B which was 10(9.1%). The groups had a statistically significant difference in terms of frequency of development of Surgical Site Infection with a *p*-value 0.045. Comparison between frequencies has been depicted in Table-II. All other outcome variables were studied and frequencies depicted in Table-III.

Table-I: Comparison of Groups in Terms of Risk Factors

Risk Factors	Group		*p*-value
	A n(%)	B n(%)	
Smoking	14(31.1)	21(46.7)	0.13
Asthma	2(4.4)	5(11.1)	0.238
Hypertension	2(4.4)	1(2.2)	0.557

Table-II: Comparison of Groups in Terms of Pre-Operative Status

Pre-operative status		Group		Total	*p*-value
		A n(%)	B n(%)		
Pre-operative chest intubation		20(44.4)	24(53.3)	44(48.9)	0.399
Persistent air leak		5(11.1)	5(11.1)	10(11.1)	1
Previous history of contralateral pneumothorax		3(6.7)	2(4.4)	5(5.6)	0.645
Side of pneumothorax	Right	21(46.7)	23(51.1)	46(51.1)	0.673
	Left	24(53.3)	22(48.9)	44(48.9)	

Table-III: Comparison of Groups in Terms of Outcomes

Outcome Variable	Study Group		*p*-value
	Group A	Group B	
Operative time (minutes)	63.91+7.28	63.13+6.86	0.978
Post operative Pain on Day 1 (VAS)	3.87+1.05	4.78+1.22	0.02
Need of additional access port	0	0	1
Duration of chest tube drainage post operatively (No of days)	3.31+0.84	2.78+0.82	0.02
Length of hospital stay (No of days)	4.13+0.75	4.64+0.85	0.038
Surgical site infection	4(8.9)	2(4.4)	0.398
Neuralgia	4(8.9)	12(26.6)	0.02
Recurrence	0	0	1

DISCUSSION

Primary spontaneous pneumothorax (PSP) generally occurs in young adults.[10] It occurs due to visceral pleural rupture or when a bulla which is located near the surface of lung ruptures in the absence of trauma or human factors resulting in air entering the pleural cavity leading to a pathological state of pleural pneumatosis.[11] Primary spontaneous pneumothorax may effect up to 28 patients out of 100,000 population yearly.[12]

As per recommendations of American Society of Chest Physicians, any patient who is stable clinically and has a relatively smaller pneumothorax (<3cm apex-copula distance) should be observed for 3–6 hours followed by discharge if pneumothorax doesn't progressively increase in size. On the other hand, any patient having a larger pneumothorax (>3cm apex-copula distance) should have some form of air drainage procedure done while those having persistent air leak or who experience a recurrent episode of PSP should be offered any of the available and suitable surgical option.[13] Air drainage procedure can be a simple air aspiration or chest tube placement to drain air. Chest intubation leads to a prolonged hospital stay as compared to simple aspiration, but have no difference in regards to recurrence of pneumothorax.[14] Chest intubation is a common procedure in emergency department and is an essential and lifesaving skill which is taught by Advanced Trauma Life Support program. However, It is also well-recognized that chest intubation procedure is associated with risks and complications. Jones et al found that Patients with a chest tube placed outside the trauma center of a tertiary care setup have increased likelihood of malposition, residual pneumothorax, residual hemothorax and having chances of a second chest tube placement.[15] Recent

evidence challenges the need to remove air systematically from pleural cavity in the stable patients, recommending conservative management as valuable therapeutic option. Hence, evidence now is favoring needle aspiration instead of chest tube insertion, when air evacuation is indicated in stable patients.[16] Independent of the method used to drain pleural cavity of air, ipsilateral recurrence rate, as high as 25% to 43% is observed.[12] Conventionally, patients with recurrent PSP were treated with thoracotomy with mechanical pleurodesis which was replaced with VATS with or without pleurodesis. Thoracotomy along with mechanical pleurodesis and VATS with pleurodesis have no statistically significant difference in preventing recurrence among patients with recurrent or persistent PSP however, VATS reduces the complications of procedure.[14]

The role of video-assisted thoracoscopic surgery (VATS) has been significantly studied at multiple trials and is widely recognized to be comparable to conventional thoracotomy in treating spontaneous pneumothorax and is associated with a reduction in the duration of hospital stay, postoperative pain and pulmonary dysfunction.[17] Conventionally, triportal VATS has been used effectively for performing apical stapling/ bullectomy with or without pleurodesis. However, single port / single incision / uniportal (U-VATS) approach has been developed as a more lesser invasive alternative to conventional Triportal VATS.[9] In recent past, few reports have evaluated efficacy of U-VATS in treatment of PSP; but most of them have been found to be retrospective, unfocussed or monocentric works that have often yielded conflicting results.[18] Some authors reports favorable postoperative outcomes revealing a reduction in operative time, reduction in average blood loss, reduced post-operative pain with U-VATS but others did not.[18,19] A meta-analysis that was published in 2015, Qin *et al.,* found that U-VATS was not associated not only with increased operative time but also do not prolong post-operative drainage or hospital stay when compared toconventional three-port VATS. However, post-operative pain as well as paresthesias were significantly found reduced in U-VATS group alongwith an improved cosmesis and patient satisfaction.[19] Such improved outcomes when considered for pain were consistent with other available studies and are perhaps related to the anterior positioning of incision in U-VATS where intercostals spaces are much wider and use of wound protect or (instead of hard material trocars) which protect intercostal tissues and neurovascular bundle from being compressed repetitively during the operative procedure.[19] Igai *et al.,* reported that conversion from uniportal to multiportal technique is very rare when encountering dense adhesions and routinely there is no need for an additional port insertion in uniportal technique and procedure can be completed with effective post-operative utcomes.[20] We had similar results where and did not encounter any case during the study where an additional port was needed to be inserted. Our data was comparable to international data in terms of pain, operative time, length of hospital stay, neuralgias and recurrence in U-VATS group however we had in increased SSI rate in our patients.

The small sample of patients is the main limitation of our study but to the best of our knowledge, this is the only randomized controlled trial that has been carried out in our population.

CONCLUSION

In conclusion, as per our data collection and analysis, U-VATS is technically feasible and an effective technique for treating of PSP and it is in line with international literature and evidence. It results in reduction in incidence of postoperative pain, neuralgia and length of hospital stay.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

RK & AA: Data acquisition, data analysis, critical review, approval of the final version to be published.

BU & AR: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MOR & MIK: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Yasser M, Feras M, Rabia C, Niaz, Yasser F. Management of Primary Spontaneous Pneumothorax: A Single-center Experience. Saudi J Med Med Sci 2018; 6(2): 100–103.
2. Grundy S, Bentley A, Tschopp JM. Primary spontaneous pneumothorax: a diffuse disease of the pleura. Respiration 2012; 83(3): 185-189. https://doi.org/10.1159/000335993
3. Plojoux J, Froudarakis M, Janssens JP, Soccal PM, Tschopp JM. New insights and improved strategies for the management of primary spontaneous pneumothorax. Clin Respir J 2019; 13(4): 195-201. https://doi.org/10.1111/crj.12990

4. MacDuff A, Arnold A, Harvey J. Management of spontaneous pneumothorax: British Thoracic Society Pleural Disease Guideline 2010. Thorax 2010; 65 Suppl 2: ii18-31. https://doi.org/10.1136/thx.2010.136986
5. Asghar N, Apparau D, Zacharias J, Shackcloth M. Approach to pneumothorax surgery: a national survey of current UK practice. Asian Cardiovasc Thorac Ann 2019; 27(3): 180-186. https://doi.org/10.1177/0218492319825943
6. Si YC, Yeon K, Jong HS, Jeong SY, Jin YJ, Chan BP. New bullae formation in the staple line increases the risk of recurrent pneumothorax following video-assisted thoracoscopic surgery bullectomy for primary spontaneous pneumothorax. J Thorac Dis 2018; 10(7): 4287–4292. https://doi.org/10.21037/jtd.2018.06.07
7. Yamamoto H, Okada M, Takada M, Mastuoka H, Sakata K, Kawamura M. Video-assisted thoracic surgery through a single skin incision. Arch Surg 1998; 133(2): 145-147. https://doi.org/10.1001/archsurg.133.2.145
8. Nachira D, Ismail M, Meacci E, Zanfrini E, Iaffaldano A, Swierzy M et al. Uniportal vs. triportal video-assisted thoracic surgery in the treatment of primary pneumothorax-a propensity matched bicentric study. J Thorac Dis 2018; 10(Suppl 31): S3712-S3719. https://doi.org/10.21037/jtd.2018.04.124
9. Yamanaka S, Kurihara M, Watanabe K. A novel dual-covering method in video-assisted thoracic surgery for pediatric primary spontaneous pneumothorax. Surg Today 2019; 49(7): 587-592. https://doi.org/10.1007/s00595-019-01785-x
10. Sui TQ, Zhang FY, Jiang AL, Zhang XQ, Zhang ZW, Yang Y et al. A randomized study on the effect of sequential acupoint stimulation on pulmonary function of patients with spontaneous pneumothorax during VATS perioperative period. Medicine (Baltimore) 2019; 98(10): e14575. https://doi.org/10.1097/MD.0000000000014575
11. Daemen JHT, Lozekoot PWJ, Maessen JG, Gronenschild MHM, Bootsma GP, Hulsewé KWE et al. Chest tube drainage versus video-assisted thoracoscopic surgery for a first episode of primary spontaneous pneumothorax: a systematic review and meta-analysis. Eur J Cardiothorac Surg 2019; 56(5): 819-829. https://doi.org/10.1093/ejcts/ezz116
12. Baumann MH, Strange C, Heffner JE, Light R, Kirby TJ, Klein J et al. Management of spontaneous pneumothorax: an American College of Chest Physicians Delphi consensus statement. Chest 2001; 119(2): 590-602. https://doi.org/10.1378/chest.119.2.590
13. Vuong NL, Elshafay A, Thao LP, Abdalla AR, Mohyeldin IA, Elsabaa K et al. Efficacy of treatments in primary spontaneous pneumothorax: A systematic review and network meta-analysis of randomized clinical trials. Respir Med 2018; 137: 152-166. https://doi.org/10.1016/j.rmed.2018.03.009
14. Jones CW, Rodriguez RD, Griffin RL, McGwin G, Jansen JO, Kerby JD et al. Complications Associated With Placement of Chest Tubes: A Trauma System Perspective. J Surg Res 2019; 239: 98-102. https://doi.org/10.1016/j.jss.2019.01.012
15. Plojoux J, Froudarakis M, Janssens JP, Soccal PM, Tschopp JM. New insights and improved strategies for the management of primary spontaneous pneumothorax. Clin Respir J 2019; 13(4): 195-201. https://doi.org/10.1111/crj.12990
16. Vohra HA, Adamson L, Weeden DF. Does video-assisted thoracoscopic pleurectomy result in better outcomes than open pleurectomy for primary spontaneous pneumothorax? Interact Cardiovasc Thorac Surg 2008; 7(4): 673-677. https://doi.org/10.1510/icvts.2008.176081
17. Masmoudi H, Etienne H, Sylvestre R, Evrard D, Ouede R, Le Roux M et al. Three Hundred Fifty-One Patients With Pneumothorax Undergoing Uniportal (Single Port) Video-Assisted Thoracic Surgery. Ann Thorac Surg 2017; 104(1): 254-260. https://doi.org/10.1016/j.athoracsur.2017.01.054
18. Yang HC, Cho S, Jheon S. Single-incision thoracoscopic surgery for primary spontaneous pneumothorax using the SILS port compared with conventional three-port surgery. Surg Endosc 2013; 27(1): 139-145. https://doi.org/10.1007/s00464-012-2381-6
19. Kim MS, Yang HC, Bae MK, Cho S, Kim K, Jheon S. Single-Port Video-Assisted Thoracic Surgery for Secondary Spontaneous Pneumothorax: Preliminary Results. Korean J Thorac Cardiovasc Surg 2015; 48(6): 387-392. https://doi.org/10.5090/kjtcs.2015.48.6.387
20. Igai H, Kamiyoshihara M, Ibe T, Kawatani N, Shimizu K. Single-incision thoracoscopic surgery for spontaneous pneumothorax using multi-degrees of freedom forceps. Ann Thorac Cardiovasc Surg 2014; 20(6): 974-979. https://doi.org/10.5761/atcs.oa.13-00278