Although relatively uncommon in athletics, thoracic injuries can become life-threatening if misdiagnosed. Signs and symptoms of thoracic injuries may vary in the severity of their presentation, therefore making an accurate assessment of these enigmatic injuries a challenge. A pneumothorax is an injury that involves an accumulation of air in the pleural space, resulting in a loss of negative pressure and collapse of a lung segment. Condition types are further divided into traumatic pneumothorax and spontaneous pneumothorax. A traumatic pneumothorax involves air accumulating in the pleural space secondary to trauma (i.e., after a rib fracture). Spontaneous pneumothorax occurs without any direct trauma, and it is further classified as either primary (no known lung disease) or secondary (pre-existing lung disease). Signs and symptoms include the following:

- Chest pain
- Dyspnea
- A decrease or absence of breath sounds
- Hyper-resonance on percussion
- Crepitus upon palpation (palpable air in subcutaneous space)
- Tracheal shift

The most prominent symptoms related to this injury are chest pain and dyspnea. Athletic trainers and therapists should be aware that a general medical condition, such as a pneumothorax, can be mistaken for a musculoskeletal injury when common signs and symptoms are not primary complaints. When symptoms are very subtle or not present initially (i.e., respiratory difficulty), pain associated with this injury may be attributed to a musculoskeletal injury in the thoracic region. Failure to recognize a pneumothorax can result in life-threatening respiratory failure and circulatory collapse.

The following case discusses a 31-year-old recreational athlete, who presented with a large, serious, and spontaneous pneumothorax that required hospital admittance and surgical correction; the patient also presented with no significant respiratory symptoms at the time of his diagnosis.

**Case Report**

The case involved a 31-year-old male who teaches at a university and is involved in weightlifting and martial arts. On the day of the injury, he had a weight training session that consisted of deadlifts and various supplemental lifts for the lower body. The lifting was performed with 90% of estimated 1-repetition maximum, which was performed for as many repetitions as possible for the set. Approximately 3 hours after the weightlifting session, he noticed a sharp pain in his upper back at approximately the levels of T4–T8. The pain gradually worsened as the night went on. The symptoms were limited to sharp pain in the region, with moderate spasm in the paraspinal and periscapular...
musculature, along with some intermittent pain radiating to the lateral thorax and chest. The patient had no respiratory symptoms at the time.

The patient had a history of thoracic facet injuries and thought it was the cause of his symptoms, but he did feel that the pain was worse than what he had experienced in the past. He began taking 800 mg of ibuprofen 3 times a day as a means to reduce pain and inflammation associated with the injury. Despite these efforts, he had great difficulty sleeping and went to a sports medicine primary care physician for an evaluation 4 days after the incident.

At the physician visit, the patient told the physician that he perceived muscle spasm in the region and treated it with ice application and self-administered myofascial release (i.e., foam rolling), which provided him with some symptomatic relief. The patient also told the physician that he had been taking 800 mg of ibuprofen 3 times a day with little to no pain relief and was unable to sleep due to pain.

Radiographs demonstrated vertebral end-plate degenerative changes at T7–T8, with no other deformities or fractures noted. The clinical evaluation revealed tightness and spasm in the paraspinal musculature from T3–T12. Most of the discomfort elicited by palpation was noted from T6–T8. The patient exhibited full range of motion in shoulder forward flexion and abduction, along with 5/5 muscle strength of the deltoid, biceps, triceps, and rotator cuff muscles. All distal sensation and pulses were normal. The patient was diagnosed with thoracic spine pain with muscle spasm and was prescribed a muscle relaxant and Lidoderm® patches for pain and spasm relief. He was instructed to continue with foam rolling and icing, and to return to activity as tolerated.

In the 3 days that followed the physician visit, the patient refrained from weightlifting activities and only walked to address cardiac efficiency (power-walking at a heart rate of 100–120). The patient still experienced mild shortness of breath when he walked up a slight incline in his neighborhood, but attributed it to the lack of activity from his injury and muscle spasm in his thoracic region. His shortness of breath resolved quickly when activity ceased, and he experienced no further problems. During this time, the patient also had some minor upper respiratory issues (cold and sinus infection). The following week, he commenced weightlifting activities; during which time he still experienced issues with being slightly short of breath and having moderate bouts of coughing, which he attributed to the upper respiratory infection.

During the week he went back to his strength training routine, the back pain seemed to subside slightly. The patient noticed increased symptoms from the upper respiratory infection, and later that week made an appointment with his family physician. While at the appointment (11 days after the back pain onset), the patient mentioned the back pain he had from a weightlifting injury. He stated that he still experienced episodes of shortness of breath related to activity and teaching, but he was not sure if it was related to the injury or if an infection had spread to his lower respiratory region. The physician performed lung auscultation, which identified a difference in sound quality in the right versus left lung. Radiographs revealed a right-sided pneumothorax (Figure 1). Because the patient was asymptomatic at rest, he declined immediate transportation to a hospital emergency room. The patient was diagnosed as having a large spontaneous pneumothorax, with over 90% of the pleural space occupied by air. There was evidence on the radiograph of a shift in the mediastinum. A chest tube was inserted in the operating room to evacuate the air in the pleural space and expand the lung (Figure 2), and the patient...
was admitted to the hospital for monitoring. Four days after insertion of the chest tube, an air leak was identified by the presence of a small apical pneumothorax. The patient was advised that a more definitive treatment of the air leak would require surgical intervention through bronchoscopy, with video-assisted thoracic surgery (VATS) for upper lobe apical wedge resection and mechanical pleurodesis.

During the procedure, an area of damage in the upper right lobe of the lung was identified. No blebs were discovered, but the surgeon identified a compromised area that was the cause of the air leak. Weinstein et al\textsuperscript{1} describes a bleb as a “blister-like” deformity of the lungs that represents a weakened area of tissue. The damaged section of the lung was resected and mechanical pleurodesis was performed on the entire right side of the thorax. The process involved the use of a mesh sponge to scrub and abrade the pleural surfaces to initiate an inflammatory response.\textsuperscript{1,4} The bleeding and inflammation created by this procedure allowed the lung to seal against the parietal pleura to prevent recurrence of the pneumothorax.\textsuperscript{1,4}

Three days postsurgery, the patient had both his chest and drain tube removed. He was scheduled for a hospital discharge at that time; however, a follow-up radiograph showed a small air leak. This required the placement of another chest tube. This chest tube was removed after 4 days, at which time radiographs showed no further air leak. The patient then was allowed to return to activities of daily living with incremental increases in walking as tolerated. Two weeks postsurgery, the patient presented with a normal exam and was cleared by his physician to return to physical activity. He was instructed to slowly increase the intensity of activities over the course of the months to follow. The doctor emphasized the necessity to avoid performing the Valsalva maneuver during that time.

**Discussion**

Primary spontaneous pneumothorax typically occurs in taller males younger than 40 years of age.\textsuperscript{1,5,6} Interestingly, less than 10% of all these injuries occur during exercise,\textsuperscript{5} and that many occurrences happen at rest or with usual daily activities.\textsuperscript{6} Running is one of the more common structured physical activities associated with the occurrence of pneumothoraces.\textsuperscript{5,7} Simoneux et al\textsuperscript{7} stated that only 10–20% of all cases of spontaneous pneumothoraces occur due to activities that involve heavy exertion. Despite the exertion associated with heavy strength training, very few reports have found this to be a cause of spontaneous pneumothorax.\textsuperscript{6,7} Treatment for this condition varies and may involve surgical intervention if there is no resolution of the pneumothorax through more conservative measures, or where repair may prevent future occurrences. The percentage classification given to a pneumothorax is based upon the amount of air in the pleural cavity, and typically a moderate to large pneumothorax (> 30%) will require at least the placement of a chest tube to facilitate healing.\textsuperscript{1,8}

Early recognition of the signs and symptoms of pneumothorax is extremely important, due to its impact on pulmonary function. A large pneumothorax can eventually cause a shift in the mediastinum, which results in compression of the heart, major blood vessels, and the opposite lung.\textsuperscript{1,3} This may result in severe dyspnea, shock, respiratory failure, and circulatory collapse.\textsuperscript{3} Although the patient in this case study presented with no respiratory symptoms, there was a mild shift in his mediastinum.

Most injuries associated with weightlifting involve the musculoskeletal system. Most instances of spontaneous pneumothorax are thought to be due to the presence of blebs in the lung apices.\textsuperscript{7} This patient had a unique presentation from the time of the initial incident until diagnosis of the condition (11 days). The most prominent symptom was upper back pain, accompa-
nied by periscapular and paraspinal muscle spasm, which was believed to be due to musculoskeletal injury.

Differential diagnosis in the thoracic spine region is difficult. Structures in the thoracic region that could have been injured include the facet joints, paraspinal musculature, intervertebral disks, and costovertebral joints.9 Further complicating identification of the cause of symptoms is the close proximity of the organs of the respiratory, cardiovascular, and gastrointestinal system, any one of which could be a source of pain in the thoracic region.9 Injuries to the thoracic spine also may refer pain to the anterior and lateral chest walls.9 The patient believed his symptoms were related to injury in his thoracic region that he had previously sustained while doing the same type of activity (weightlifting). The muscle spasm, and minimal respiratory symptoms during the early stage, made a musculoskeletal cause seem very plausible. The first radiograph was obtained primarily for the purpose of evaluating the thoracic spine. In the early stages of a pneumothorax development, there may not be any visible abnormalities on a radiograph, particularly if the pneumothorax is small.10,11 A small pneumothorax can progress in size as a progressively greater amount of air gets trapped in the pleural cavity through a one-way valve mechanism.11

After having been treated for back pain, the patient returned to normal exercise (weightlifting and cardiorespiratory training) with very mild dyspnea that would resolve quickly (less than one minute). Despite the significant size of the pneumothorax at the time of its diagnosis, the patient was not in respiratory distress. At the postsurgery follow-up evaluation, the physician attributed the lack of respiratory symptoms to the patient’s good level of fitness. The patient only experienced dyspnea during physical activity and when teaching after his back pain had decreased. Although the patient also trained in martial arts, he had not participated in activities involving contact to the body in the previous 6 months. The onset of symptoms occurred after the weightlifting session, which involved use of relatively heavy weights and a Valsalva maneuver that was held for an extended period of time. The surgeon attributed the lung injury to the strength training session.

Treatment for spontaneous pneumothorax is based on size and effect of the injury.5 Kersey5 reported a 25% pneumothorax in a college soccer player that resolved without any advanced treatment. This patient was monitored in a hospital and released after 4 hours of monitoring. He was only seen for follow-up evaluations and returned to activity in approximately one month without complications.

Surgical wedge resection and mechanical pleurodesis were performed in the reported case to manage an air leak that was present 4 days after chest tube placement. After removal of the damaged portion of lung, the mechanical pleurodesis involves abrading the parietal pleural until bleeding occurs.4 As the lung is reinflated, it adheres to the abraded pleural lining. This procedure has been shown to reduce the recurrence of primary pneumothorax to 1.7%–3.7%.4

A return to activity without complete resolution of the condition could significantly increase the chance of pneumothorax recurrence. When symptoms resolve and the lung has fully expanded, return to play in contact sports may be permitted after 3 weeks.8 No specific guidelines have been reported for return to athletic activity after a surgical intervention. The patient in the reported case had a follow-up physician evaluation at 16 days postsurgery. At that time, the patient was given permission to return to strength training activities. He was advised to gradually increase the intensity of activities over a period of a few months and to avoid using a Valsalva maneuver.

Conclusion

Although this case had a rare presentation, athletic trainers and therapists should be aware of the possibility that mild breathing difficulties can be a sign of a progressively worsening condition. Abnormal lung sounds that are combined with any breathing difficulty should be referred for evaluation by a physician. Athletic trainers and therapists should recognize that symptoms associated with pneumothorax can initially be attributed to a musculoskeletal injury, and that a small pneumothorax can progressively worsen to become a life-threatening condition.

References


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