

# Spontaneous Pneumomediastinum in a Pediatric Patient After a 1600-m Run: Case Report and Literature Review

CPT Zachary C. Booms, DO  
MAJ George A. Barbee, PA-C

From the 122nd Aviation Support Battalion, the 82nd Combat Aviation Brigade (Dr Booms) and the Department of Emergency Medicine at Womack Army Medical Center (Dr Barbee) in Fort Bragg, North Carolina.

Dr Barbee also holds a doctor of science physician assistant degree.

Financial Disclosures:  
None reported.

Support: None reported.

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Address correspondence to CPT Zachary C. Booms, DO, 82nd Combat Aviation Brigade M2513, Fort Bragg, NC 28310-0001.

E-mail: zachary.c.booms.mil@mail.mil

Submitted July 27, 2014;  
final revision received  
December 24, 2014;  
accepted February 5, 2015.

**Pneumomediastinum occurs as a result of traumatic or iatrogenic causes or in patients with preexisting lung conditions such as interstitial lung disease, asthma, and chronic obstructive pulmonary disease. Spontaneous pneumomediastinum (SPM), however, is rarely seen in clinical practice. The authors report the case of a 14-year-old boy who presented to the emergency department with chest discomfort and shortness of breath after a 1600-m run as part of a physical education class. The patient was found to have SPM, was admitted to the pediatric service for monitoring and pain control, and made a full recovery within 24 hours. This case is notable because SPM occurred in the absence of identifiable organic causes and as the result of sustained noncontact physical activity. A review of the literature provides background information and highlights pathophysiologic processes of SPM and suggested treatment. Physicians should consider pneumomediastinum in young patients or runners presenting with chest pain even in the absence of any known inciting event.**

*J Am Osteopath Assoc.* 2015;115(5):338-341  
doi:10.7556/jaoa.2015.065

**P**neumomediastinum is the presence of air in the mediastinum. The underlying cause may be traumatic or iatrogenic.<sup>1,2</sup> The condition can also occur in patients with preexisting lung conditions such as interstitial lung disease, asthma, and chronic obstructive pulmonary disease.<sup>2</sup> Spontaneous pneumomediastinum (SPM) is rarely seen in clinical practice<sup>2</sup> and occurs in the absence of a directly identifiable traumatic or iatrogenic cause. This phenomenon may be further divided into primary SPM (no known underlying lung disease) and secondary SPM (known underlying lung disease). Primary SPM in particular is exceedingly rare and has been described in few case reports.<sup>3-5</sup>

We report the case of a patient who was found to have SPM after presenting with chest discomfort and shortness of breath after running 1600 m. To our knowledge, this case is the first reported instance of SPM after a moderate-distance run.

## Report of Case

A 14-year-old boy presented to the emergency department with a chief complaint of chest discomfort and shortness of breath after running 1600 m (1 mile) on an asphalt track during physical education class at school 4 hours before presentation. The patient stated that he completed the run in 6 minutes, 8 seconds. The patient noted no adverse weather or ambient pressure change.

The patient had no allergies, was taking no medications, and had no notable medical or surgical history. The patient denied any history of asthma, reactive airway disease, SPM,

or spontaneous pneumothorax. The patient also denied any history of similar symptoms after exercise. The patient's immunizations were current, and he denied alcohol and other illicit drug use. Although the patient never smoked cigarettes, he was exposed to secondhand smoke from his father. The patient had no prior hospitalizations.

Review of systems was positive for shortness of breath and chest discomfort. His vital signs at presentation were a temperature of 98.7°F, a pulse rate of 77/min, a blood pressure of 122/62 mm Hg, and a respiratory rate of 20/min. His oxygen saturation level while breathing room air was 100%. The patient's height was 185 cm; weight, 54 kg; and body mass index, 16.9—placing him in the 60th percentile for weight and in the 99th percentile for height for his age according to US Centers for Disease Control and Prevention growth charts.<sup>6</sup>

The patient was in no acute distress, and results of his physical examination were initially unremarkable with no evidence of neck, back, or chest trauma. The lungs were clear throughout bilaterally. The results of both the cardiac examination and osteopathic structural examination were unremarkable. No pectus deformity was noted. Aside from the patient's long height and thin build, no marfanoid features were noted.

Results of an electrocardiogram were normal. Because the patient complained of persistent chest discomfort and shortness of breath, chest radiographs with posterior-anterior and lateral views were obtained and were notable for pneumomediastinum with air tracking along the mediastinal borders of the chest (*Figure 1*) and around the pulmonary artery and aorta (*Figure 2*).

The patient was admitted to the pediatric service for observation and pain control, and he received supplemental oxygen to facilitate regular functional residual capacity. After radiologic and clinical stability was demonstrated, he was discharged the following afternoon. A second set of radiographs obtained 7 days after discharge showed complete resolution of the patient's pneumomediastinum.

## Discussion

To our knowledge, the present case is the first reported instance of SPM after a moderate-distance run. An extensive literature review yielded 2 case reports of SPM after running—1 after several continuous short sprints (each less than 100 m),<sup>7</sup> and 1 after a full marathon (42.2 km).<sup>8</sup> Running is also mentioned as a preceding event in 2 cases described by Newcome and Clarke<sup>5</sup>; however, running was not mentioned as an isolated precursor, and running distance was not specified in either case.

Far more commonly reported are cases of SPM after blunt trauma during contact sports (eg, rugby, football, basketball) or brief Valsalva maneuvers during a variety of athletic competitions.<sup>4,5,7-9</sup> An association with barotrauma has been described in a patient after scuba diving,<sup>4</sup> and several cases have been reported after smoking,<sup>1,2,5</sup> illicit drug use,<sup>1,2,5</sup> sneezing,<sup>5</sup> coughing,<sup>1,2,5</sup> and retching.<sup>1,2,5</sup> It is rare for SPM to occur after a sporting event or other intentional physical activity; in the largest case review<sup>2</sup> to date, 2 of 62 cases occurred after physical activity, and both patients in these cases had participated in contact sports.<sup>2</sup>

The pathophysiologic process of SPM was first described in detail by Macklin and Macklin<sup>10</sup> as terminal alveolar rupture into the lung interstitial space secondary to increased alveolar pressure or decreased perivascular interstitial pressure, with subsequent dissection of gas along the hilum and into the mediastinum.<sup>4,10-12</sup> Resultant symptoms include chest pain (up to 90% of patients),<sup>4</sup> dyspnea (up to 49%),<sup>13</sup> and neck pain (up to 20%).<sup>4</sup>

Osteopathic physicians must consider that forces intrinsic and extrinsic to the patient may contribute to SPM. In the present case, we suspect that the patient's body type may have been a factor. Tall, thin patients are predisposed to spontaneous pneumothorax because of the lower, more negative pleural pressure at the apex of the lungs that yields a greater mean distending pressure of the apical alveoli, which may contribute to subpleural bleb formation.<sup>12</sup> Accordingly, such patients may experience a similar predisposition to SPM. Repeated Valsalva maneuvers and suboptimal inspiratory forces during the prolonged



**Figure 1.** Posterior-anterior radiograph showing air along the mediastinal borders of the chest in a 14-year-boy with spontaneous pneumomediastinum.



**Figure 2.** Lateral radiograph exhibiting the pulmonary artery and aorta with ring sign in a 14-year-boy with spontaneous pneumomediastinum.

extrinsic event of the 1600-m run likely exacerbated any predisposition in the present case. In addition, although not evident on the basis of our patient's examination, one may consider the existence of rib somatic dysfunction, particularly inhalation dysfunction, as a predisposing factor to SPM development because of resultant increased intrathoracic pressure and inadequate respiration.

Of note, our patient's age is an outlier in comparison with previously described cases of SPM, with a reported mean age of occurrence ranging from 18 to 27 years.<sup>4,14</sup> Cases have been described in children as young as age 6 years; however, SPM in children is almost always owing to a secondary cause.<sup>15</sup>

Spontaneous pneumomediastinum remains predominantly a pathologic event of young men, with men comprising 78% to 90% of reported cases.<sup>4,5</sup> Overall incidence is rare, with reported rates ranging from 1 in 800 to 1 in 44,511 patients presenting to the emergency

department.<sup>7,10</sup> Complications include concomitant pneumothorax (reported in anywhere from 6%-32% of patients<sup>2</sup>) and, rarely, tension pneumomediastinum requiring surgical drainage.<sup>16</sup>

Subcutaneous emphysema is a common physical finding in patients with SPM and the pathognomonic Hamman sign (crunching, crackling, or bubbling sounds synchronous with the heartbeat on auscultation) occurs in as few as 12% of patients.<sup>4,10</sup> Frequently, the findings from the physical examination are unremarkable and vital signs are within reference range,<sup>10</sup> as in the present case. Radiographic findings include the thymic sail sign (elevation of the thymus with sufficient mediastinal air) and ring sign (air surrounding the pulmonary artery or either of its branches, especially the right intramediastinal segment [*Figure 2*]).<sup>12</sup>

In the evaluation of the young, hemodynamically stable patient presenting with chest pain and no known

cardiac history, we recommend obtaining plain film radiographs of the chest. Physicians should consider SPM in runners presenting with chest pain. If no pathologic findings are identified on plain film radiographs and clinical concern remains, a computed tomographic scan of the chest with or without contrast is warranted. If pneumomediastinum is identified by either study and the patient remains stable, further radiologic or procedural workup is rarely indicated.<sup>2</sup>

Treatment for patients with SPM should include both pain control and supplemental oxygen to promote rapid absorption of air—a protocol successfully used in the present case and in previous cases.<sup>10</sup> Patients should remain in the hospital for treatment and monitoring until they are clinically stable. For SPM patients without complications, the mean hospital length of stay is 2.5 days.<sup>2</sup> Many studies<sup>2,4,12,13,17,18</sup> have noted that most patients with SPM have not required additional treatment beyond the acute recovery period and routine postrecovery imaging is probably unwarranted.

## Conclusion

To our knowledge, the present case is the first reported instance of SPM after a moderate-distance (ie, 1600 m) run. Although SPM is a rare clinical entity, it should be considered in young patients or runners presenting with chest pain even in the absence of any known inciting event. The most common presenting symptoms are chest pain and dyspnea, and plain film radiographs are necessary to confirm the diagnosis and to rule out pneumothorax. Physicians should strongly consider admitting SPM patients to the hospital for monitoring and supportive care to avoid the risk of rare serious complications.

## References

- Fajardo LL. Association of spontaneous pneumomediastinum with substance abuse. *West J Med*. 1990;152(3):301-304.
- Iyer VN, Joshi AY, Ryu JH. Spontaneous pneumomediastinum: analysis of 62 consecutive adult patients. *Mayo Clin Proc*. 2009;84(5):417-421. doi:10.1016/S0025-6196(11)60560-0.
- Vanzo V, Bugin S, Snijders D, Bottecchia L, Storer V, Barbato A. Pneumomediastinum and pneumopericardium in an 11-year-old rugby player: a case report. *J Athl Train*. 2013;48(2):277-281. doi:10.4085/1062-6050-48.1.11.
- Mihos P, Potaris K, Gakidis I, Mazaris E, Sarras E, Kontos Z. Sports-related spontaneous pneumomediastinum. *Ann Thorac Surg*. 2004;78(3):983-986.
- Newcome AE, Clarke CP. Spontaneous pneumomediastinum: a benign curiosity or a significant problem? *Chest*. 2005;128(5):3298-3302.
- US Centers for Disease Control and Prevention (CDC). *CDC Growth Charts: 2 to 20 years: Boys*. Atlanta, GA: US Dept of Health and Human Services, CDC; 2000. <http://www.cdc.gov/growthcharts/data/set1clinical/cj41021.pdf>. Accessed December 16, 2014.
- Turban JW. Spontaneous pneumomediastinum from running sprints [published online September 2, 2010]. *Case Rep Med*. 2010;2010:927467. doi:10.1155/2010/927467.
- Townes DA. Spontaneous pneumomediastinum in a marathon runner. *Br J Sports Med*. 2006;40(10):878-879.
- Pierce MJ, Weesner CL, Anderson AR, Albohm MJ. Pneumomediastinum in a female track and field athlete: a case report. *J Athl Train*. 1998;33(2):168-170.
- Macklin MT, Macklin CC. Malignant interstitial emphysema of the lungs and mediastinum as an important occult complication in many respiratory diseases and other conditions: an interpretation of the classic literature in the light of laboratory equipment. *Medicine*. 1944;23:281-352.
- Macklin CC. Transport of air along sheaths of pulmonary blood vessels from alveoli to mediastinum: clinical implications. *Arch Intern Med (Chic)*. 1939;64(5):913-926. doi:10.1001/archinte.1939.00190050019003.
- Shankar PS, Raoof S, Gupta D. Pneumothorax. In: Jindal SK, executive ed. *Textbook of Pulmonary and Critical Care Medicine*. Vol 2. New Delhi, India: Jaypee Brothers Medical Publishers; 2011:2043.
- Sahni S, Verma S, Grullon J, Esquire A, Patel P, Talwar A. Spontaneous pneumomediastinum: time for consensus. *N Am J Med Sci*. 2013;5(8):460-464. doi:10.4103/1947-2714.117296.
- Caceres M, Ali SZ, Braud R, Weiman D, Garrett HE Jr. Spontaneous pneumomediastinum: a comparative study and review of the literature. *Ann Thorac Surg*. 2008;86(3):962-966. doi:10.1016/j.athoracsur.2008.04.067.
- Macia I, Moya J, Ramos R, et al. Spontaneous pneumomediastinum: 41 cases [published online April 8, 2007]. *Eur J Cardiothorac Surg*. 2007;31(6):1110-1114.
- Beg MH, Reyazuddin, Ansari MM. Traumatic tension pneumomediastinum mimicking cardiac tamponade. *Thorax*. 1998;43(7):576-577.
- Wong KS, Wu HM, Lai SH, Chiu CY. Spontaneous pneumomediastinum: analysis of 87 pediatric patients. *Pediatr Emerg Care*. 2013;29(9):988-991. doi:10.1097/PEC.0b013e3182a26a08.
- Yellin A, Gapanov-Gapanavicius M, Lieberman Y. Spontaneous pneumomediastinum: is it a rare cause of chest pain? *Thorax*. 1983;38(5):383-385.

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