

Gastric Emphysema: An Etiologic Classification

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INTRODUCTION

The radiological detection of gas within the wall of the stomach is not diagnostic entity per se but rather a sign of underlying abnormality. Several terms have been applied to this condition including intramural or interstitial gastric emphysema, emphysematous gastritis, gastric pneumatosis, nonbacterial gastric emphysema and pneumatosis cystoides intestinalis. Based on our etiologic understanding, gas accumulating in the wall of the stomach can arise outside the stomach or can be formed within the gastric wall. The terms gastric emphysema and emphysematous gastritis refer to these respective processes. Cystic pneumatosis of the stomach, either isolated or as part of a generalized process of pneumatosis cystoides intestinalis, should be considered a separate entity, the etiology of which is the subject of much conjecture and controversy.

This report deals primarily with gastric emphysema, emphasizing its subclassification into traumatic, obstructive and pulmonary types depending upon the etiology and pathogenesis. The clinical significance of this classification is important from management and prognostic standpoints, where the radiologist may play a significant role. Three cases of gastric emphysema, each of different etiology, are summarized in the following case reports.

Key Words:

Gastric emphysema, emphysematous gastritis, gastric pneumatosis.

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CASE REPORTS

Case 1.

A 74-year-old man with an inoperable hypopharyngeal carcinoma had a feeding tube gastrostomy in June, 1982 at the Veterans Administration Medical Center, Ann Arbor. He was readmitted in August 1982, because of marked weakness and malfunctioning of the gastrostomy tube.

On physical examination he was very emaciated and malnourished. His blood pressure was 110/70, pulse 80/minute, and respiration 18/minute. The liver was palpable four fingers breadths below the costal margin. The gastrostomy tube was loose and sagging. Laboratory data revealed a hemoglobin of 10 grams per 100 ml, a hematocrit of 34, and a WBC of 8000/Cu ml with a normal differential count. Urine analysis was normal.

The plain radiograph of the abdomen revealed linear gas collections in the left upper quadrant suggesting intramural gas in the stomach. An upper gastrointestinal examination (Figure 1) using water soluble iodinated contrast material injected through the gastrostomy tube confirmed the presence of linear gas collections located in the wall of the stomach. No free gastric perforation or leakage of contrast material was noted. The gastrostomy tube was sagging from its original position, and its tip was lying partially in the intramural portion of the stomach. The patient underwent surgical adjustment of gastrostomy tube. The stoma around the tube was tightened. Since surgical revision the gastrostomy tube has been functioning well. The gas in the wall of the stomach resolved within two days.

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Comment: The gastric emphysema in this patient is of traumatic origin due to a mucosal breach produced by gastrostomy tube insertion. It resolved spontaneously following correction of sagging of the gastrostomy tube.

Case 2.

A 62-year-old man complaining chiefly of shortness of breath was admitted to the Veterans Administration Medical Center, Ann Arbor in October 1981. He had a long history of chronic obstructive pulmonary disease. He denied chest pain, fever or chills. His past history was non-contributory. He had smoked two packs of cigarettes per day for thirty years.

On examination the patient had a typical emphysematous build and was in moderate respiratory distress. His pulse rate was 100/minute, blood pressure 150/90, respiration 28/minute and temperature 98°F. The chest radiograph revealed advanced chronic obstructive pulmonary disease. There was no evidence of pneumonitis, pulmonary neoplasia, mediastinal lesions or cardiac abnormalities. The electrocardiogram showed slight right ventricular enlargement. The biochemical profiles of blood and urine were normal. The patient was treated

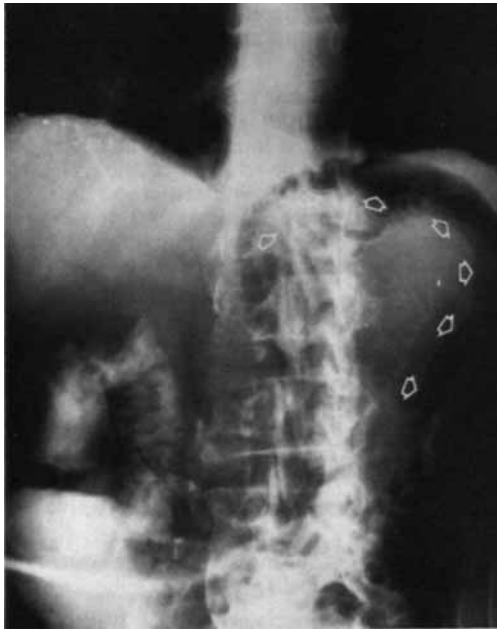


FIGURE 1. — *Case 1.* Traumatic gastric emphysema. Gastrostomy tube injection with water soluble contrast medium showing linear collection of intramural air outlining the proximal half of the stomach (arrows).



FIGURE 2A

FIGURES 2A & 2B. — *Case 2.* Pulmonary gastric emphysema. Supine and lateral projections of the upper abdomen showing extensive retroperitoneal emphysema and gastric emphysema best seen as the lateral projection (arrows) (S — Stomach).

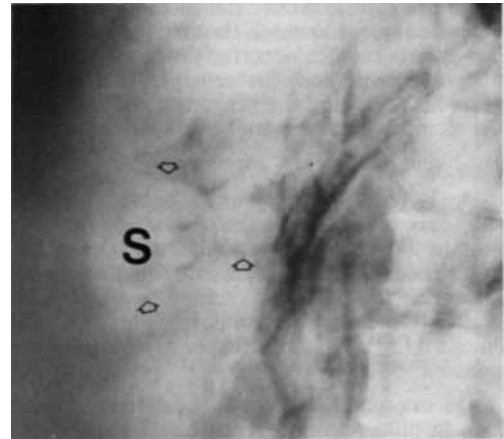


FIGURE 2B

with general supportive measures. His shortness of breath did not improve and he suffered cardiac arrest on the following day. Extensive resuscitative measures revived the patient. On the next day marked emphysema was noted in the neck and mediastinum. Abdominal radiographs (Figure 2) revealed retroperitoneal emphysema with air outlining the gastric wall. The respiratory status of the patient continued to deteriorate and he died two days later.

Comment: These radiographs illustrate an example of the pulmonary origin of gastric emphysema. The air leaking through pulmonary



FIGURE 3A. — Case 3. Plain abdominal film showing mottled lucencies in the upper abdomen in the region of the stomach.



FIGURE 3B. — Case 3. Obstructive gastric emphysema. Upper gastrointestinal series shows an annular partially obstructing carcinoma of the stomach several nodular defects along the contour of the stomach (arrows) represent air in the wall of the stomach.

alveoli ruptured by extensive mechanical respiratory assistance dissected along the vascular sheaths to reach the mediastinum. Further dissection then occurred down the paraesophageal plane into the retroperitoneum and some air following the peritoneal reflections of the stomach caused gastric emphysema.

Case 3.

A 37-year-old black man complaining of shortness of breath, and early satiety of three months duration, was admitted to Veterans Administration Medical Center, Ann Arbor in December 1981. He had recently developed epigastric fullness and discomfort with occasional emesis. His past family and social histories were noncontributory.

On examination, he was a cachectic young man in mild respiratory distress. The liver was palpable three fingers breadths below the right costal margin and there was epigastric fullness. The chest radiograph revealed a small left pleural effusion. The abdominal radiograph showed several mottled lucencies in the left upper abdomen (Figure 3A). An upper gastrointestinal series showed an annular obstructing carcinoma of the stomach (Figure 3B). Several nodular lucencies, representing gastric emphysema, were noted in the wall of the stomach. Gastroscopy and biopsy of the antral lesion confirmed poorly differentiated adenocarcinoma of the stomach. A radionuclide liver scan showed diffuse hepatic metastases. The left pleural tap revealed a malignant effusion. Because of the extensive nature of the disease, he received palliative supportive therapy for pain and short-

ness of breath. Chemotherapy was considered and surgery was ruled out. His general condition continued to deteriorate and he died eight days following admission. The autopsy revealed an extensive poorly differentiated obstructing carcinoma of the gastric antrum with widespread metastases.

Comment: This case represents an example of the obstructive type of gastric emphysema. At first sight the mottled lucencies in the left upper abdomen appear to be retained gastric contents. The lack of change in their location and distribution in several projections suggest intramural gastric air. The changes in the upper gastrointestinal contrast examination are subtle.

DISCUSSION

Gas within the wall of the stomach has been categorized by most authors under three headings:

1. Gastric emphysema (intramural, interstitial or nonbacterial)¹⁻²⁰.
2. Emphysematous gastritis (infective or bacterial)²¹⁻²⁸.
3. Cystic pneumatosis (pneumatosis cystoides intestinalis)²⁹⁻³⁴.

The presence of gas within the wall of the stomach is a sign of an underlying abnormality. Ways by which gas can accumulate within the gastric wall are either by entering from without or by being formed within the wall. Gastric em-

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TABLE 1
Gastric Emphysema Cases Reported in the Literature (Total 26 Cases)

Author (Ref.-Year)	Clinical Condition	Comment
1. Nitch (29-1926)	Carcinoma of stomach	Obstructive gastric emphysema
2. Baumann-Schenker (34-1939)	Pyloric obstruction carcinoma of stomach	Obstructive gastric emphysema
3. Myhre & Wilson (1-1948)	Post gastroscopy	Traumatic gastric emphysema
4. Myhre & Wilson (1-1948)	Post gastroscopy	Traumatic gastric emphysema
5. Fierst <i>et al</i> (3-1951)	Post gastroscopy	Traumatic gastric emphysema
6. Cancelmo (4-1954)	Cancer of esophagus Sever vomiting	Traumatic gastric emphysema Vomiting producing microtears in the gastric mucosa
7. Lumsden (5-1956)	Pyloric obstruction carcinoma of stomach	Obstructive gastric emphysema
8. Plachta & Speer (6-1957)	Pulmonary emphysema	Gastric emphysema of pulmonary origin
9. Plachta & Speer (6-1957)	Pulmonary emphysema	Gastric emphysema of pulmonary origin
10. Plachta & Speer (6-1957)	Pulmonary emphysema	Gastric emphysema of pulmonary origin
11. Plachta & Speer (6-1975)	Pulmonary emphysema	Gastric emphysema of pulmonary origin
12. Ward (7-1960)	Obstructive carcinoma of stomach	Obstructive gastric emphysema
13. Druckman (33-1961)	Pyloric obstruction due to peptic ulcer disease	Pyloroduodenal obstruction causing obstructive gastric emphysema.
14. Key-Butler (9-1962)	Obstruction of duodenum and five days of persistent vomiting. Cancer of pancreas	Obstructive gastric emphysema Persistent severe vomiting producing microtears in the gastric mucosa.
15. Schoor & Marcus (10-1962)	Duodenal obstruction by gall stone	Obstruction gastric emphysema
16. Berdon <i>et al</i> (11-1964)	Necrotizing enterocolitis	Loss of mucosal integrity
17. Seaman & Fleming (14-1967)	Gastric volvulus	Obstructive gastric emphysema
18. Seaman & Fleming (14-1967)	Persistent vomiting	Traumatic gastric emphysema
19. Seaman & Fleming (14-1967)	Necrotizing enterocolitis	Loss of mucosal integrity
20. Chamberlain (2-1967)	Post gastroscopy	Traumatic gastric emphysema
21. Siegel (17-1975)	Carcinoma of stomach	Obstructive gastric emphysema
22. Turnbull (19-1979)	Pyloric obstruction due to duodenal ulcer	Obstructive gastric emphysema
23. Kussin (20-1982)	Carcinoid obstructing stomach	Obstructive gastric emphysema
24. Agha (P-1983)*	Obstructing carcinoma of stomach	Obstructive gastric emphysema
25. Agha (P-1983)*	Sagging tube gastrostomy	Traumatic gastric emphysema
26. Agha (P-1983)*	Patient on respirator	Pulmonary gastric emphysema

*P: Present Report.

physema and emphysematous gastritis refer to these processes respectively. Cystic pneumatosis of the stomach, whether isolated finding or part of generalized pneumatosis cystoides intestinalis, should be considered a separate entity. Gastric emphysema refers to a situation in which gas collects in the wall of the stomach without associated infection by gas forming organisms. The radiologic features are characteristic linear streaks of radiolucencies parallel to the border of the stomach, few millimeters in width and separated from the lumen by an area of intervening gastric wall. These streaks do not change in location in different radiographic projections^{35, 36}. The gas usually collects in the submucosa or subserosa. To date only twenty-six examples of intramural gastric emphysema have been recorded in the literature including three from the present report (Table 1).

Gastric emphysema is a radiographic finding that may result due to a variety of clinical conditions. Depending upon the etiology and pathogenesis, it can be divided into three categories; traumatic, obstructive, or pulmonary.

a) **Traumatic gastric emphysema** — Myhre and Wilson¹ studied abdominal films on 119 consecutive patients 24 hours after gastroscopy and found only one case who developed gastric emphysema without gastric perforation. The patient remained asymptomatic. Chamberlain² and Fierst³ each added a single case of asymptomatic gastric emphysema following endoscopy. Most recently Katz *et al* described this finding following fibroptic endoscopy. Because of these reports, the finding of linear streaks of gas within the wall of the stomach is viewed as a benign self-limiting condition. With increasing use, endoscopy it has become the most frequent cause of gastric emphysema^{16, 21}.

The patient is usually asymptomatic. Microorganisms are not involved. The source of the gas is intraluminal air. It is probably related to direct transmural diffusion of gas from the air-distended stomach. The clinical course is benign, and spontaneous resolution is the rule. No treatment is required. When mucosal integrity is impaired following gastric biopsy or gastrostomy, transient localized intramural air may be seen. Breaching of mucosal integrity and partial intramural location of the tip of the gastrostomy tube are obvious explanations of gastric emphysema in Case 1.

b) **Obstructive** — Interstitial gastric emphysema is usually associated with chronic peptic ulcer producing partial gastric outlet obstruction. Lumsden⁵ described the first case associated

with obstructive carcinoma of the stomach. Increased intragastric pressure and a diseased mucosa associated with gastric outlet obstruction due to carcinoma or peptic ulcer permits intraluminal air to enter the wall of the stomach. Only eleven examples of gastric emphysema due to obstructing lesions have been recorded^{7, 9, 10, 12, 14, 17, 29, 33, 34} including one case from this report. Gastric obstruction by gastric volvulus, duodenal obstruction due to gall stone and to pancreatic carcinoma have been reported as causes of gastric emphysema. In obstructive gastric emphysema, the gas enters the wall through a breach in the mucosa associated with increased intragastric pressure, and vomiting. With gastric obstruction associated with a normal mucosa such as gastric volvulus and gallstones causing duodenal obstruction, there are other possible routes that allow passage of gas into the submucosa. These include the areas around the vascular sheaths³⁴ and perilymphatic areas². The linear collection of air is usually progressive and may even produce pneumoperitoneum by passage of the gas along the peritoneal reflections of the stomach into the gastrohepatic and phrenoesophageal ligaments or the greater omentum. Relief of obstruction results in resolution of gastric emphysema within a few days.

c) **Pulmonary type** — This is the rarest type of gastric emphysema. Only five cases of pulmonary gastric emphysema have been recorded, four reported by Plachta and Speer⁶ and one in the present report. The four cases reported by Plachta and Speer were due to bullous emphysema. Air from ruptured bullae dissected along the vascular sheaths and reached the paraoesophageal area followed by a gradual downward dissection into the submucosa of the stomach leading to gastric emphysema. All four patients had no abdominal symptoms and no radiographs of the abdomen were obtained. The diagnosis of esophageal and gastric emphysema was made at autopsy. In our case marked emphysema of the mediastinum and retroperitoneum developed due to extensive resuscitative efforts. Some air also dissected into the wall of the stomach producing gastric emphysema.

The subclassification of gastric emphysema on the basis of its pathogenesis into traumatic, obstructive and pulmonary types has definite clinical and prognostic implications. These features are summarized in Table 2.

ABSTRACT

Gas within the wall of the stomach is a rare

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TABLE 2
Classification of Gastric Emphysema

Types	Clinical Signs and Symptoms	Etiology and Pathogenesis	Lab Culture	Natural History and Therapy
Traumatic	None	Distension of lumen with transmural diffusion of gas through micro mucosal tears	Negative	Spontaneous remission. Self limiting no treatment
Obstructive	Severe vomiting with obstructive symptoms	Distended stomach with increased intragastric pressure and breach of mucosal integrity	Usually negative	Progressive treatment of underlying disease causing gastric or duodenal obstruction
Pulmonary	None related to gastric emphysema. Pulmonary symptoms present due to chronic obstructive pulmonary disease	Rupture of pulmonary alveoli or emphysematous blebs causing mediastinal emphysema with dissection of air into neck, retroperitoneum and along peritoneal reflection of the stomach	Negative	Self limiting. Treatment directed to pulmonary problem.

radiologic finding. The stomach has been the least often reported site of intramural gas in the hollow viscera. Based on etiology, gas in the wall of the stomach can be classified as either gastric emphysema or emphysematous gastritis. Gastric emphysema may be classified into traumatic, pulmonary or obstructive types depending upon the mechanism and pathogenesis. Three cases of gastric emphysema, each of different etiology, are presented to emphasize the subclassification of gastric emphysema. The clinical and prognostic significance of this classification is emphasized.

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