The Comparison of Therapeutic Approaches for Spontaneous Pneumomediastinum

Spontan Pnömomediastinumda Tedavi Yaklaşımlarının Karşılaştırılması

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ABSTRACT Objective: Spontaneous pneumomediastinum (SPM) is defined as the presence of air in the mediastinum that develops in the absence of traumatic, iatrogenic, or preceding pulmonary pathologies. In this study, the etiology of SPM patients who developed clinical course were evaluated, and compared the effectiveness of treatment modalities in these cases. **Material and Methods:** A retrospective case series was conducted to identify adult patients with SPM who were diagnosed and treated between January 2011 and December 2014. **Results:** Eleven patients were identified included 10 men and 1 women with a mean age of 21.09 years. The most common presenting complaint was chest pain in 8 patients, dyspnea in 5, swellings of their necks in 3.Cases While cervical mediastinotomies were perfomed in 5 cases, conservative approaches were preferred in 6 of the cases. Although hospital stays of the patients with cervical mediastinotomies and those who received conservative treatment were not significantly different), the patients with cervical mediastinotomies showed a more rapid clinical improvement. **Conclusion:** SPM is a benign process primarily affecting young men. SPM should be considered in the differential diagnosis of acute chest pain. A cervical mediastinotomy helps to improve the patient's clinical status via a rapid air decompression.

Key Words: Mediastinal emphysema; pneumomediastinum, diagnostic; surgery

ÖZET Amaç: Spontan pnömomediastinum (SPM), iyatrojenik travma veya akciğer patolojileri olmadan mediastinal alanda serbest hava bulunmasıdır. Bu çalışmada, SPM gelişen olguların etiyolojileri, klinik seyirlerinin değerlendirilmesi ve uygulanan tedavi yöntemlerinin etkinliklerinin karşılaştırılması amaçlanmıştır. **Gereç ve Yöntemler:** Ocak 2011-Aralık 2014 tarihleri arasında SPM tanısı konulan ve tedavi edilen hastalar retrospektif olarak değerlendirildi. **Bulgular:** On bir hastanın 10'u erkek, 1'i kadın ve yaş ortalaması 21,09 yıl idi. En sık görülen semptom göğüs ağrısı idi. Hastaların 8'inde göğüs ağrısı, 5'inde nefes darlığı ve 3'ünde boyunda şişlik şikayeti mevcuttu. Hastaların 5'ine servikal mediastinotomi uygulanırken 6'sına konservatif tedavi uygulandı. Servikal mediastinotomi uygulanan hastalar ile konservatif tedavi uygulanalar arasında hastanede kalış sürelerinde istatistiksel olarak fark saptanmadı. Ancak servikal mediastinotomi uygulanan hastalarda klinik olarak daha hızlı iyileşme olduğu gözlendi. **Sonuç:** SPM,genellikle genç erkeklerde görülen benign bir olaydır. Akut göğüs ağrısının ayırıcı tanısında akıla gelmelidir. Servikal mediastinotomi, havanın hızlı boşaltılmasını ve hastanın kliniğinin hızla düzelmesini sağlar.

Anahtar Kelimeler: Mediastinal amfizem; pnömomediasten, tanısal; cerrahi

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A pneumomediastinum, from a clinical sense, originates from the presence of air in the mediastinum region, and may be found between mediastinal organs and in mediastinal fat pads.[1-3] It occurs when air moves into the mediastinum from peribronchial and perivascular areas by the rupture of alveoli due to instant pressure increases within the alveoli.[1] This may occur spontaneously or it may occur after a trauma.[4] A pneumomediastinum that oc-

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curs spontaneously without trauma is called a spontaneous pneumomediastinum (SPM).[1,2,5] SPM was initially defined by Hamman in 1939, thus, it is also called Hamman's syndrome.[3]

Although the exact incidence of spontaneous pneumomediastinum is not known, it has been reported between 1/29670-1/44511.[6,7] The most common complaints are retrosternal pain and dyspnea.[5] A differential diagnosis should be conducted for an esophageal perforation, tracheobronchial rupture, mediastinitis, and pneumothorax, which have similar clinical symptoms. However, the therapeutic approach for these conditions is different, thus, they require immediate treatment.[1,2] Therapeutics generally include observation and are symptomatic-based, but when a cause is detected, the treatment for this cause is administered.[3,5,8] However, if there is dyspnea, cyanosis, collapse and insufficient filling related to pressure in major vascularities, the air must be drained immediately. Needle aspiration in the mediastinum, cervical mediastinotomy, tracheostomy, and emergent thoracotomy can be administered in this case.[9] In this study, we aimed to compare the precipitating factors, clinical courses, and the effectiveness of treatment modalities in SPM cases.

MATERIAL AND METHODS

Eleven treated patients diagnosed between January 2011 and December 2014 were examined. Posteroanterior chest X-rays of all patients were taken, as well as full blood counts. Additionally, routine biochemical tests were made and if needed, a thorax computed tomography (CT) was taken, a flexible or rigid bronchoscopy was done, and an esophagoscopy was performed.

The sex, age, complaints, precipitating factors, physical examination findings, offered treatments, length of hospital stays, and examination processes of the patients were assessed by examination. Precipitating factors reviewed included a recent or remote history of drug abuse, the performance of a Valsalva-type maneuver and a recent history of physical activity.

Bed rest, intermittent oxygen treatment, and analgesic medicaments were administered to six of the patients. In addition mediastinitis prophylaxis was applied a wide-spectrum doublet (3rd generation cephalosporin, metronidazole) antibiotic treatment. In addition to these treatment the five patients with serious complaints of shortness of breath and difficulty swallowing, detected as subcutaneous emphysema spread up to neck in the physical examination and chest CT, were underwent cervical mediastinotomy.

The cervical mediastinotomy technique involves a transverse incision applied over the suprasternal incisura with local anesthetic. The trachea was exposed by dissection of the pretracheal muscles. Pretracheal fascia was opened and a catheter was implanted in this region (Figure 1). The properties of catheter to be used was: not collapsed between the tissues, its thickness according to the age and polyethylene. Our choice was nasotracheal aspiration catheter.

The catheter was removed after the regression of symptoms and radiological findings were observed. When the recovery of pneumomediastinum was achieved clinically and radiologically, patients were discharged.

The medical treatment used and cervical mediastinotomy underwent patients were compared.

STATISTICAL ANALYSES

The Statistical Package for the Social Sciences (SPSS, Inc, Chicago, IL, USA) version 22 program was used for data analysis. Normal distribution of

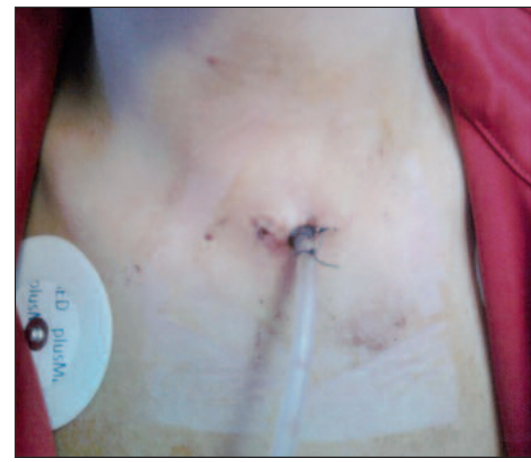

FIGURE 1: Cervical mediastinotomy and cervical catheter.

the data was examined with the Shapiro-Wilk test and coefficients of variation. Parametric methods were used for the variables that had a normal distribution and nonparametric methods were used for variables that were not normally distributed.

In the comparison of two independent groups, the Mann-Whitney U test was used with the Monte Carlo simulation technique. The Pearson chi-square Monte Carlo simulation technique was used in the comparison of the categorical data. Quantitative data were expressed as mean±SD. (standard deviance) and median range (maximum- minimum) values. Data were examined at the 95% confidence level and $p<0.05$ values were considered significant.

RESULTS

The patients were comprised of 10 (90.9%) males and 1 (9.09%) female with an average age for all subjects of 21.09 years (range: 7-62 years). The most common complaints from the patients were chest pain (n=8), dyspnea (n=5), and a sudden swelling at the neck (n=3) (Table 1).

Through patient anamnesis, we determined that the complaints presented themselves after an acute cough in three (27.27%) patients, after heavy physical exercise in two (18.18%) patients, and after vomiting in two (18.18%) patients. No etiological factor was determined in four (36.36%) patients (Table 2). Subcutaneous emphysema was detected in five (45.45%) patients during the physical examinations. While subcutaneous emphysema at the chest wall and neck were detected in three (27.27%) patients, two (18.18%) patients had only subcutaneous emphysema at the neck. Biochemical and hemogram blood values were normal. Chest X-rays of all patients were taken. While the diagnosis was made by chest X-rays for seven (63.63%) patients, the diagnosis for four (36.36%) patients could only be made by a CT of the thorax following the chest X-ray. The subcutaneous emphysema presented in the chest X-rays and the radiolucent image presented both between the heart edge and mediastinal pleura and around the aortic knob (Figure 2). Subcutaneous emphysema and the presence of free air around the mediastinal organs and in mediastinal fat pads was detected in the thorax CT (Figure 3). We detected

TABLE 1: Patients' symptoms at presentation.

Complaints	Incidence (%)
Chest pain	8 (72.72)
Dyspnea	5 (45.45)
Swelling neck	3 (27.27)
Dysphagia	2 (18.18)
Palpitation	1 (9.09)
Convulsion	1 (9.09)

TABLE 2: Patients' histories at presentation.

History	Incidence (%)
Severe cough	3 (27.27)
Heavy exercise	2 (18.18)
Vomiting	2 (18.18)
Unknown	4 (36.36)
Total	11

SPM accompanying spinal epidural emphysema in thorax CT of two patients (Figure 4). The tracheobronchial system was examined by flexible bronchoscopy in three (27.27%) patients where there was a suspicion of a tracheobronchial rupture and by rigid bronchoscopy in one (9.09%) patient where no pathological findings were detected. A thorax CT with water soluble radiopaque material was performed with two patients who a history of vomiting and two patients who had suffered from dysphagia for esophagus examination. No pathological finding

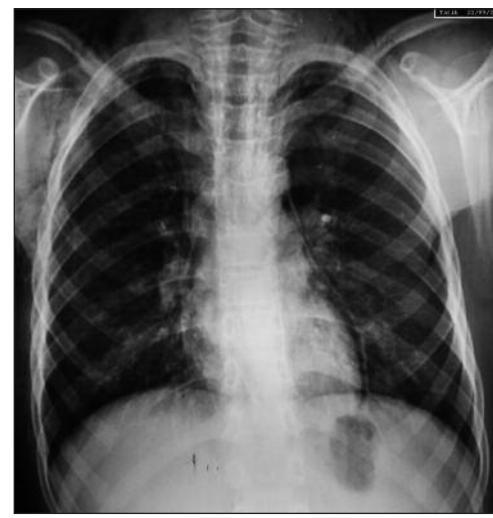

FIGURE 2: A radiolucent line between the left heart border and the mediastinal pleura in a chest X ray, graphy.

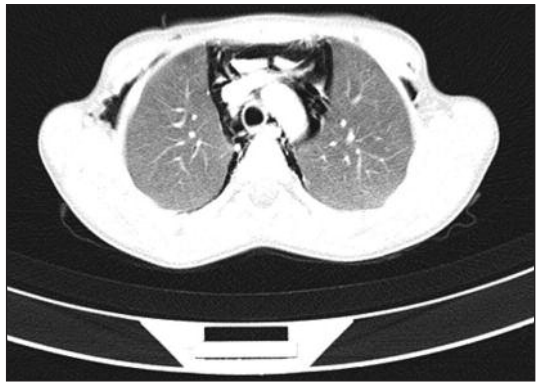

FIGURE 3: Mediastinum and subcutaneous emphysema in a thorax CT.

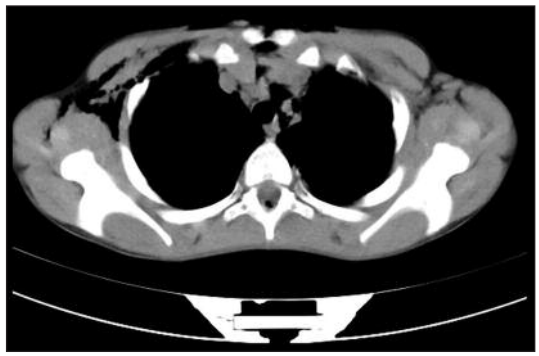

FIGURE 4: Spinal epidural emphysema in a thorax CT.

was detected. Esophagoscopy of these four patients was made and there were no pathologies detected. The hospitalization average of the patients to whom only conservative treatments and cervical mediastinotomies were administered was 4.5 (range: 3-6) and 3 (range: 3-5) days, respectively. The average follow-up period was 10.2 (range: 1-20) months. No significant difference was detected in the two groups with regard to age, sex, and hospitalization periods (p>0.05). However, a prominent and rapid amelioration in the symptoms was observed from the patients to whom cervical mediastinotomy was administered. Additionally, their hospitalization period was shorter than other group (Table 3). Upon recovery, each patient was discharged, no persistent complications developed, and the pneumomediastinum did not recurrence in any of the patients.

DISCUSSION

SPM is a pneumomediastinum manifestation stemming from an increase in intrapulmonary pressure without trauma and it may develop after heavy exercise, vomiting, excessive coughing in which the Valsalva maneuver was performed, or in patients with asthma.[2,5,6,8] SPM also develops in certain people who suffer from interstitial lung disease and people who use cocaine.[5,7,10,11] However, the precipitating factor cannot be determined in 8–54% of the cases.[10,12,13] In our study, we determined that SPM developed most frequently after an acute cough (27.27%), however, we were unable to determine the causative factor in 36% of cases.

If the air leak is high in pneumomediastinum, the air shows dispersion towards the neck by the mediastinocervical fascia. If the air leak is high and air drainage is not achieved, it leads to a tension pneumomediastinum by increasing the amount of air in the mediastinum. Thus, it may lead to hypotension with cardiac tamponade and venous vascular impression by impressing the heart. However, a tension pneumomediastinum is not defined in humans.[9,14,15]

Spontaneous pneumomediastinum may be asymptomatic or sudden severe respiratory failure may occur. The clinical presentation of SPM can often be subtle and the diagnosis sometimes missed or delayed.[10] The most common symptoms for SPM are retrosternal chest pain, dyspnea, and neck pain. Other observed symptoms include dysphagia, dysphonia, odynophagia, and neck swelling.[2,5,6,12,16] Like other studies, the most common symptoms in our study were chest pain (72.72%) and dyspnea (45.45%).

In the differential diagnosis of SPM, pneumothorax, pneumonia, pulmonary embolism, tracheobronchial rupture, reflux esophagitis, Boerhaave's syndrome, costochondritis, ischemic heart diseases, and pericarditis should be considered. Therefore, the medical history, physical examination, and electrocardiographic evaluation, if necessary, must be well evaluated by radiological and

TABLE 3: Cervical mediastinotomy.

	No	Yes	p values
Age*(year)	22.5 (62-16)	15 (16-7)	0.008
Hospitalization Period*(day)	4.5 (6-3)	3 (5-3)	0.361
Sex (Female/Male)	1 (16.7)/5 (83.3)	0 (0)/5 (100)	1

Pearson chi-square test (Monte Carlo)-Mann-Whitney U test (Monte Carlo).
* Median Range (Maximum-Minimum).

endoscopic examination.[1,2,10] In a thorax CT, air is detected in the mediastinum and liquid is detected in the esophagus. The leakage in the esophagus is detected by an esophagography with water-soluble radiopaque material and by a thorax CT.[1,13] For two patients who had a history of vomiting, a thorax CT with water-soluble radiopaque material was used to exclude an esophageal perforation; ultimately, no perforation was detected in these cases. A bronchoscopy should be used to establish a final diagnosis when there is a suspicion of a tracheobronchial rupture.[7] Therefore, flexible bronchoscopies were performed on three patients that were suspicious for having tracheobronchial ruptures, a rigid bronchoscopy was applied to one patient; however, no ruptures were detected in tracheobronchial system.

Physical examinations revealed that subcutaneous emphysema is most frequently found with the presence of free air in the chest. Subcutaneous emphysema has been reported as presenting in 32–100% of the cases in the literature.[2,3,13] Subcutaneous emphysema is generally detected at the neck and supraclavicular regions. We detected subcutaneous emphysema in 45.45% of our patients. Other physical examination findings may include venous distension in the neck, cyanosis, tachycardia, and tachypnea.[2,6,12,13] "Hamman symptom," is pathognomonic for the diagnosis of pneumomediastinum..[3] Hamman symptom is detected in 0-44% of the patients in the literature.[1,2,7] We did not detect this symptom in our patients.

Chest X-rays are another standard method for diagnosis. The diagnosis in chest X-rays is made by the presence of air in the mediastinum; a hyperlucent line between the left side of the heart and mediastinal pleura, evident in the aortic arch, air around the aorta in the mediastinum, trachea, esophagus, and thymus; and a continuous line in the diaphragm. Subcutaneous emphysema can be seen in both the chest wall and neck in chest X-rays. Since it can also be seen in a pneumothorax, careful attention should be paid to this in a differential diagnosis.[7,8,10] Light pneumomediastinum cases of 30% can not be diagnosed with a chest X-ray. Therefore, chest X-ray is normal, but clinical suspicion should be evaluated by chest CT.[17] The free air around the mediastinal organs and in the mediastinal fat pads is detected in thorax CT. The accompanying pathologies may include a tracheobronchial rupture, esophagus perforation, and pneumothorax, all of which can be determined in a thorax CT.[2,8,12] We made our diagnoses with chest X-ray for seven (63%) patients. We also used thorax CT for the diagnosis of four (36%) patients when we were unable to make a diagnosis with chest X-rays. We detected SPM with accompanying spinal epidural emphysema in two of the patients whose thorax CT was performed.

The air within the spinal epidural space is called pneumorachis. Pneumorachis may develop by traumatic or iatrogenic reasons.[18] Koelliker et al. reported a pneumorachis case that developed after SPM.[19] Some authors did not detect any neurological symptoms in either of the cases and they suggested that pneumorachis is resorbable as a result of pneumomediastinum regression without any additional treatment.[19,20] Our cases were no convulsion in the follow-up and as the mediastinal emphysema became resorbable, emphysema in the spinal canal regressed.

The treatment for SPN usually involves sufficient observation and symptomatic treatment. Bed rest, oxygen treatments, and analgesic treatments are typically administered. Hence, the air resolution is achieved in the mediastinum. Clinical and radiological recovery are also observed. The prevention of Valsalva maneuvers is also an important part of the treatment. Antitussive treatment can be used for cough prevention.[2,8,12] Prophylactic antibiotic treatment for SPM is a contradictory subject. It is not recommended to administer antibiotics for cases that carry a mediastinitis development risk.[10] It is been reported in the publications that 1st, 2nd or 3rd generation cephalosporin treatment has been used for Mediastinitis prophylaxis.[10,21,22] We also administered third generation cephalosporin and metronidazole.

Severe subcutaneous emphysema suppresses the upper respiratory system and leads to cyanosis. Additionally, when air is present in the mediastinum, it leads to both a collapse of the major veins and to insufficient cardiac filling related to impression. Under these conditions, the air should be drained immediately. Needle aspiration from the mediastinum, cervical mediastinotomy, tracheostomy, and acute

thoracotomy can be administered for these cases.[9,21,22] Çobanoğlu et al. divided the pneumomediastinum patients into two groups. A conservative treatment was used for one group and the other group was treated with a subcutaneous intravascular catheter. It was reported that the group treated with the subcutaneous intravascular catheter showed more prominent and rapid recovery than the other group.[21] However, they was not reported that the catheter used days. In our series, catheter was used for an average of 2 (2-4) days. We recommend that the catheter used for up to 7 days. Fazlıoğlu et al. performed a mediastinotomy on two cases of their eight cases that suffered from dyspnea and subcutaneous emphysema; they reported that recovery was achieved.[22] We also administered only conservative treatment to six patients as well as providing both conservative treatment with cervical mediastinotomy to five patients. We detected prominent and rapid symptom recovery from the patients who were administered cervical mediastinotomies. Moreover, the hospitalization period of these patients was shorter.

If there are no clinical or radiological progressions, patients may be discharged. If there is no additional disease related to SPM, a 24 to 48-hour follow-up will be sufficient.[1,6] However, certain studies report this period as 2-9 days.[1,2,7] Similar to previous reports, the hospitalization period in our serial was 3-6 days. Pneumomediastinum did not recurrence in many serials reported in the literature.[2,10,16] However, Macia et al. reported 1 recurrence in 41 cases and Abolnik et al. reported 1 recurrence in 25 cases, and they also reported that they achieved good results from conservative treatments.[7,23] Similarly, there was no pneumomediastinum recurrence in our follow-ups.

CONCLUSION

SPM is a rarely seen disease. It is the first disease we should consider as a prediagnosis in patients suffering from chest pain and subcutaneous emphysema. Even if conservative treatments are sufficient for SPM, cervical mediastinotomy leads to a rapid discharge of the air and consequently, rapid recovery times for those with severe subcutaneous emphysema and pneumomediastinum. As larger and larger case series are reported in the future, we will be able to more clearly establish both the incidence of spontaneous pneumomediastinum and the validity of current treatment protocols.

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