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Case report

Spontaneous Pneumomediastinum in an Adolescent Soccer Player

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Abstract
Spontaneous pneumomediastinum (SPM) is an uncommon and usually benign self-limiting clinical disorder found in young people, often without apparent precipitating factors or diseases. A pressure gradient exists between the peripheral pulmonary alveoli and the hilum, and increased intra-alveolar pressure causes rupture of the terminal alveoli. We present the case of a 15-year-old male soccer player who presented with a complaint of anterior chest pain and dysphagia after stopping the strong ball with his chest. His symptom gradually progressed over hours. We can make the diagnosis of SPM using by chest X-ray and computed tomography (CT) scanning. His symptoms were gradually resolved over the course of approximately one week with no exercise and careful observation. We believe that our case provides very useful information to alert clinicians and coaches regarding this rare disease that may occur in anyone including adolescent soccer players.

Key words: Spontaneous pneumomediastinum, adolescent, sports, chest pain, free air.

Introduction

Spontaneous pneumomediastinum (SPM) which is first reported by Hamman in 1939 is a rare and mostly benign condition in children caused by alveolar rupture and dissection of air into the mediastinum and hilum (Abolnik et al., 1991; Lee et al., 2009). SPM is commonly seen in asthmatics sometime as severe complication in children. The most common clinical symptoms involve dyspnea, chest or neck pain, subcutaneous emphysema and hoarse voice (Caceres et al., 2008). Chest X-ray is the gold standard for image examination, and the treatment is basically conservative therapy includes rest. Observation and cardiopulmonary monitoring of children due to an extremely rare risk of developing complications such as tension pneumomediastinum or tension pneumothorax (Freixinet et al., 2005; Kaneki et al., 2000; Kim et al., 2015). To the best of our knowledge, there are no case reports of SPM in adolescent diagnosed based on chest pain after a sports-related injury in soccer. Herein, we report about an otherwise healthy 15-year-old high school soccer player who presented with complaints of chest pain just after a stopping the ball with his chest during a soccer game. In addition, we aim to increase the awareness of orthopedist regarding the differential diagnoses of such cases.

Case report

We present the case of a 15-year-old male who presented with a complaint of anterior chest pain and dysphagia occurred during soccer game. He plays soccer as high school club activity (his position is midfield), and he has played soccer for 6 years. About symptom onset, while he was playing practice game of soccer in the morning, he felt mild anterior chest pain just after stopping the strong ball with his chest. A few hours later, he found his voice hoarseness and difficulties of swallowing and breathing. He played soccer in the evening and those symptoms had gradually developed, he presented to the emergency department after 11 hours of the onset of symptoms. His height and weight were 1.74 m and 55 kg, respectively. He had no known history of bronchial asthma and other pulmonary diseases. His vital signs were as follows: blood pressure, 100/53 mmHg; heart rate, 61 beats/min; respiratory rate, 20 breaths/min; and oxygen saturation on room air, 97%. Physical examination did not reveal any abnormal finding including decreased breathing sounds or cardiac murmurs. The doctor diagnosed he had no urgent abnormalities. On the following day, he visited orthopedic clinic reporting no improvement in his condition. At the clinic, on physical examination, mild tenderness was observed from the neck to both sides of the clavicles, but there were no other findings, such as subcutaneous emphysema. However, Chest X-ray showed bilateral linear air shadow over the lower neck (Figure 1). Computer Tomography (CT) revealed extra-luminal gas within the mediastinum and soft tissue emphysema over the right upper chest and lower neck (Figure 2). Based on the clinical findings and image findings, he was diagnosed with SPM. He was treated with no exercise and careful observation, and his symptoms were gradually resolved over the course of approximately one week. Chest X-ray revealed complete resorption of air shadow after two weeks. After confirming that the symptoms had completely resolved, mild exercise was resumed gradually. He was able to return to soccer completely approximately one month after the injury. One year after returning, he had been playing soccer without recurrence.

Discussion

We experienced a case of SPM in an adolescent soccer player after sports-related injury. SPM is a rare and benign clinical condition that usually occurs in young lanky adult without a clear precipitating factor or disease (Freixinet et al., 2005; Kaneki et al., 2000). Kim et al. (2015) reported the condition presented predominantly in men. SPM is reported to be related to repeated cough, asthma or inhalation therapy, and sometimes traumatic event such as iatrogenic

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injury and traumatic accident could be the causes. In the present case, the patient was healthy and suddenly developed symptoms during soccer game without any underlying disease. SPM caused by sports-related injury is so rare and there have been just two reports of sports-related SPM in the past. Smet et al. reported a case of soccer induced SPM in a 39 year-old man. Although he noticed swelling of his neck during half time, there was clear event which triggered his symptom (De Smet et al., 2011). Mihos et al. (2004) reported 10 cases of sports-related SPM (4 in scuba diving, 2 in basketball, 3 in soccer and 1 in volleyball) and the mean age of the patients was 18.9 years (range 15 to 25 years). Furthermore, SPM has been mostly reported in adults, and this is the first case report of adolescent SPM which caused during soccer game.

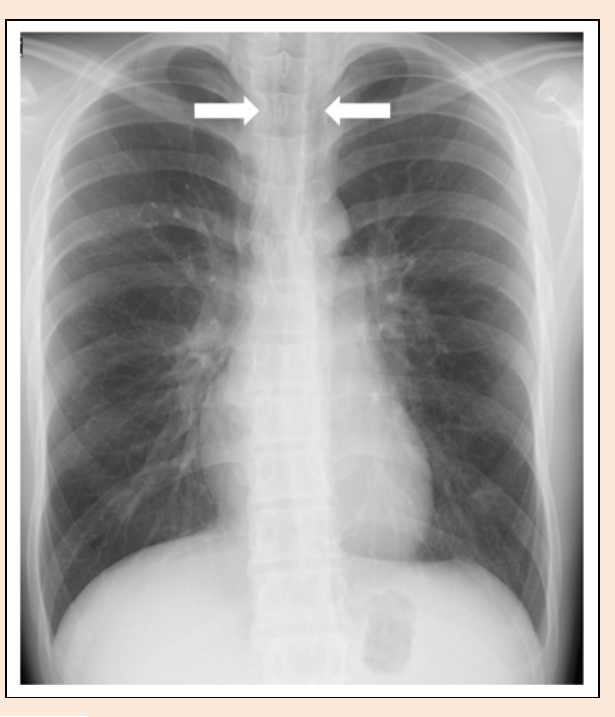

Figure 1. The chest X-ray showed bilateral linear air densities over the lower neck (white arrow).

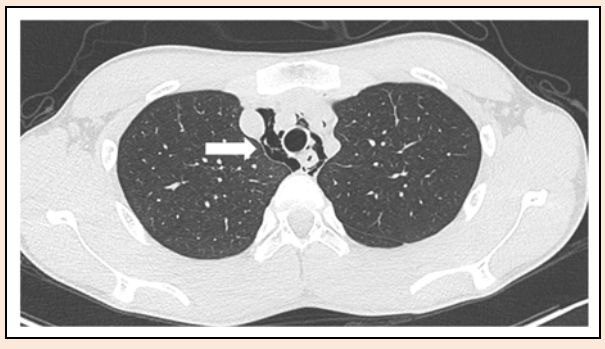

Figure 2. CT revealed extra-luminal gas within the mediastinum and soft tissue emphysema over the right upper chest and lower neck regions (white arrow).

SPM is observed in young people often without apparent precipitating factors or diseases. Previous studies has been reported that the cause is related to an increase in alveolar pressure such as coughing and vomiting. According to the Macklin effect, a pressure gradient exists between the peripheral pulmonary alveoli and the hilum, and increased intra-alveolar pressure causes rupture of the terminal alveoli (Panacek et al., 1992; Wintermark and Schnyder, 2001; Bullaro and Bartoletti, 2007). Alveolar rupture allows air to extend along the pulmonary vasculature toward the hilum, into the peribronchial spaces and subsequently into the mediastinum (Newcomb and Clarke, 2005). Various actions such as vomiting, forcible cough, crying and screaming leading to an increase in the intra-alveolar pressure can cause SPM (Abolnik et al., 1991; Macia et al., 2007; Nounla et al., 2004). Sometime it is difficult to find out the onset of SPM. Kim et al. (2015) investigated 11 SPM patients in adolescent and reported there was no apparent event in all patients. Macia et al. (2007) reported that there was no specific trigger in 21 of 41 SPM cases (Nounla et al., 2004). However, in this case, chest pain occurred after stopping the ball with his chest, and it must be the trigger of SPM onset. Caceres et al. reported various precipitating events triggering strong Valsalva maneuver often develops SPM (Caceres et al., 2008). We speculated that both breath holding like as Valsalva maneuver during ball stopping and shock to the chest by speedy ball could cause SPM in this case. In this case, major symptom was chest pain and difficulty during swallowing and breathing.. According to some previous reports the most common clinical picture of SPM includes retrosternal chest pain potentially spreading to the neck or shoulders, the back and the arms, subcutaneous emphysema and dyspnea (Kim et al., 2015; Mondello et al., 2007; Tsai et al., 2005). Kim et al. (2015) reported the symptoms of 11 SPM patients were as follows: The main symptom was pleuritic chest pain, and the most common associated symptom was neck pain (54.5%), others included sore throat (27.3%), cough (27.3%), odynophagia (9.1%), and anxiety (9.1%). With regard to physical signs, subcutaneous emphysema is reported to be the most common sign of SPM (Macia et al., 2007). Hamman's sign, the crepitus heard with the heartbeat on chest auscultation, is major and well known sign of pneumomediastinum. The only physical finding in this case was tenderness in the neck whereas neither subcutaneous emphysema nor Hamman's sign were elicited. When adolescent soccer player come to orthopedic clinic with chief complaint of chest pain after playing soccer, under before or without taking chest X-ray, some orthopedists might not include SPM as differential diagnosis. These specific sign of pneumomediastinum might be missed if doctors did not observe carefully. Thus, SPM should be considered in adolescents with pleuritic chest pain, even after sports activity. Chest X-ray remains the gold standard diagnostic tool for SPM, and the sensitivity of postero-anterior and lateral chest X-ray is nearly 100% (Kaneki et al., 2000; Iyer et al., 2009). However, the sensitivity is for physician and could be lower for surgeons including orthopedists. If pneumomediastinum is suspected and not confirmed by chest X-ray, it is recommended to perform chest CT. Orthopedists must not misdiagnose SPM as "chest bruise" for patients with chest pain after sports related

injury. In such cases, CT scan seems to be necessary because it often reveals additional diseases such as perforated esophagus, and it is as sensitive method in diagnosing mild pneumomediastinum, especially when the clinical picture is atypical (Kaneki et al., 2000; ; Maunder et al., 1984). Esophageal rupture is extremely rare in children, however it is a vital disease (Rogers et al., 1972). SPM is a rare self-limited condition and not specific treatment is required. General treatment will be careful observation, bed rest. Depending on the medical condition, analgesics and oxygen therapy may also be required. Sometimes, antibiotic prophylaxis is adopted for the prevention of mediastinitis (Koullias et al., 2004). And recurrence rate of SPM is quite low(Lee et al., 2009). In our case, the patient's symptoms gradually improved with no exercise and careful observation. Fortunately, he has continued to compete without recurrence.

Conclusion

We reported the case of an adolescent soccer player who developed SPM, a rare disease. The diagnosis of SPM was based on a careful physical examination and chest X-ray and CT. SPM tends to be underdiagnosed, in particular with symptoms after sports-related event. It should be considered in the differential diagnosis of chest pain, especially among healthy adolescents and young adults. We believe that our case provides very useful information to alert clinicians and coaches regarding this rare disease that may occur in anyone including adolescent sports players.

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The authors report no conflict of interest. The present study complies with the current laws of the country in which the study was performed.

References

Abolnik, I., Lossos, I.S. and Breuer, R. (1991) Spontaneous pneumomediastinum. A report of 25 cases. *Chest* **100,** 93-95.

Bullaro, F.M. and Bartoletti, S.C. (2007) Spontaneous pneumomediastinum in children: a literature review. *Pediatric Emergency Care* **23,** 28-30.

Caceres, M., Ali, S.Z., Braud, R., Weiman, D. and Garrett, H.E., Jr. (2008) Spontaneous pneumomediastinum: a comparative study and review of the literature. *Annals of Thoracic Surgery* **86,** 962-966.

De Smet, K., Ilsen, B., De Mey, J., De Maeseneer, M. and Vincken, W. (2011) Spontaneous soccer-induced pneumomediastinum in a 39-year-old man. *Journal Belge de Radiologie - Belgisch Tijdschrift voor Radiologi* **94,** 346-347.

Freixinet, J., Garcia, F., Rodriguez, P.M., Santana, N.B., Quintero, C.O. and Hussein, M. (2005) Spontaneous pneumomediastinum long-term follow-up. *Respiratory Medicine* **99,** 1160-1163.

Iyer, V.N., Joshi, A.Y. and Ryu, J.H. (2009) Spontaneous pneumomediastinum: analysis of 62 consecutive adult patients. *Mayo Clinic Proceedings* **84,** 417-421.

Johnson, J., Jones R, Wills BK. (2008) Spontaneous pneumomediastinum. *Western Journal of Emergency Medicine* **9,** 217-218.

Kaneki, T., Kubo, K., Kawashima, A., Koizumi, T., Sekiguchi, M. and Sone, S. (2000) Spontaneous pneumomediastinum in 33 patients: yield of chest computed tomography for the diagnosis of the mild type. *Respiration* **67,** 408-411.

Kim, S.H., Huh, J., Song, J. and Kang, I.S. (2015) Spontaneous Pneumomediastinum: A Rare Disease Associated with Chest Pain in Adolescents. *Yonsei Medical Journal* **56,** 1437-1442.

Koullias, G.J., Korkolis, D.P., Wang, X.J. and Hammond, G.L. (2004) Current assessment and management of spontaneous pneumomediastinum: experience in 24 adult patients. *European Journal of Cardio-Thoracic Surgery* **25,** 852-855.

Lee, C.Y., Wu, C.C. and Lin, C.Y. (2009) Etiologies of spontaneous pneumomediastinum in children of different ages. *Pediatrics and Neonatology* **50,** 190-195.

Macia, I., Moya, J., Ramos, R., Morera, R., Escobar, I., Saumench, J., Perna, V. and Rivas, F. (2007) Spontaneous pneumomediastinum: 41 cases. *European Journal of Cardio-Thoracic Surgery* **31,** 1110-1114.

Maunder, R.J., Pierson, D.J. and Hudson, L.D. (1984) Subcutaneous and mediastinal emphysema. Pathophysiology, diagnosis, and management. *Archives of Internal Medicine* **144,** 1447-1453.

Mihos, P., Potaris, K., Gakidis, I., Mazaris, E., Sarras, E. and Kontos, Z. (2004) Sports-related spontaneous pneumomediastinum. *The Annals of Thoracic Surgery* **8(3),** 983-986.

Mondello, B., Pavia, R., Ruggeri, P., Barone, M., Barresi, P. and Monaco, M. (2007) Spontaneous pneumomediastinum: experience in 18 adult patients. *Lung* **185,** 9-14.

Newcomb, A.E. and Clarke, C.P. (2005) Spontaneous pneumomediastinum: a benign curiosity or a significant problem? *Chest* **128,** 3298-302.

Nounla, J., Trobs, R., Bennek, J. and Lotz, I. (2004) Idiopathic spontaneous pneumomediastinum: an uncommon emergency in children. *Journal of Pediatric Surgery* **39,** E23-24.

Panacek, E.A., Singer, A.J., Sherman, B.W., Prescott, A. and Rutherford, W.F. (1992) Spontaneous pneumomediastinum: clinical and natural history. *Annals of Emergency Medicine* **21,** 1222-1227.

Rogers, L.F., Puig, A.W., Dooley, B.N. and Cuello, L. (1972) Diagnostic considerations in mediastinal emphysema: a pathophysiologic-roentgenologic approach to Boerhaave's syndrome and spontaneous pneumomediastinum. *American Journal of Roentgenology, Radium Therapy and Nuclear Medicine* **115,** 495-511.

Tsai, M.S., Chiang, W.C., Chen, W.J., Yuan, A. and Yang, P.C. (2005) Occult spontaneous pneumomediastinum. *American Journal of Emergency Medicine* **23,** 410-411.

Wintermark, M. and Schnyder, P. (2001) The Macklin effect: a frequent etiology for pneumomediastinum in severe blunt chest trauma. *Chest* **120,** 543-547.

Key points

- Spontaneous pneumomediastinum (SPM) may occur in anyone including adolescent soccer players.
- SPM should be considered in the differential diagnosis of chest pain in adolescents and young adults.

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