Gastric rupture during cardiopulmonary resuscitation

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Gastric rupture following ventilation during cardiopulmonary resuscitation is a rare occurrence. We report two cases of documented gastric rupture plus two additional cases in which the clinical diagnosis of pneumoperitoneum was made and gastric rupture was assumed to be the mechanism. Review of the literature reveals the lesser curvature of the stomach to be the common site of rupture. This complication emphasizes the necessities of correct positioning of the jaw with mouth-to-mouth ventilation and careful assessment of air entry and chest movement following endotracheal intubation.

Key words

CARDIOPULMONARY RESUSCITATION: complication, endotracheal intubation, mouth-to-mouth ventilation.

Effective management of the cardiopulmonary arrest victim includes adequate control of the airway and delivery of oxygen. Techniques employed range from head and neck extension with mouth-to-mouth ventilation to advanced techniques such as endotracheal intubation in association with gas powered oxygen delivery devices.¹ Gastric rupture and pneumoperitoneum associated with these manoeuvres is a rare occurrence. During the past three years, we have seen two cases of gastric rupture during cardiopulmonary resuscitation. In two other cases the clinical presentation was highly suggestive of gastric rupture although confirmation of this complication was lacking.

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Case reports

Case 1

A 75-year-old woman presented to the emergency department with symptoms and signs of an acute brain stem stroke. While awaiting transfer to the ward the patient suffered a cardiopulmonary arrest. Resuscitative measures were instituted. Airway management involved immediate attempts at endotracheal intubation. Initially, the oesophagus was intubated and the patient manually ventilated with a bag-valve unit (resuscitation bag) for approximately 15 seconds. The second attempt at tracheal intubation was successful. During the resuscitation it was noted that the patient's abdomen had become grossly distended and tympanic. Following re-establishment of a stable cardiac rhythm, re-examination of the abdomen confirmed these findings. Chest x-ray revealed air under both diaphragms (Figure 1). A subsequent abdominal x-ray confirmed the massive pneumoperitoneum.

The etiology of the abdominal distention was uncertain. An exploratory laparotomy was postponed because of the severe brain stem lesion. The patient expired 24 hours later. Autopsy findings confirmed the recent mid-brain infarction. Examination of the stomach revealed a full thickness tear on the lesser curvature, close to the cardia.

Case 2

A 78-year-old woman sustained an in-hospital cardiopulmonary arrest. Resuscitative measures were instituted. Initial airway management included mouth-to-mouth ventilation, insertion of an oral airway and manual ventilation with a bag-valve unit and mask. Attempts at endotracheal intubation resulted in intubation of the oesophagus and the patient was manually ventilated for a short period of time before the error was noted and the trachea

FIGURE 1 Chest roentgenogram showing clear lung fields and free air under both diaphragms (case 1).

successfully intubated. Pertinent physical findings following resuscitation included a comatose, severely vasoconstricted patient. The abdomen was grossly distended. An abdominal x-ray showed a large amount of free intraperitoneal air. Exploratory laparotomy was undertaken but the source of the intraperitoneal air could not be determined. Post-operatively the patient progressively deteriorated and died approximately eight hours later.

At autopsy no leak initially could be demonstrated in the gastric mucosa. However, following inflation and direct pressure on the stomach, the site of the tear was found on the lesser curvature of the stomach along the attachment of the lesser omentum, 8 cm below the cardia.

Case 3

A 70-year-old man was admitted to the intensive care unit after sustaining an acute anterior myocardial infarction. Eight hours after admission to hospital the patient had a cardiopulmonary arrest. External cardiac compression and drug therapy was initiated. Endotracheal intubation was attempted

immediately but the oesophagus was intubated twice prior to correct placement of the endotracheal tube in the trachea. Between these attempts an oral airway was inserted with continued ventilation and oxygen delivery by the bag-valve unit. Subsequent to this it was noted that the patient's abdomen had become markedly distended. A naso-gastric tube was passed but no change in the abdominal girth occurred. Percussion of the abdominal wall elicited marked tympany. A large bore IV needle was inserted through the anterior abdominal wall with a resultant dramatic decompression of the abdomen. Resuscitative attempts were unsuccessful. Permission for autopsy was refused. It was presumed that a gastric perforation had occurred.

Case 4

A 57-year-old man suffered an out of hospital cardiopulmonary arrest. External cardiac massage and vigorous mouth-to-mouth resuscitation was begun by lay bystanders. When the emergency medical attendants arrived, marked abdominal distention was noted. An oesophageal obturator airway (EOA) was successfully inserted with the first attempt. On arrival at hospital an endotracheal tube was passed into the trachea and the EOA removed. Attempts were made to decompress the abdomen by inserting a nasogastric tube. When this manoeuvre was unsuccessful, a large bore IV needle was inserted through the anterior abdominal wall with subsequent decompression of the abdomen. The resuscitative attempt was unsuccessful.

No site of the leak in either the stomach or rest of the gastrointestinal tract could be found at autopsy. However, some oedema of the gastric mucosa was noted. There were no fractured ribs, nor was there trauma to any of the abdominal viscera.

In none of these patients were there any attempts at intracardiac injections of drugs.

Discussion

Review of the English literature revealed only ten case reports in adults of whom gastric rupture was documented and one highly suggestive case of gastric rupture, secondary to ventilation during cardiopulmonary resuscitation.²⁻¹² Over half of these followed mouth-to-mouth ventilation. In two patients either a bag-valve mask or gas powered oxygen delivery unit was used.^{11,12} In one patient an oesophageal obturator airway was inserted dur-

ing cardiopulmonary resuscitation.⁹ Whether the balloon on the instrument ruptured or was only partially inflated was not known. Gastric rupture following accidental oesophageal intubation has been previously reported only once.¹⁰ This is somewhat surprising as the commonest cause of faulty technique of tracheal intubation causing cerebral damage or death is placement of the tracheal tube in the oesophagus.¹³ Although one of our patients did not have an autopsy performed and no gastric tear or rupture was demonstrated in another, the clinical presentation of pneumoperitoneum under these circumstances in both patients suggests that rupture of their stomachs did occur. These latter two cases are notable in that the attending physician recognized that a pneumoperitoneum had developed after the insertion of nasogastric tubes into the stomach had failed to decompress the abdomen. Management of the distention involved inserting a large bore IV needle through the anterior abdominal wall.

A second point worth stressing is that initially in Case 2, no leak could be demonstrated in the gastric mucosa. Only after inflating the stomach and applying direct pressure to the stomach was the leak demonstrated. Unfortunately this step was not followed in Case 4 even though oedema along the lesser curvature was noted.

Air enters the stomach during mouth-to-mouth resuscitation when the upper airway is obstructed at the level of the pharynx.^{2,14} The presumed mechanism is due to incorrect positioning and support of the jaw. This necessitates higher inflation pressures. Ruben,¹⁵ investigating paralysed patients during anaesthesia, found that the cardia of the stomach acts as a pressure sensitive valve. Inflation pressures between 15 and 25 cm H₂O will open the cardia in most cases, practically always above 25 cm H₂O. These pressures appear to be easily achieved. The pressure needed to rupture a stomach is not known. Cassebaum noted that in stomachs of cadavers (four to 24 hours post mortem) rupture occurred when intragastric pressures were between 60 and 120 cm H₂O.³ Gastric rupture is possible when gas entry into the stomach is greater than its egress through the pylorus. Distention of the stomach interferes with the valve function of the cardia and pylorus further reducing the volume of gas escaping via these routes.¹⁶ The net effect is a rise in intragastric pressures which

contributes to the formation of mucosal tears and the later rupture of the gastric wall. The same principles would apply to patients in whom the oesophagus is accidentally intubated with an endotracheal tube. The site of rupture is the lesser curvature of the stomach. This area has fewer mucosal folds and is less elastic.⁴ These are thought to be contributing factors.

Although uncommon, this complication emphasizes the caution to be exercised in airway support during cardiopulmonary resuscitation. Lundberg¹⁷ and Anthony¹⁸ recorded ten and twelve per cent incidences, respectively, of gastric lacerations in necropsied patients on whom cardiac resuscitation had been attempted. Thus the potential to rupture may be much higher than expected. Correct positioning of the jaw and avoiding of high inflation pressures with mouth-to-mouth or mask-to-mouth resuscitation is important. Careful assessment of air entry and chest movements following endotracheal intubation will reduce the complications attendant on accidental oesophageal intubation.

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Résumé

La rupture gastrique au cours de manoeuvres de ressuscitation est un phénomène plutôt rare. Nous présentons ici l'observation de deux cas prouvés de rupture gastrique et de deux cas où la présence d'un pneumopéritoine laisse penser qu'il y a eu rupture gastrique sans que celle-ci ait pu être prouvée hors de tout doute. La revue de la littérature sur le sujet nous apprend que la petite courbure de l'estomac est le site privilégié pour ces ruptures. Cette complication souligne encore une fois la nécessité de bien placer la mâchoire pour la ventilation bouche-à-bouche et de vérifier de façon très attentive la position du tube à la suite de l'intubation.