CASE REPORT

Synchronous perforations of the oesophagus and stomach by air insufflation: an uncommon complication of endoscopic dilation

Arthur M Fung, Fion S Chan, Ian Y Wong, Simon Law

¹Department of Surgery, The University of Hong Kong, Queen Mary Hospital, Hong Kong

Correspondence to

Professor Simon Law, Cheung Kung-Hai Professor in Gastrointestinal Surgery, Chief, Division of Oesophageal and Upper Gastrointestinal Surgery Department of Surgery, The University of Hong Kong, Queen Mary Hospital, 102 Pokfulam Road, Hong Kong slaw@hku.hk

Accepted 19 October 2016

SUMMARY

A 72-year-old woman had a history of carcinoma of the hypopharynx treated by total laryngectomy, circumferential pharyngectomy and free jejunal graft. Endoscopic dilation of the pharyngojejunal anastomotic stricture resulted in synchronous perforations of the oesophagus and stomach. We postulate that the perforations were caused by high intraoesophageal and intragastric pressure resulted from air insufflation during the procedure; in a situation simulating closed-loop obstruction, because of proximal obstruction by the endoscope at the stricture site and distal obstruction by pylorospasm. The sites of perforations were inherent points of weakness at the left side of the distal oesophagus and at the high lesser curve of stomach. Satisfactory outcome of our patient was attributed to prompt diagnosis and surgical repair. Endoscopists should be aware of this possibility during oesophagogastroduodenoscopy and dilation. Rapid and over insufflation of air should be avoided.

BACKGROUND

Synchronous perforations of the oesophagus and stomach during therapeutic oesophagogastroduodenoscopy (OGD) by air insufflation have not been reported in the literature.

CASE PRESENTATION

A 72-year-old woman had a history of carcinoma of the hypopharynx and underwent total laryngectomy, circumferential pharyngectomy and reconstruction by free jejunal graft in 2004, followed by postoperative adjuvant radiotherapy. The disease was in remission, but she suffered from recurrent anastomotic stricture at the pharyngojejunal anastomosis requiring repeated endoscopic dilation since 2005. The procedures were previously performed by surgeons of the Division of Head and Neck Surgery, and endoscopic images of the stomach and pylorus were not taken. There was no history of chronic steroid use, and she did not undergo other endoscopic procedures apart from dilation of the stricture. In the current episode, endoscopy was performed in another hospital in 2011 under general anaesthesia. Carbon dioxide was not used during the procedure. A tight stricture was found. The endoscopist attempted to pass a flexible bronchoscope with an external diameter of 5 mm. This was successful and was then followed by a flexible endoscope with an external diameter of 9.8 mm. The endoscopist failed to pass the endoscope

through the stricture, and increased difficulty in ventilation of the patient was encountered during the procedure. Clinical examination revealed subcutaneous emphysema of the face, neck and upper chest and reduced air entry bilaterally compatible with pneumothoraces on both sides. The procedure was abandoned. The condition improved after bilateral chest drain insertion. The patient was then transferred to our hospital for further management.

INVESTIGATIONS

1. Chest radiograph showed pneumoperitoneum in addition to pneumomediastinum and bilateral pneumothoraces (figure 1).
2. Oesophagogastroduodenoscopy (OGD) was performed with a neonatal endoscope of external diameter 5.5 mm which showed that the pharyngojejunal anastomosis was intact. There was a 1 cm perforation at the distal oesophagus on the left side and a linear perforation at the high lesser curve of the stomach (figure 2). The pylorus looked spastic, but endoscopy photograph was not taken.
3. CT scan of the thorax and abdomen showed pneumomediastinum, bilateral pneumothoraces and pneumoperitoneum. The pylorus appeared thickened but a proper measurement was not possible as the stomach was not distended at the time of examination. The small bowel was not dilated, and there was small amount of pelvic fluid (figure 3).

Figure 1 Chest radiograph showing subcutaneous emphysema, pneumomediastinum, bilateral pneumothoraces and pneumoperitoneum.

CrossMark

To cite: Fung AM, Chan FS, Wong IY, et al. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2016-216375

Figure 2 Oesophagogastroscopy was performed to assess the perforations. (A) A perforation at distal oesophagus. (B and C) Mucosal laceration and perforation at the high lesser curve of stomach.

Figure 3 CT scan of the thorax and abdomen was performed shortly after transfer to our hospital. (A) The pylorus (arrow) appeared thickened. (B) No gaseous distension of small bowel was noted.

DIFFERENTIAL DIAGNOSIS

Perforations at the distal oesophagus on the left side and high lesser curve of the stomach were diagnosed.

TREATMENT

The perforation at the high lesser curve of stomach is relatively big, and endoscopic clipping was not feasible using a neonatal endoscope with the working channel of 2 mm. Surgical treatment was therefore decided. Emergent laparotomy revealed a 1 cm longitudinal tear at the left anterior distal oesophagus just proximal to the oesophagogastric junction located above the left crus of diaphragm and another 4 cm longitudinal perforation over the high lesser curve of the stomach (figures 4 and 5). The pylorus appeared thickened on palpation. There was no evidence of ulcer or tumour in the oesophagus and stomach on careful assessment of the perforations; biopsy of edges of perforation site was not performed. The peritoneal cavity was contaminated with turbid peritoneal fluid. Primary repair of both perforations and a Heineke-Mikulicz pyloroplasty was also performed. The patient was prescribed broad-spectrum antibiotics and was temporarily fed via a nasoduodenal tube.

OUTCOME AND FOLLOW-UP

A subsequent water-soluble contrast study did not show any leakage. She resumed oral feeding gradually. Her recovery was complicated by pulmonary embolism, which was managed conservatively. She was discharged home 62 days after her surgery. The patient was well, and there was no evidence of mucosal lesion in the oesophagus and stomach on endoscopic reassessment 4.5 years after the perforations.

DISCUSSION

OGD-induced perforation has been comprehensively reviewed in the literature. Misra and associates reviewed perforations resulted from OGD since 1972 and found that perforation rates for diagnostic OGD ranged from 0.0009% to 0.1%. For therapeutic OGDs, this rate varied from 0.3% to 6.4%.¹

Figure 4 A 1 cm perforation at distal oesophagus.

A retrospective large-scale study at the Mayo Clinic, involving 217 507 OGDs from 1996 to 2008, found that the majority of the perforations were in the oesophagus (51%); with the distal thoracic oesophagus (19.5%) and the oesophagogastric junction (13.0%) as the commonest sites. This was followed by the duodenum (32%), jejunum (6%), unknown sites (5%), stomach (3%) and the common bile duct (3%).²

Figure 5 A 4 cm perforation at the high lesser curve of stomach.

Synchronous perforations of the oesophagus and stomach following endoscopic dilation have not been reported in the literature. The unusual presentation of subcutaneous emphysema, pneumomediastinum, bilateral pneumothoraces and gross pneumoperitoneum confused the diagnosis. There was no doubt that perforation had taken place; the most obvious presumed site was the pharyngojejunal anastomosis or the upper oesophagus. However, this would not have led to pneumoperitoneum, and the larger endoscope did not pass through the stricture during the procedure. Another careful OGD was thus performed, and the correct diagnosis was made. We postulated that the perforations were related to high intraoesophageal and intragastric pressure as a result of air insufflation during endoscopy. The mechanism is not unlike that in Boerhaave syndrome and gastric rupture after Heimlich manoeuvre, where a sudden rise in intraoesophageal and gastric pressure would perforate the oesophagus and the stomach at the weakest points, which is the lower oesophagus on the left side and the high lesser curvature of the stomach, respectively. However, we believe this is the first described patient with synchronous perforations of both sites.

From the original description in 1724, Boerhaave syndrome refers to barogenic oesophageal rupture because of a sudden rise in intraoesophageal pressure. It is most commonly preceded by vomiting and is often associated with functional obstruction of the proximal oesophagus, such as a closed upper oesophageal sphincter.³ In our patient, the pharyngojejunal stricture gripping on the endoscope used for dilation could have contributed to mechanical obstruction of the proximal oesophagus. Most commonly again, emetogenic rupture involves the distal thoracic oesophagus on the left side, with rare involvement of the abdominal oesophagus. It is postulated that there exists a weak zone of the oesophageal wall at this level. This was supported by the experimental model of Korn *et al*,⁴ in which iatrogenic rupture of the oesophagus was achieved by insufflation of air

into the oesophageal lumen of six fresh human cadavers. They reported an area of weakness of the distal oesophagus at the junction where the semicircular (clasp) fibres run transversely on the distal oesophagus and gastric lesser curve, and the oblique (sling) fibres embraced the distal oesophagus and greater curve of stomach. It was observed that air insufflation resulted in distension of proximal stomach and particularly the fundus, which brought the greater curvature to a left anterolateral position, consequently rotating the oesophagus towards the left hemithorax. Perforations occurred almost invariably at the margin of contact between clasp and oblique fibres and extended upwards. The site of perforation in our patient was located at the left anterior distal oesophagus, which was compatible with the proposed zone of weakness.

The Heimlich manoeuvre, applying subdiaphragmatic compression to raise the expiratory volume and pressure in a short time to expel obstructing objects causing asphyxiation in the airway, was introduced in 1974.⁵ Rupture of the stomach could be a result of an improper technique leading to barotrauma to the stomach. Gastric distension after a full meal and repeated attempts of the manoeuvre further contribute to its occurrence. From 1975 to 1999, a total of 9 patients were reported to develop gastric rupture following Heimlich manoeuvre. The perforations occurred invariably on the lesser curve.⁶ The preponderance of the high lesser curve tear was proposed to be related to its fewer mucosal folds and less elasticity comparing with the greater curve.⁷ Barker *et al*⁸ applied the LaPlace's law in human stomach and suggested that the lesser curve had a smaller sum of principal radii compared to the greater curve; it would therefore receive a higher surface tension and thus pre-disposed to rupture with rise in intragastric pressure. Other proposed mechanism by McDonnell *et al*⁹ suggested that prolonged, severe gastric distension could impair venous drainage, leading to ischaemia and necrosis and eventually gastrorrhesis.

The concomitant perforations in both organs could have resulted from overinflation of the oesophagus and stomach. Proximally, the pharyngojejunal stricture was obstructed by the endoscope. Gastric outlet obstruction was suspected as there

Learning points

- ▶ Physicians who perform endoscopic therapeutic procedures should be aware of the potential complication of synchronous perforation of distal oesophagus and stomach.
- ▶ Carbon dioxide instead of air insufflation should be considered during endoscopic therapeutic procedures. Gentle insufflation and regular suction should be practiced to minimise the risk of over distension of the oesophagus and stomach.
- ▶ Endoscopic dilation should better be performed using balloon dilator or Bougie under fluoroscopic guidance. Blind dilation with endoscope should be avoided.
- ▶ Proper assessment of perforation site(s) could be made by a careful oesophagogastrroduodenoscopy by an experienced endoscopist with minimal air or CO₂ insufflation. This can facilitate the decision on definite management. Endoscopic clipping of small perforation may be attempted in patients without stricture at oesophagus or cardia.
- ▶ Timely diagnosis and surgical intervention was the key for satisfactory recovery of the patient.

was absence of gaseous distension of small bowel in preoperative CT scan. Transient pylorospasm was one conjecture, but there was no report on the occurrence of gastric perforation due to pylorospasm on the literature search. While the patient was under general anaesthesia and failed to report any abdominal discomfort, the exceptionally high pressure in the oesophagus and stomach was not noticed. This is a potential pitfall of performing a therapeutic endoscopic procedure under general anaesthesia as perforation due to overinflation of gas or tangential pressure from the shaft of endoscope could occur without the operator's knowledge. The perforation was unlikely resulted from tumour recurrence as there was no mucosal lesion in the oesophagus and stomach on endoscopic assessment 4.5 years after this incidence.

Access to the distal oesophagus is possible via a laparotomy and exposure could be facilitated by opening the hiatus wide with splitting of the crus laterally and the diaphragm anteriorly whenever necessary. As in this case, repair of both perforations with a laparotomy was successful.

Contributors AMF involved in drafting of the article. FSC contributed to conception and critical revision of the article. IYW and SL involved in critical revision of the article. AMF, FSC, IYW and SL contributed to final approval of the version to be published.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- 1 Misra T, Lalor E, Fedorak RN. Endoscopic perforation rates at a Canadian university teaching hospital. *Can J Gastroenterol* 2004;18:221–6.
- 2 Merchea A, Cullinane DC, Sawyer MD, *et al.* Esophagogastrroduodenoscopy-associated gastrointestinal perforations: a single-center experience. *Surgery* 2010;148:876–82.
- 3 de Schipper JP, Pull ter Gunne AF, Oostvogel HJ, *et al.* Spontaneous rupture of the oesophagus: Boerhaave's syndrome in 2008. Literature review and treatment algorithm. *Dig Surg* 2009;26:1–6.
- 4 Korn O, Oñate JC, López R. Anatomy of the Boerhaave syndrome. *Surgery* 2007;141:222–8.
- 5 Heimlich HJ. A life-saving maneuver to prevent food-choking. *JAMA* 1975;234:398–401.
- 6 Tung PH, Law S, Chu KM, *et al.* Gastric rupture after Heimlich maneuver and cardiopulmonary resuscitation. *Hepatogastroenterology* 2001;48:109–11.
- 7 Darke SG, Bloomfield E. Case of complete gastric rupture complicating resuscitation. *BMJ* 1975;3:414–5.
- 8 Barker SJ, Karagianes T. Gastric barotrauma: a case report and theoretical considerations. *Anesth Analg* 1985;64:1026–8.
- 9 Ishikawa T, Miyaishi S, Yamamoto Y, *et al.* Sudden unexpected death due to rupture of the stomach. *Leg Med* 2003;5:60–4.

Copyright 2016 BMJ Publishing Group. All rights reserved. For permission to reuse any of this content visit <http://group.bmj.com/group/rights-licensing/permissions>.
BMJ Case Report Fellows may re-use this article for personal use and teaching without any further permission.

Become a Fellow of BMJ Case Reports today and you can:

- Submit as many cases as you like
- Enjoy fast sympathetic peer review and rapid publication of accepted articles
- Access all the published articles
- Re-use any of the published material for personal use and teaching without further permission

For information on Institutional Fellowships contact consortiasales@bmjgroup.com

Visit casereports.bmj.com for more articles like this and to become a Fellow