

# A Case of Pneumomediastinum: A Rare Complication of Diabetic Ketoacidosis

Devin Steenkamp, MD, Vishal Patel, DO, and Ruth Minkin, MD

## PRESENTATION

An 18-year-old male college student with type 1 diabetes of 10 years' duration presented to the emergency department with acute onset of intractable vomiting and retching, which had started earlier the same day. He also described frequent urination and thirst and progressive dyspnea. His recent glycemic control had been poor as a result of frequent missed insulin doses. He had experienced three recent episodes of diabetic ketoacidosis (DKA) in the past year as a result of poor adherence to his basal-bolus insulin regimen.

On examination, his blood pressure was 158/88 mmHg, his heart rate was 131 bpm, his respiratory rate was 37 breaths per minute, and his oxygen saturation was 97% on ambient air. His rectal temperature was 99.5°F. He displayed a marked Kussmaul's breathing pattern with a distinctive fruity odor and signs of marked dehydration. Of significance was the incidental finding of bilateral subcutaneous emphysema of the superficial anterior neck. The rest of his examination was unremarkable with no abnormal findings on cardiac or respiratory exam. Hamman's crunch was not observed.

Laboratory tests revealed an anion gap metabolic acidosis (anion gap 37 mEq/L, venous pH of 6.98, plasma bicarbonate < 5 mmol/l) and strongly positive blood acetone levels. His blood glucose level was recorded as 806 mg/dl with a serum potassium of 6.6 mmol/l. His

leucocyte count was 23.1 with 88% neutrophils, blood urea nitrogen of 21 mg/dl, and creatinine of 1.6 mg/dl. A 12-lead electrocardiogram revealed sinus tachycardia.

A chest radiograph showed bilateral subcutaneous emphysema and a continuous diaphragm sign consistent with pneumomediastinum (PM) with no evidence of pneumothorax. Based on this finding, a gastrografin esophagram was performed on an emergent basis to rule out esophageal perforation consistent with Boerhaave's syndrome. This test revealed no extravasation of contrast.

While admission to the medical intensive care unit (ICU) was being co-coordinated, prompt treatment was initiated with intravenous insulin infusion and aggressive saline- and then dextrose-containing fluid resuscitation with close attention to electrolyte homeostasis. Broad-spectrum antibiotics were initiated and subsequently stopped after blood cultures returned negative.

Within 24 hours, he had improved substantially. The clinical finding of subcutaneous emphysema resolved within 48 hours, and repeat chest imaging revealed marked improvement in his PM. He was discharged from the ICU within 48 hours of admission, and his further clinical course was uneventful.

## QUESTIONS

1. In which conditions has PM been described, and what is the perceived pathophysiological abnormality?
2. What conditions need to be actively excluded in patients with DKA, vomiting, and PM?
3. Who are the typical patients with diabetes who may be at risk for this rare complication?
4. What radiological investigations should be considered?
5. What complications should be anticipated?
6. What is the expected prognosis?

## COMMENTARY

PM is a rare condition characterized by the accumulation of air within the mediastinum. It is most commonly caused by alveolar rupture secondary to alveolar over-distension and barotrauma seen in conditions that increase intrathoracic pressure. This increased pressure leads to an air leak into the pulmonary interstitium, and this air may dissect along the broncho-vascular bundles into the mediastinum and track up into the subcutaneous tissues of the neck or pericardial space, leading to pneumopericardium. Very rarely, air may leak into the retro-peritoneum or epidural space and lead to mediastinal pleural rupture and pneumothorax.<sup>1</sup> It is important to differentiate spontaneous PM from traumatic PM (e.g., secondary to esophageal tear).

PM complicating DKA is rare; as of 2003, there were 49 cases of PM in association with DKA published in

the medical literature.<sup>1</sup> DKA and its associated deep ketotic hyperventilatory pattern may lead to increases in the alveolar pressure of 20–30 mmHg, which may be significant enough to lead to alveolar rupture.<sup>2</sup> Additionally, vomiting and retching is common in DKA. In one review, 71% of the patients with DKA and PM were vomiting at the time of presentation.<sup>1</sup> Other conditions associated with PM are thought to relate to the elevation in intra-thoracic pressure and include asthma, seizures, coughing, valsalva maneuvers, parturition, strenuous physical activity, and aspiration pneumonia. Esophageal or tracheo-bronchial rupture during instrumentation or positive pressure ventilation are examples of conditions leading to traumatic PM.<sup>3</sup>

Esophageal rupture (Boerhaave's syndrome) needs to be strongly considered in patients with DKA, PM, and intractable vomiting because the mortality rate may be as high as 70%. However, the prognosis for spontaneous PM in DKA is excellent; the PM tends to resolve once the acidosis is corrected.

Cases of PM complicating DKA may be underestimated given the common presentation of breathlessness in these patients, which may all be attributed to the ketosis. Chest radiography may not be a routine investigation, particularly in patients without cough or vomiting.

Approximately 50% of diagnoses of PM may be missed if a single postero-anterior radiograph is obtained. Therefore, lateral films are essential when considering this diagnosis.<sup>4</sup>

Typical patients with diabetes and PM complicating their DKA are young males on insulin. The average age is in the early 20s. Young men likely have greater musculature and may thus create larger swings in alveolar pressure, leading to an increased risk of alveolar rupture.<sup>1</sup>

Given that the major differential consideration in patients with vomiting and PM is Boerhaave's syndrome and the associated high mortality, this condition needs to be excluded with contrast esophagram or computed tomography (CT) scan of the chest with oral contrast before attributing the PM solely to ketotic hyperventilation.

Pneumothorax, pneumopericardium, and secondary cardiac tamponade complicating PM is extremely rare. There has been one case report described to date of air in the epidural space associated with PM and DKA.<sup>1</sup>

#### CLINICAL PEARLS

- PM complicating DKA is a rare entity with a favorable prognosis, provided that more sinister etiologies such as traumatic PM secondary to esophageal rupture are excluded.
- Typical patients with diabetes and PM are young males on insulin with profound acidosis and Kussmaul's respirations, who may present with chest pain or breathlessness.
- Hamman's crunch is the most typical physical finding, which presents as a crunching, popping or rasping sound during cardiac systole. It may be present in 35–64% of patients with PM.<sup>1</sup>

- Postero-anterior and lateral chest radiography should be ordered to confirm the diagnosis, as well as contrast esophagram or CT scan of the chest with oral contrast in patients who are vomiting to rule out Boerhaave's syndrome.
- Prompt treatment of the underlying acidosis usually leads to spontaneous resolution of the PM. However, careful monitoring for potential rare complications such as pneumopericardium or pneumothorax is warranted.

#### ACKNOWLEDGMENT

Consent was obtained from the patient and his parents before this case was written for publication.

#### REFERENCES

- <sup>1</sup>Pooyan P, Puruckherr M, Summers JA: Pneumomediastinum, pneumopericardium and epidural pneumatosis in DKA. *J Diabetes Complications* 18:242–247, 2004
- <sup>2</sup>Bullaboy CA: Radiological case of the month: pneumomediastinum and subcutaneous emphysema caused by diabetic hyperpnea. *Am J Dis Child* 143:93–94, 1989
- <sup>3</sup>Levsky JM, Feuer BH, Di Vito J Jr: Pneumomediastinum in a patient with diabetic ketoacidosis. *J Emerg Med* 26:233–235, 2004
- <sup>4</sup>Watson JP, Barnett AH: Pneumomediastinum in diabetic ketoacidosis. *Diabet Med* 6:173–174, 1989

---

*Devin Steenkamp, MD, is a resident, Vishal Patel, DO, is a pulmonary/critical care fellow, and Ruth Minkin, MD, is a pulmonary/critical care attending physician in the Department of Medicine at St Luke's Roosevelt Hospital Center, Columbia University College of Physicians and Surgeons, in New York City.*