

Management of primary spontaneous pneumothorax in children: Current practices among Turkish pediatric surgeons

Çocuklarda primer spontan pnömotoraks yönetimi: Türk çocuk cerrahlarında güncel uygulamalar

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ABSTRACT

Background: This study aims to evaluate current practices in the management of primary spontaneous pneumothorax among Turkish pediatric surgeons.

Methods: Between October 2021 and November 2021, an online survey comprising 19 questions was delivered to all members of the Turkish Association of Pediatric Surgeons (TAPS). A total of 74 respondents (42 males, 32 females; mean age: 42.3±7.9 years; range, 29 to 61 years) were included.

Results: The response rate was 17.1% among all society members. The rate of utilization of computed tomography in the initial admission was 27.4%, and the rate of use in cases requiring surgical treatment was 78.4%. A total of 81% of surgeons reported that the size of the pneumothorax influenced management. For the first episode of primary spontaneous pneumothorax, 75.7% of surgeons opted for chest tube drainage, 14.9% for only oxygen administration, 4.1% for needle aspiration, and none of the surgeons preferred video-assisted thoracoscopic surgery. For patients with a persistent air leak after chest tube placement, there was a wide variation in the duration of observation before performing surgery. Video-assisted thoracoscopic surgery was the most preferred surgical intervention (75.3%) and the most preferred surgical method was stapled bullectomy (43.8%).

Conclusion: There are practice variations in the management of pediatric primary spontaneous pneumothorax among the society members. However, the majority of members seem to agree on the use of computed tomography, initial treatment, and surgical interventions.

Keywords: Chest tube, child, diagnostic imaging, pneumothorax, surgery.

ÖZ

Amaç: Bu çalışmada Türk çocuk cerrahları arasında primer spontan pnömotoraks yönetimine ilişkin güncel uygulamalar değerlendirildi.

Çalışma planı: Ekim 2021 - Kasım 2021 tarihleri arasında Türkiye Çocuk Cerrahisi Derneği'nin (TÇCD) tüm üyelerine 19 sorudan oluşan çevrimiçi bir anket gönderildi. Ankete yanıt veren toplam 74 kişi (42 erkek, 32 kadın; ort.yaş: 42.3±7.9 yıl; dağılım, 29-61 yıl) çalışmaya alındı.

Bulgular: Tüm dernek üyeleri arasında yanıt oranı %17.1 idi. İlk başvuruda bilgisayarlı tomografi kullanım oranı %27.4, cerrahi tedavi gerektiren olgularda cerrahi öncesi kullanım oranı %78.4 idi. Cerrahların %81'i, pnömotoraks boyutunun tedaviyi etkilediğini bildirdi. Primer spontan pnömotoraksın ilk epizodu için cerrahların %75.7'si göğüs tüpü drenajı, %14.9'u sadece oksijen uygulaması, %4.1'i iğne aspirasyonu tercih ederken, katılımcıların hiçbiri video yardımcı torakoskopik cerrahiyi tercih etmedi. Göğüs tüpü yerleştirildikten sonra kalıcı hava kaçağı olan hastalar için, cerrahi öncesi gözlem süresinde önemli farklılıklar vardı. En çok tercih edilen cerrahi girişim video yardımcı torakoskopik cerrahi (%75.3), en çok tercih edilen cerrahi yöntem ise stapler ile büllectomi (%43.8) idi.

Sonuç: Dernek üyeleri arasında primer spontan pnömotoraks yönetiminde uygulama farklılıkları vardır. Bununla birlikte, üyelerin çoğunluğu arasında bilgisayarlı tomografi kullanımı, başlangıç tedavisi ve cerrahi girişimler konusunda fikir birliği olduğu görülmektedir.

Anahtar sözcükler: Göğüs tüpü, çocuk, tanısal görüntüleme, pnömotoraks, cerrahi.

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Primary spontaneous pneumothorax (PSP) is a rare pulmonary pathology that occurs in the absence of underlying lung disease and trauma.^[1] It is widely adopted that PSP develops as a result of rupture of the bullae and blebs adjacent to visceral pleura.^[2] The incidence of pediatric PSP is 4/100,000 in males and 1.1/100,000 in females.^[1]

There are guidelines published by the British Thoracic Society (BTS), American College of Chest Physicians (ACCP), and European Respiratory Society (ERS) regarding the management of PSP in adults.^[3-5] However, there is still a lack of pediatric-specific guidelines.^[6] Management of PSP in children is currently based on either clinician's experience or adult guidelines.^[1,6-8]

In the present study, we aimed to evaluate current practices in the management of PSP among Turkish pediatric surgeons.

MATERIALS AND METHODS

This electronic survey study was conducted at Sancaktepe Şehit Prof. Dr. İlhan Varank Training and Research Hospital, Department of Pediatric

Surgery between October 2021 and November 2021. An electronic survey was used to investigate the management of PSP among pediatric surgeons in Türkiye.^[9] The survey comprised 19 questions about surgeons' academic degrees, practice setting, and management of PSP. The Turkish Association of Pediatric Surgeons (TAPS) had a total of 432 members during the study period. The survey was distributed to all members of TAPS via e-mail. After initial survey distribution, reminder e-mails were sent 15 and 30 days later. A total of 74 respondents (42 males, 32 females; mean age: 42.3±7.9 years; range, 29 to 61 years) were included in the study.

Statistical analysis

Statistical analysis was performed using the SPSS version 16.0 software (SPSS Inc., Chicago, IL, USA) and MedCalc version 12.3 software (MedCalc Software Ltd., Ostend, Belgium). Continuous variables were expressed in mean ± standard deviation (SD) or median and interquartile range (IQR), while categorical variables were expressed in number and frequency. Continuous variables were analyzed using the Fisher exact test or chi-square test. Normality tests with Shapiro-Wilk were conducted for numerical variables and one-way analysis

Table 1. The use of computed tomography in primary spontaneous pneumothorax management among Turkish pediatric surgeons

	%
Using CT at initial admission	
No	72.4
Yes	27.4
Influence of size of pneumothorax on management	
Strong	52.7
Moderate	28.4
None	18.9
Chest CT for operative decision-making	
Routinely	78.4
Selectively	21.6
Surgery offered based on blebs on CT	
Yes	64.9
Yes/no	18.9
No	16.2
Surgery offered on asymptomatic side based on presence of blebs	
No	73
Yes	17.6
Yes/no	9.5

CT: Computed tomography.

of variance (ANOVA) or Kruskal-Wallis test was used to analyze categorical variables. A *p* value of <0.05 was considered statistically significant.

RESULTS

A total of 74 respondents were included in the study, indicating a response rate of 17.1% among all TAPS members. Responses were received from pediatric surgeons working in training and research hospitals (52.7%), faculties of medicine (31.1%), state hospitals (8.1%), private hospitals (6.8%), and private offices (1.4%). A total of 54.7% of the participants were academicians (21.9% Assistant Professors, 16.4% Associate Professors, and 16.4% Professors), while 45.3% were specialist physicians.

Totally, 41.9% of the participants reported that one to five PSP cases were admitted to their pediatric surgery department per year. The admittance numbers were reported as 5 to 10 cases for 31.1% and more than 10 cases for 25.7% of the participants.

Most respondents (66.2%) were in practice for at least 10 years, 21.6% were in practice for 5 to 10 years, and 12.2% were in practice for five years or less. Tube thoracostomy was preferred the initial management by a majority of respondents (75.7%). The rate of using computed tomography (CT) at initial admission was 27.4%. Initial management was not significantly associated with practice setting (*p*>0.05). Minimum days for removal of chest drain and observation of air leak before performing surgery were not significantly

Table 2. Initial and surgical treatment of primary spontaneous pneumothorax in Turkish pediatric surgeons

	%
Initial treatment	
Tube thoracostomy	75.7
Oxygen therapy	14.9
Depends on the patient's clinic, rate of PSP etc.	5.6
Needle aspiration	4.1
VATS	0
Minimum days for removal of chest drain	
3 days	32.9
5 days	27.4
2 days	24.7
Over 5 days	9.6
Others	5.5
Observation of air leak before performing surgery	
Over 10 days	34.2
7 days	28.8
5 days	23.3
10 days	6.8
Criteria for surgery	
Recurrence, persistent air leak, large bullous lesions on CT	73
Recurrence, persistent air leak	9.5
Persistent air leak, large bullous lesions on CT	8.1
Others	9.4
Operative approach	
VATS	75.3
Thoracotomy	21.9
Others	2.8

PSP: Primary spontaneous pneumothorax; VATS: Video-assisted thoracoscopic surgery; CT: Computed tomography.

Table 3. Operative management and using pleurodesis agents in primary spontaneous pneumothorax among Turkish pediatric surgeons

	%
Interventions	
Stapled blebectomy	43.8
Wedge resection + partial decortication	21.9
Mechanical pleurodesis + blebectomy	20.5
Others	13.8
Surgery timing for recurrences	
Second episode	38.4
Third episode	30.1
First episode	23.3
Fourth or more	8.2
Factors prompting VATS during initial admission	
Persistent air leak, failure of complete lung expansion, recurrence after chest tube removal	66.2
Persistent air leak	17.6
Recurrence after chest tube removal	6.8
Failure of complete lung expansion	5.4
Others	4
Autologous blood pleurodesis or chemical pleurodesis	
No	50.7
Yes	49.3
Approach for pleurodesis	
Autologous blood pleurodesis	45.8
Chemical pleurodesis other agents (Talc, Minocycline, etc.)	41.7
Others	12.5

VATS: Video-assisted thoracoscopic surgery.

different among the surgeons ($p>0.05$). There was no significant difference using video-assisted thoracoscopic surgery (VATS) for operative approach ($p>0.05$).

The responses to survey and their percentages are shown in Table 1, Table 2, and Table 3, respectively.

DISCUSSION

The correct management of pediatric PSP is still controversial. Questions about diagnostic tools, initial treatment, timing of surgery, and surgical method have not been clearly established, yet.

The diagnosis of PSP is usually clinically suspected based on the medical history and physical examination of the patient and confirmed by chest radiograph (posteroanterior/lateral radiography).^[10] However, chest

radiograph is not 100% reliable for the definitive diagnosis.^[11] In case of PSP with equivocal or negative chest radiographs, CT may be warranted to detect smaller pneumothoraces.^[12] Soccorso et al.^[13] suggested performing early chest CT scan to identify blebs, plan for surgery, and rule out secondary pathological conditions causing pneumothorax in pediatric PSP. In contrast, recent studies in the pediatric population have argued the limited benefit of CT in the management of pneumothorax due to the low sensitivity to detect blebs and the risk of ionizing radiation.^[7,14] The ACCP panel does not recommend routine use of CT in patients with first-time pneumothorax, while BTS recommends CT for “ambiguous or complex cases”^[3,4] and ERS recommends use of CT only in patients requiring surgery and complicated cases.^[5] According to our study, the members of TAPS frequently preferred

using CT in the preoperative period, but the rate of CT utilization in initial admission was low as recommended in adult guidelines.

The guidelines of the BTS and the ACCP emphasize the importance of the clinical characteristics of the patient rather than the size of the pneumothorax in the management of PSP.^[3,4] Miscia et al.^[6] argued that the management of PSP should depend on the presence of symptoms rather than the size of pneumothorax in children. In contrast, Williams et al.^[8] revealed that the size of the pneumothorax on imaging affects the surgeons' choice of PSP management. In our study, similar to Williams et al.'s study, the size of the pneumothorax on imaging influenced TAPS members' management of PSP. We believe that further studies are needed in the pediatric population on this subject.

The initial management of the first episode of a pediatric spontaneous pneumothorax is controversial.^[15] Treatment options include oxygen therapy, needle aspiration, tube thoracoscopy, and surgery.^[4,8,12,16] Even if BTS guidelines proposed needle aspiration as first-line management for symptomatic PSP, Soccorso et al.^[13] argued needle aspiration to be ineffective in pediatric PSP. The ACCP recommended a more aggressive approach, suggesting intercostal drain placement in every pneumothorax larger than 20% of the hemithorax. Young Choi et al.^[6] suggested that asymptomatic patients with small pneumothorax should be managed with oxygen administration, while small, symptomatic pneumothorax or pneumothorax of any other size should be managed with chest tube insertion. Another study concluded that children treated with surgery as the first-line therapy showed better outcomes.^[6] The present survey revealed that majority of TAPS members preferred tube thoracostomy as the initial management. The second preferred option was oxygen administration. Needle aspiration option was rare. None of the participants preferred VATS as the initial treatment. According to the current study, tube thoracostomy and oxygen therapy were prioritized, and VATS was not preferred in the initial treatment among Turkish pediatric surgeons.

The ACCC recommends removal of the chest tube, when the air leak stops and chest radiographs show no residual pneumothorax.^[3] However, no recommendations are made on the minimum number of days the tube should remain. In our study, the most common response we obtained was to keep the tube for at least three days, while the second most common response was to keep it for five days. The minority of the responses suggested waiting for more than

five days. According to our study, the majority of the Turkish pediatric surgeons believe that the tube should not be kept for more than five days, if the air leak stops and there is no residual pneumothorax on chest radiographs.

Persistent air leakage indicate failure of non-operative management, which may necessitate an operation. The reported definition of a persistent air leak varies in reported studies from three to 10 days.^[8] The ACCP recommends surgery for adults, if the air leak lasts longer than four days for spontaneous pneumothorax. In the survey, there was a wide variation in the duration of observation before performing surgery. However, the majority of respondents chose the option to wait over 10 days. Other pediatric studies have supported the ACCP recommendations and suggesting that refractory air leaks are best treated surgically, as these are unlikely to close spontaneously after three days.^[17,18] We consider that further studies are needed on this subject.

In the present study, the majority of the members responded to the question regarding the surgical criteria as recurrence, persistent air leak, and large bullous lesions on CT. Williams et al.^[8] revealed that there was a broad consensus among pediatric surgeons to utilize a minimally invasive approach (98%) and to perform stapled blebectomy (97%) and mechanical pleurodesis (77%) among the North American pediatric surgeons. Among the Turkish pediatric surgeons, VATS was the commonly preferred surgical intervention and the most preferred surgical methods were stapled bullectomy, wedge resection-partial decortication, and bullectomy-mechanical pleurodesis. The present study indicates that VATS is accepted and used as a reliable intervention in the surgical treatment of PSP in Türkiye, as well.

Following successful non-operative management of an initial episode of PSP, recurrence occurs in 40 to 60% of children.^[7,8] The management of recurrent PSP continues to be debated, partly due to the lack of well-conducted, randomized-controlled studies in this area.^[5] The majority of the Turkish surgeons participated in this survey would recommend operative intervention, if and when patients developed a second recurrence of PSP.

Pleurodesis has been proven as a safe and effective procedure to reduce the recurrence of PSP, regardless of the chemical or surgical methods in the adult population.^[19,20] Talc poudrage at thoracoscopy and talc or minocycline pleurodesis as an adjunct to

surgery provide low recurrence rates. Less invasive options include pleurodesis using tetracycline or blood patch via chest drain.^[21] However, there are a few studies on pleurodesis focusing on the pediatric population.^[22] In a study, mechanical or chemical pleurodesis decreased the recurrence rate and the need for subsequent surgical intervention among pediatric patients with PSP.^[22] Another study in children concluded that pleurodesis might be required as the first-line therapy of PSP.^[23] In our study, we found that the rate of the usage of chemical pleurodesis was 49.3% among the Turkish pediatric surgeons. The most preferred method was autologous blood pleurodesis. Our study indicates that the use of pleurodesis in treatment is not a priority among the Turkish pediatric surgeons. We believe that this may be due to the lack of experience on pleurodesis in the Turkish pediatric surgeons.

Nonetheless, there are several limitations to this study. The main limitation was the response rate (17.1%) among TAPS members. Another limitation is, in the interest of preserving the brevity of the survey to maximize our response rate, additional clinical details about the exact clinical signs and symptoms were not established.

The management algorithm of PSP varies in neonates and adolescents.^[1,6,15,24] Therefore, the fact that the survey was not prepared by classifying the pediatric age groups for the management strategy is another limitation. In our further study, it is planned to prepare a questionnaire by classifying pediatric age groups and including thoracic surgeons.

In conclusion, there are practice variations in the management of pediatric primary spontaneous pneumothorax among Turkish Association of Pediatric Surgeons members. However, the majority of members seem to agree on the use of computed tomography, initial treatment, and surgical interventions. Most of members prefer utilizing computed tomography in the preoperative period, although the rate of computed tomography use in initial admission is low. The majority of Turkish Association of Pediatric Surgeons members prefer tube thoracostomy for the initial treatment. Video-assisted thoracoscopic surgery is the most preferred intervention in cases requiring surgery. Long-term prospective data are needed to better inform guidelines and standardize practice.

Ethics Committee Approval: The study protocol was approved by the University of Health Sciences, Sancaktepe Sehit Prof. Dr. Ilhan Varank Training and Research Hospital Ethics

Committee (date: 27.10.2021, no: 2021/205). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Study conception and design, analysis and interpretation of results, draft manuscript preparation: S.S., L.E.; Data collection: S.S.; All authors reviewed the results and approved the final version of the manuscript.

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