Pneumatoceles Causing Respiratory Compromise*

Treatment by Percutaneous Decompression

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Pulmonary pneumatoceles are uncommon but generally benign, thin-walled parenchymal air collections arising in association with acute pneumonia. Rarely, they may attain such size as to severely affect respiration. We describe the percutaneous placement of multiple drains in a patient with pneumonia due to atypical measles and large pneumatoceles. Decompression via tubes resulted in improved ventilation and acceleration of recovery.

(Chest 1993; 103:1266-67)

A pulmonary pneumatocele is usually a benign and transient thin-walled air-containing space occurring in association with acute pneumonia. In isolated cases, such an air collection may enlarge and significantly compress adjacent lung, becoming what might be termed a "tension pneumatocele." We report a patient with postpartum pneumonia due to measles who developed multiple bilateral large pneumatoceles causing severe respiratory impairment. The patient was treated with percutaneous placement of decompression tubes, which resulted in prompt improvement and contributed to her ultimate recovery.

CASE REPORT

A 33-year-old woman at 3 weeks postpartum developed a maculopapular rash, followed by onset of fevers, conjunctivitis, and photophobia. She was admitted to a local hospital with shortness of breath and progressive respiratory compromise. Her breathing continued to deteriorate, and 1 week later, she was intubated and transferred to our institution.

On physical examination, the patient had bibasilar rales and was on assist-control ventilation with a rate of 20 breaths per minute, inspired oxygen concentrations (FiO\textsubscript{2}) of 75 percent, tidal volume of 800 ml, and positive end-expiratory pressure (PEEP) of 10 mm Hg. The patient's temperature was 39.0°C. On admission, her blood gas values were a pH of 7.46, P\textsubscript{co2} of 78 mm Hg, and P\textsubscript{o2} of 35 mm Hg. She had leukocytosis of 19,400/mm\textsuperscript{3} and chest radiographic findings of bilateral diffuse interstitial pneumonia. Cultures of blood and sputum were obtained, and the patient was placed on therapy with multiple broad-spectrum antibiotics.

On the second day of hospitalization, a chest radiograph showed worsening of the interstitial infiltrates, as well as subcutaneous emphysema in the neck. Later that day, the patient developed tachypnea and hypotension. A right-sided tension pneumothorax was discovered and decompressed with a 28F chest tube. The next morning, a left-sided pneumothorax arose and was treated by placement of a 32F chest tube.

Over the next 2 weeks the patient's respiratory status gradually deteriorated. The ventilator settings at that time were 28 breaths per minute, FiO\textsubscript{2} of 60 percent, tidal volume of 500 ml, and PEEP of 10 mm Hg. The blood gas values were pH of 7.46, P\textsubscript{co2} of 60 mm Hg, and P\textsubscript{o2} of 38 mm Hg. Measles titer measurements showed acute titers of 1:16 and convalescent titers of 1:64.

Beginning on the sixth day of hospitalization, small focal air collections were noted in both lungs, and these gradually enlarged. On the 15th day of hospitalization, the patient needed additional chest tubes on each side to control her unresolved pneumatothoraces. There were several subsequent revisions of her chest tubes to control continued air leaks (Fig 1). A tracheostomy tube was placed on the 32nd day of hospitalization. By the 39th day, there was a single chest tube on the right; two chest tubes on the left; ventilator settings of 20 breaths per minute, FiO\textsubscript{2} of 55 percent, tidal volume of 500 ml, and PEEP of 10 mm Hg; and blood gas values of pH of 7.51, P\textsubscript{co2} of 87 mm Hg, and P\textsubscript{o2} of 41 mm Hg.

At this point, we in the section of interventional radiology were consulted to try to improve the patient’s ventilatory status by decompression of the largest of the patient's huge pneumatoceles. Initially, a 10F catheter (Medi-Tech APD) was inserted into the largest right-sided pneumatocele under computed tomographic guidance on the 45th day of hospitalization (Fig 2). A chest film demonstrated improvement, and blood gas measurements obtained that evening showed a pH of 7.48, P\textsubscript{o2} of 149 mm Hg, and P\textsubscript{co2} of 39 mm Hg. On the 48th day of hospitalization, a similar catheter was placed into a left-sided pneumatocele. After the second tube was placed, the ventilator settings were adjusted to 18 breaths per minute. The FiO\textsubscript{2} was 40 percent, tidal volume was 500 ml, and PEEP, 5 mm Hg; and blood gas values were pH of 7.48, P\textsubscript{o2} of 140 mm Hg, and P\textsubscript{co2} of 40 mm Hg. A third tube was placed into another left-sided pneumatocele on the 52nd day of hospitalization. All surgically placed chest tubes could be removed by the following day, and the patient was weaned from her respiratory support (Fig 3).

On the 54th day of hospitalization, the patient was placed on continuous positive airway pressure via a tracheostomy mask. Four days later, the pneumatocele drains were removed, and the patient maintained oxygen saturation levels greater than 90 percent. On the 62nd day of hospitalization, the tracheostomy tube was removed, and the patient was discharged on the 66th day of hospitalization.

On a follow-up visit 8 months after discharge, the patient's chest radiograph showed resolution of her right-sided pneumatoceles, with a single moderate-sized residual thin-walled air-containing space on the left. The residual pneumatocele had not been one of

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FIGURE 1. Anteroposterior chest radiograph obtained on 25th day of hospitalization, demonstrating large left pneumothorax, bibasilar large pneumatoceles, and multiple chest tubes in place bilaterally.
DISCUSSION

The formation of a pneumatocele is a common complication of staphylococcal pneumonia in infants and children but is rare in adults with pneumonia due to measles. Atypical measles may occur in individuals who have received the killed vaccine (as had this patient) and have been subsequently exposed to measles. Most early reports of atypical measles described adolescents and young adults; however, those who received the killed vaccine are now reaching their 30s. Atypical measles characteristically presents with an urticarial, vesicular, or hemorrhagic rash arising peripherally and spreading centrally. Prodromal symptoms of fever, malaise, myalgia, headache, nausea, and vomiting are frequently followed by sore throat, photophobia, conjunctivitis, cough, and pleuritic chest pain. Patients with pneumonia due to atypical measles may be expected to have segmental to diffuse infiltrates on chest radiography. Other findings previously reported, but not seen in our patient, include hilar adenopathy, pleural effusions, and small nodules which may persist for years. Measles-induced pneumonia usually resolves without sequelae; however, our patient presented with diffuse interstitial infiltrates and acute respiratory failure, with clinical, physiologic, and radiographic findings similar to those of the adult respiratory distress syndrome. Her condition deteriorated fairly rapidly with the development of the large pneumatoceles.

Most pneumatoceles resolve spontaneously, with no long-term adverse effects; however, occasionally, they may enlarge greatly. One of the proposed mechanisms for pneumatocele formation is bronchial and bronchiolar wall necrosis leading to rupture and interstitial emphysema. Once this process is initiated, pneumatoceles may enlarge by a check-valve mechanism. Our patient required high ventilator pressures to maintain adequate oxygenation. We would suggest that this led to the production of "tension pneumatoceles" which severely compressed surrounding lung parenchyma.

Previously the only accepted method for treating large pneumatoceles has been thoracotomy with excision. Tube drainage has been avoided for fear of causing a bronchopleural fistula. On the basis of this experience, we propose that percutaneous tube thoracostomy under radiologic guidance is an effective option for treatment. Percutaneous tube placement can be performed quickly and without general anesthesia in patients already severely compromised by pulmonary, mediastinal, or cardiovascular compression. Our patient responded quickly and ultimately left the hospital with resolution of most of her pneumatoceles. The only residual gas collection at 8-month follow-up is a left-sided pneumatocele which had not been subjected to tube decompression, and bronchopleural fistula did not develop in this patient.

REFERENCES

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Figure 2. Computed tomographic scan on 45th day of hospitalization immediately prior to placement of first percutaneous decompressive tube.

Figure 3. Anteroposterior chest radiograph obtained on 56th day of hospitalization, with three percutaneously inserted catheters in place. Catheters were removed shortly afterward.