



Original Article

Thoracic Surgeons' Perspective on the Management of Primary Spontaneous Pneumothorax

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Abstract

OBJECTIVE: The study aimed to determine the current practice of thoracic surgeons in the management of primary spontaneous pneumothorax in Saudi Arabia and to compare the results with the British Thoracic Society guidelines.

MATERIAL AND METHODS: This is a questionnaire-based study. The questionnaire included 41 questions and was directed to those involved in the management of primary spontaneous pneumothorax in Saudi Arabia; namely thoracic, cardiac, and general surgeons. It was distributed electronically through email. Out of 47 registered surgeons at the time of the study, 47 responses were obtained with a 100% response rate.

RESULTS: Among the participants, 39 were thoracic surgeons. It was noted that all surgeons agreed on ordering an initial chest radiograph and most would order an additional view. Also, approaches varied regarding grading systems used. While 26% of the respondents use the British Thoracic Society grading system, 16% follow the American College of Chest Physicians system, and the rest chose other parameters. The majority of surgeons would choose a chest tube of a size not greater than 28 Fr for initial placement. As for video-assisted thoracoscopic surgery, we noted that 55% of the respondents opted for 3 ports, while 36% would place 2 ports.

CONCLUSION: Primary spontaneous pneumothorax is a common condition managed by thoracic surgeons. Various guidelines were established to guide practice. Our study showed some variability in practice which could result in serious medico-legal consequences and can affect the careers of thoracic surgeons. We hope that our results will shed light upon variabilities to influence proper directed management.

KEYWORDS: Thoracic surgery, pneumothorax, primary spontaneous pneumothorax (PSP), treatment, diagnosis

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INTRODUCTION

Pneumothorax refers to the accumulation of air in the pleural cavity. Pneumothorax may develop spontaneously or due to trauma. Spontaneous pneumothorax is further divided into primary and secondary subtypes. Primary spontaneous pneumothorax (PSP) occurs in the absence of underlying pulmonary disease, while secondary spontaneous pneumothorax frequently occurs in elderly people with underlying lung conditions.¹ PSP tends to develop in young, thin, and tall males due to rupture of subpleural blebs or bullae. It is more common in men than in women. The incidence varies among different geographical areas, for example, the incidence in the United States is 7.4 per 100 000 population per year.^{1,2} Similar results were obtained in Arab countries.³ The recurrence rate is estimated to be around 25%-50%, mostly occurring within the first year.⁴ If non-operative management was opted for a patient presenting with a second attack, 54% of those patients will develop a third recurrence.⁵ Risk factors that predispose to the condition include cigarette smoking, family history, Marfan's syndrome, homocystinuria, and meteorological factors.⁶

Management approaches vary, ranging from conservative to surgical therapeutic options. These interventions include bed rest, oxygen supplementation, aspiration, and tube thoracostomy, in addition to thoracoscopic and other surgical modalities.⁷

The British Thoracic Society (BTS) produced guidelines for the management of spontaneous pneumothorax in 1993 which were updated in 2010. A conservative approach was strongly favored, with emphasis on observation without intervention in selected patients. Aspiration was recommended as an initial procedure in all cases of PSP if the patient is symptomatic, irrespective of the size of the pneumothorax. Surgical intervention is recommended in ipsilateral second attack or contralateral pneumothorax.⁸ Despite the availability of these guidelines, previous studies have shown poor compliance with the guidelines.^{9,10}

The healthcare system in Saudi Arabia is composed of the government and private sectors. The ministry of health is the major government provider of healthcare services in Saudi Arabia, including the provision of primary healthcare services. Other government bodies include referral and teaching hospitals, among others. The private sector also contributes to the

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delivery of healthcare services.¹¹ In Saudi Arabia, PSP patients are mostly managed by thoracic surgeons from the time of admission. At present, there are no national guidelines on the management of PSP in Saudi Arabia. Nevertheless, adherence to any of the international guidelines was not previously reported in our region.

The aim of this work is to determine the current practice of thoracic surgeons in the management of PSP in Saudi Arabia and to compare the results with BTS guidelines.

MATERIAL AND METHODS

The proposal was reviewed by the institutional review board (IRB) of Imam Abdulrahman Bin Faisal University and ethical approval was attained on February 17, 2019 (Number: IRB-PGS-2019-01-120).

Study Design

This is a cross-sectional questionnaire-based study. The questionnaire included 41 questions regarding the management and follow-up of patients with PSP in addition to the demographic data of the participants (Tables 1-3). Questions were divided into those with a binary response (i.e., yes/no) and open-ended questions. The questionnaire was developed following a systemic, scientifically accepted methodology based on previous studies, experts' opinion, validation, and statistical analysis (Cronbach's alpha). The questionnaire was tested for validity and reliability with a value of 0.622 which was obtained and calculated based on the responses. It was distributed electronically either by email or through a professional WhatsApp group.

Participants

The questionnaire targeted thoracic surgeons involved in the management of PSP throughout Saudi Arabia. Other specialties (e.g., pulmonary and emergency physicians) are not involved in the management of PSP in our region and hence were not included in the survey. Participant names were obtained from the Saudi Thoracic Society registry.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 20 (IBM Corp.; Armonk, NY, USA). For data analysis, we used the Chi-square

test for categorical variables and the Mann-Whitney *U* test for continuous variables. $P < .05$ was considered to be significant.

RESULTS

Out of 47 registered thoracic surgeons at the time of the study, 47 responded with a 100% response rate. Table 1 demonstrates the demographic data of all participants. Twenty-eight questions with binary responses, that is, yes/no are shown in Table 2, while 13 are open-ended and are demonstrated in Table 3. Table 4 shows a comparison of responses by thoracic surgeons versus others.

Table 1. Demographic Data of All Participants

Parameter	All Participants n = 47	
Age (years)		
Average 44.9 (33-59)*		
Experience (years)		
Average 13.3 (1-30)*		
Gender (n, %)		
Male	44	94
Female	1	2
Not specified	2	4
Board certification (n, %)		
General Surgery	27	57
Cardiothoracic Surgery	20	43
Current primary position (n, %)		
Thoracic surgeon	39	83
Cardiac surgeon	4	9
General surgeon	2	4
Others (e.g., senior registrar, fellow, administrative)	2	4
Fellowship certificate country (n, %)		
North American	16	34
European	8	17
Saudi	5	11
Arab board	15	32
Others	3	6
Health care institution (n, %)		
Governmental	42	89
Private	5	11
Region (n, %)		
East	20	43
Central	12	26
West	12	26
South	2	4
North	1	2

*min-max.

MAIN POINTS

- Various protocols and guidelines were established to guide primary spontaneous pneumothorax (PSP) management.
- There is a variability in the management of PSP among thoracic surgeons and deviation from the current guidelines.
- Deviation from guidelines may pose medico-legal consequences and financial burdens on hospitals.
- There is a strong need for high-quality studies to reach an international consensus on the management of PSP.

Table 2. Binary Response Questions by All Participants

Question	Answer			
	Yes		No	
	n	%	n	%
1) Ordering an initial CXR	47	100	0	0
2) Further views (lateral)	14	30	33	70
3) Further views (expiratory film)	7	15	40	85
4) Routine radiological grading of PSP	19	40	28	60
5) Routine CT scan for the first attack	28	60	19	40
6) Routine drainage	19	40	28	60
7) Performing simple aspiration	3	6	44	94
8) Using Heimlich valve	19	40.4	28	59.6
9) Operating during the first attack	22	47	25	53
10) Stapling the lung involved	46	98	1	2
11) Release of adhesions routinely	40	85	7	15
12) Exploring each lobe for concomitant pathology routinely	42	89	5	11
13) Performing apical pleurectomy routinely	21	45	26	55
14) Performing mechanical pleurodesis routinely	32	68	15	32
15) Performing chemical pleurodesis routinely	6	13	41	87
16) Insertion of chest tube in the procedure	40	85	7	15
17) Routine use of NSAIDs	22	47	25	53
18) Positive effect of NSAIDs on the outcome	21	45	26	55
19) Performing daily CXR	37	79	10	21
20) Keeping chest tube under continuous suction routinely	40	85	7	15
21) Clamping of chest tube before removal	17	36	30	64
22) Performing CXR following removal of chest tube	37	79	10	21
23) Putting a pre take suture	38	81	9	19
24) Follow-up of patients routinely in the first week	33	70	14	30
25) Follow-up of patients routinely in the first month	40	85	7	15
26) Repeating CT scan	2	4	45	96
27) Instructing patients not to fly within 2-4 weeks	30	64	17	36
28) Is such consensus important?	38	81	9	19

CT, computed tomography; CXR, chest radiograph; NSAIDs, non-steroidal anti-inflammatory drugs; PSP, primary spontaneous pneumothorax.

Initial Radiological Imaging

All participants perform an initial chest radiograph (CXR). Sixty percent of the participant surgeons choose to perform computerized tomography (CT) scans routinely for the first PSP attack. Of those who choose to perform routine CT scan, 79% order plain CT scan, while the rest order CT scan with contrast. Surgeons’ decision to perform a CT scan for the first PSP attack was not related to their experiences, type of board certification, type of the hospital or geographical location within Saudi Arabia.

Estimation of the Size of Pneumothorax

Nineteen participants (40.4%) measure the size of PSP radiologically. Five participants (10.6%) measure the size of the pneumothorax in CXR according to BTS guidelines. Other measurement methods, namely, American College of Chest Physicians Delphi Consensus Statement

(ACCPDCS), interpleural distance, and percentage measurement methods are used by 6.4%, 4.3%, and 4.3%, respectively. Seven participants (14.9%) use other non-specified methods.

Initial Management of Pneumothoraces

Nineteen participants (40.2%) routinely drain the PSP. However, only 1 participant (2.1%) employs simple aspiration for drainage. Additionally, 29.8% prefer to insert a pig-tail for drainage of the PSP and the rest (70.2%) prefer chest tube insertion. Twenty-two participants (46.8%) treat the first attack of PSP by surgical intervention. The indications for surgical intervention (other than the first attack) returned 76 responses (Table 3). Recurrence was the highest indication for surgical intervention according to 23 respondents (30%). Persistent air leak and presence of bullae represented 20% and 17% of responses, respectively.

Table 3. Questions with Open-ended Responses by All Participants

		n	%
1) PSP grading system used	System		
	BTS	5	26
	ACCPDCS	3	16
	AID	2	10.5
	Percentage	2	10.5
	Others	7	37
2) Type of CT scan done	Type of CT scan	n	%
	Plain CT	22	79
	With contrast	6	21
3) Method of drainage	Method	n	%
	Chest tube	32	68
	Pigtail catheter	8	17
	Both	6	13
4) Size of chest tube (if used)	Size	n	%
	Not specified	1	2
	20 Fr	3	7
	22-24 Fr	13	28
	26-28 Fr	23	50
5) Indication to operate (other than the first attack)	30-32 Fr	3	7
	Not specified (age, body size, etc.)	4	9
	Indication	n	%
	Recurrence	23	30
	Persistent air leakage	15	20
	Bullae or blebs	13	17
	Failure of conservative treatment or lung expansion	7	9
	High-risk occupation	5	7
	Remote residence	4	5
	First attack in selected cases	4	5
6) Approach used	Illicit drug use or smoking	2	3
	Others	3	4
	Procedure	n	%
	VATS	36	77
	Uniportal VATS	9	19
	Thoracotomy	1	2
7) Number of ports (if VATS)	Axillary thoracotomy	0	0
	All	1	2
	Ports	n	%
	3	23	55
	2	15	36
8) Agent used in chemical pleurodesis	1	3	7
	Not specified	1	2
	Agent	n	%
	Talc powder	4	66.7
	Blood	1	16.7
	Betadine	1	16.7

Table 3. Questions with Open-ended Responses by All Participants (*Continued*)

Question	Category	n	%
9) Size of chest tube (if used in the procedure)	Size		
	20 Fr	1	2.2
	22-24 Fr	9	20
	26-28 Fr	29	64.2
	30-32 Fr	5	11.2
	Not specified (age, body size, etc.)	1	2.2
10) Primary postoperative analgesia protocol	Protocol		
	PCA	12	25.5
	NSAIDs	14	29.8
	Epidural catheter	3	6.4
	Paravertebral block	4	8.5
	Others (acetaminophen, intercostal block, etc.)	14	29.8
11) Duration of keeping chest tube under suction	Duration		
	24-48 hours	31	77.5
	>48 hours	6	15
	Not specified	3	7.5
12) Duration of chest tube use postoperatively	Duration		
	24-48 hours	15	32
	>48 hours	25	53
	Not specified	7	15
13) Days of sick leave granted	Duration		
	1-2 weeks	39	83
	2-4 weeks	8	17
	Depending on situation	0	0

ACCPDCS, American College of Chest Physicians Delphi Consensus Statement; AID, average interpleural distance; BTS, British Thoracic Society; CT, computed tomography; NSAIDs, non-steroidal anti-inflammatory drugs; PCA, patient-controlled analgesia; PSP, primary spontaneous pneumothorax; VATS, video-assisted thoracoscopic surgery.

Use of Suction

Eighty-five percent of our participants believe that suction should be applied routinely to a chest tube. Nine participants were not certain about the duration of the suction. Thirty participants apply suction for 48 hours or more.

Clamping of the Chest Tube

If the insertion of an intercostal drain results in stopping an air leak and full expansion of the lung, 30 participants (63.8%) would act in accordance with the guidelines and would remove the chest tube without first clamping the tube. Seventeen participants would clamp the tube before removal. It was observed that consultants with an experience of 6-15 years (42.6%) do not clamp the chest tube before removal which was statistically significant at $P = .005$.

Surgical Strategies

Video-assisted thoracoscopic surgery (VATS) is the approach of choice for 46 surgeons (97.9%) to treat PSP. To lower the rate of recurrence, 4 participants (12.8%) would use chemical pleurodesis, mechanical pleurodesis or apical pleurectomy, while 8 participants do not use any of these techniques. Eleven participants may perform apical pleurectomy or mechanical pleurodesis, while 16 and 6 participants perform only mechanical pleurodesis or only apical pleurectomy, respectively.

DISCUSSION

Diagnostic and therapeutic guidelines for PSP do exist, but the significant variations in clinical practice observed worldwide make it difficult for clinicians to feel confident about following the recommendations in those guidelines. Moreover, there is a need for an update to these guidelines since they were suggested around 10 years back. This study showed a variation in both the knowledge of existing international guidelines and management of PSP among thoracic surgeons in Saudi Arabia.

Routine performance of CT scan after the first attack was reported by 60% of the participants. When paralleled with the guidelines, the BTS guidelines stated that there are practical constraints that preclude the general use of CT scans as the initial diagnostic modality. However, CT scan is considered the gold standard in the detection of small pneumothoraces and its size estimation.⁸ Sihoe et al¹² highlighted the importance of CT scan to predict the risk of occurrence of PSP by the detection of lung bullae in the contralateral lung, thus allowing preemptive surgical intervention in selected patients.

Table 4. Comparison of Responses by Thoracic Surgeons Versus Others

Question	P
1) Ordering an initial CXR	N/A
2) Further views (lateral)	.6005
3) Further views (expiratory film)	.8346
4) Routine radiological grading of PSP	.8531
5) Routine CT scan for the first attack	.8531
6) Routine drainage	.3291
7) Performing simple aspiration	.4372
8) Using Heimlich valve	.1149
9) Operating during the first attack	.1371
10) Stapling the lung involved	.6471
11) Release of adhesions routinely	.3781
12) Exploring each lobe for concomitant pathology routinely	.006828*
13) Performing apical pleurectomy routinely	.6538
14) Performing mechanical pleurodesis routinely	.7099
15) Performing chemical pleurodesis routinely	.255
16) Insertion of chest tube in the procedure	.8346
17) Routine use of NSAIDs	.3289
18) Positive effect of NSAIDs on the outcome	.6538
19) Performing daily CXR	.7776
20) Keeping chest tube under continuous suction routinely	.8346
21) Clamping of chest tube before removal	.3715
22) Performing CXR following removal of chest tube	.1065
23) Putting a pre take suture	.1308
24) Follow-up of patients routinely in the first week	.6005
25) Follow-up of patients routinely in the first month	.3781
26) Repeating CT scan	.001417*
27) Instructing patients not to fly within 2-4 weeks	.9315
28) Is such consensus important?	.1533

*P = .05 is statistically significant.

CT, computed tomography; CXR, chest radiograph; N/A, not applicable; NSAIDs, non-steroidal anti-inflammatory drugs; PSP, primary spontaneous pneumothorax.

Both the BTS and ACCPDCS guidelines use the combination of patient's clinical status and size of pneumothorax to direct the management options. The BTS guidelines divide the size of pneumothoraces into "small" and "large" when the lung surface to the chest wall is <2 cm or >2 cm, respectively. The ACCPDCS, however, uses the apex to cupola distance in which a small pneumothorax is less than 3 cm in collapse and a large pneumothorax >3 cm in collapse.^{8,13} Rhea et al¹⁴ use the average interpleural distance which is obtained from 3 linear measurements and closely predicts true pneumothorax size as determined by radiographic thoracic gas volume measurement. For clinically compromised patients, all agree

that drainage is required. For clinically well patients, each bases its recommendations on pneumothorax size. The poor agreement between guidelines in the size estimation of pneumothorax explains the management variation, that is, the use of thoracostomy tube drainage and the limited use of conservative management.¹⁰ This disagreement can also be appreciated between our participants and hence the variation in the management strategy of PSP in our region. A randomized controlled trial conducted by Brown et al¹⁵ concluded that conservative management was non-inferior to interventional management for radiographic resolution of moderate-to-large PSP within 8 weeks. However, this study did not provide information about the long-term follow-up and recurrence rate of those patients who were managed conservatively.

The management of the chest tube primarily with water seal or added suction is a subject of debate and the benefits of one versus the other are unclear. In a study by So and Yu¹⁶ on 52 patients with spontaneous pneumothorax, the application of suction did have an effect in shortening the hospital stay. Weissberg and Refaely¹⁷ analyzed 1199 patients with pneumothorax. They recommended the application of suction if the lung does not expand well initially but otherwise should not be used routinely. The BTS guidelines do not recommend the routine use of suction and limit its use to persistent air leak with or without incomplete re-expansion of the lung.⁸ Most of our participants apply suction to the chest tube routinely. The presence or absence of air leak or lung collapse does not influence either the application of suction or its duration.

The management of pneumothorax depends on the severity of symptoms, the size of pneumothorax, type of pneumothorax, and whether an air leak is likely to be present.⁷ The choice of method for the initial treatment of a PSP remains controversial.¹⁸ Only 6.4% of our participants would attempt simple aspiration to treat the pneumothorax. The BTS guidelines recommend simple aspiration as the first-line treatment for all small (<2 cm) PSPs in minimally breathless patients under the age of 50 years requiring intervention.⁸ The ACCPDCS however recommends chest drain insertion as the first line of intervention in such patients as simple aspiration is not effective even in symptomatic PSP patients with small pneumothorax.¹³ However, in the lack of prospective randomized studies, many authors support simple aspiration as the initial management of PSP compared to chest drain insertion because of the potential to immediately discharge patients and hence a shorter hospital stay which has cost-saving benefits. Furthermore, the procedure is less invasive with lower complication rates and less analgesic requirements.^{19,20} Most of our participants (70.2%) would insert a chest tube as initial management for the first attack of PSP.

Several retrospective studies have shown, unanimously, that VATS has superior outcomes in terms of recurrence rates, duration of chest tube placement, and mean hospital stay with the first episode of PSP.²¹ Additionally, the reduced length of stay and decreased recurrence mitigate the increased cost associated with VATS. In addition to the patient's choice, the BTS guidelines outline certain indications for the surgical intervention for the first PSP episode. Fifteen of our participants (20%) would intervene surgically during the first attack of PSP when there is persistent air leak. The BTS guidelines

did not advocate a certain time limit for surgical intervention in the case of prolonged air leak. A period between 5 and 14 days is reported in the literature.⁸ Thirteen of our participants (28%) reported that the presence of bullae in the CT scan is an indication for surgical intervention because of higher rates of recurrence in such patients. The BTS has no such recommendation. Nevertheless, many authors believe that bullectomy is justifiable for elimination of the source of air leak and lower rate of recurrence.^{5,21}

Several factors might contribute to the deviation from existing guidelines. These include a lack of awareness, personal experience, and academic background.⁹ We agree with Soulsby²² that those guidelines should be incorporated in teaching modules and that adherence should be audited. Additionally, randomized controlled trials evaluating the management options of PSP are deficient. More studies are needed to generate the best evidence-based practice guidelines.

The aim of this study is to initiate a national consensus on PSP management approach among thoracic surgeons in our region that would result in better outcomes in terms of patient safety and satisfaction. However, this study has a potential limitation. The small number of participants included in the survey is due to the fact that thoracic surgeons are the ones solely managing PSP in Saudi Arabia.

CONCLUSION

PSP represents a heterogeneous group of patients with distinctive symptomatology, radiology, and pathological basis of the disease. Various protocols and guidelines were established to guide clinical practice. Our study showed variability in the management of PSP between thoracic surgeons and deviation from the current guidelines. The impact of this deviation may have medico-legal consequences as well as financial burdens on hospitals. There is a strong need for high-quality studies to reach an international consensus on the management of PSP.

Ethics Committee Approval: Ethical committee approval was received from the institutional review board (IRB) of Imam Abdulrahman Bin Faisal University and ethical approval was attained on 17/02/2019 (Number: IRB-PGS-2019-01-120).

Informed Consent: All participants were informed about the purpose of the study and that participation was voluntary.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – Y.A.; Design – Y.A.; Supervision – Y.A., H.E.; Data Collection and/or Processing – A.A., N.A., B.A.; Analysis and/or Interpretation – R.A.; Literature Review – F.A., A.A., R.A., N.A., M.A.; Writing – F.A., A.A., R.A.; Critical Review – H.E.

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