Rigler's sign and the football sign

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Rigler's sign was first described in 1941 by L G Rigler as a new radiological sign for recognising free air in the peritoneal cavity on supine radiograph. The presence of pneumoperitoneum allows free intraperitoneal air to be contrasted with intraluminal gas, accentuating the wall of gas-containing viscera. It is observed in infants and very ill patients where only limited radiographs of the abdomen are possible. The football sign was first described by R E Miller in the 1960s. Seen on supine abdominal radiographs, this describes an oval radiolucency resembling an American football. It is important for the radiologist to recognise the supporting signs of pneumoperitoneum, such as Rigler's sign and the football sign, on supine abdominal radiographs, especially in neonates and infants, where erect chest/abdominal radiographs are not always possible.

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Case history

A 3-day-old premature neonate presented with significant abdominal distension. The patient had a history of a difficult intubation for respiratory distress a few hours prior to this presentation. On clinical examination, the abdomen was significantly distended with absent bowel sounds. A portable supine abdominal radiograph demonstrated the Rigler's and football signs in keeping with a pneumoperitoneum (Fig. 1a). This was confirmed on a lateral decubitus view (Fig. 1b). At surgery, an iatrogenic gastric perforation was repaired.

Signs of pneumoperitoneum

Rigler's sign was first described in 1941 by L G Rigler as a new radiological sign for recognising free air in the peritoneal cavity on supine radiograph.[1] Normally, the mucosal surface of the bowel wall is seen as it is lined by intraluminal gas. The serosal surface of the bowel wall is surrounded by abdominal tissue and not delineated.[2] The presence of pneumoperitoneum allows free intra-peritoneal air to be contrasted with intraluminal gas, accentuating the wall of gas-containing viscera.[3] Both the inner and outer bowel wall are therefore visible; therefore, it is also known as the double-wall sign.[2] It is observed in infants and very ill patients where only limited radiographs of the abdomen are possible.[3] According to some authors, Rigler's sign is present in 14 – 32% of patients with gastro-intestinal perforation.[2] A pseudo-Rigler's sign may be visualised when neighbouring walls of distended bowel loops are outlined by intraluminal gas without any free intra-abdominal air.[2]

The football sign was first described by R E Miller in the 1960s.[5] Seen on supine abdominal radiographs, it describes an oval radiolucency that resembles an American football. The long axis of the football runs supero-inferiorly, with the blunted edges formed by the diaphragm and the pelvic floor.[6] The oval shadow seen in the football sign is due to a large pneumoperitoneum, which distends the peritoneal cavity. The free intraperitoneal air also outlines the falciform ligament which may be seen in the right upper abdomen as a faint linear opacity positioned longitudinally. The vertical opacity of the falciform ligament represents the laces and the remaining abdomen represents the reaming portion of an American football.[7]

The visualisation of the football sign is indicative of a large amount of intraperitoneal air relative to the patient size, while Rigler's sign can be seen with a small amount of intraperitoneal air and is a more sensitive sign for early pneumoperitoneum.[6] As infants are unable to communicate their symptoms, which may result in delayed detection, they commonly present with the football sign, as opposed to adults, with a 2% incidence of the football sign.[6]

Other signs of pneumoperitoneum on supine abdominal film include the doge's cap sign (triangular collection of gas in Morrison's pouch), large area of hyperlucency over the liver shadow, parahepatic air (gas bubble lateral to the right edge of the liver), air outlining the fissure of ligamentum teres and the cupola sign (gas trapped below central tendon of diaphragm).[4]

Causes of pneumoperitoneum in neonates and infants

While there are numerous causes of pneumoperitoneum, gastric perforation is more likely to result in the football sign than small bowel perforation, because gastric perforations are usually associated with release of a larger amount of free air.[6] However, small bowel perforation owing to necrotising enterocolitis is a far more common cause of perforation in South African clinical practice.

A large pneumoperitoneum may not be identified with small bowel perforation or ruptured appendicitis owing to the localised inflammatory process adjacent to the perforation.[6] Causes of neonatal gastro-intestinal perforation include necrotising enterocolitis, bowel obstruction (i.e. malrotation with midgut volvulus, Hirschsprung's disease, meconium ileus or bowel atresia) and inflammatory causes such as gastric or duodenal ulcers.[6] Gastric perforation, as described in our patient, accounts for 10

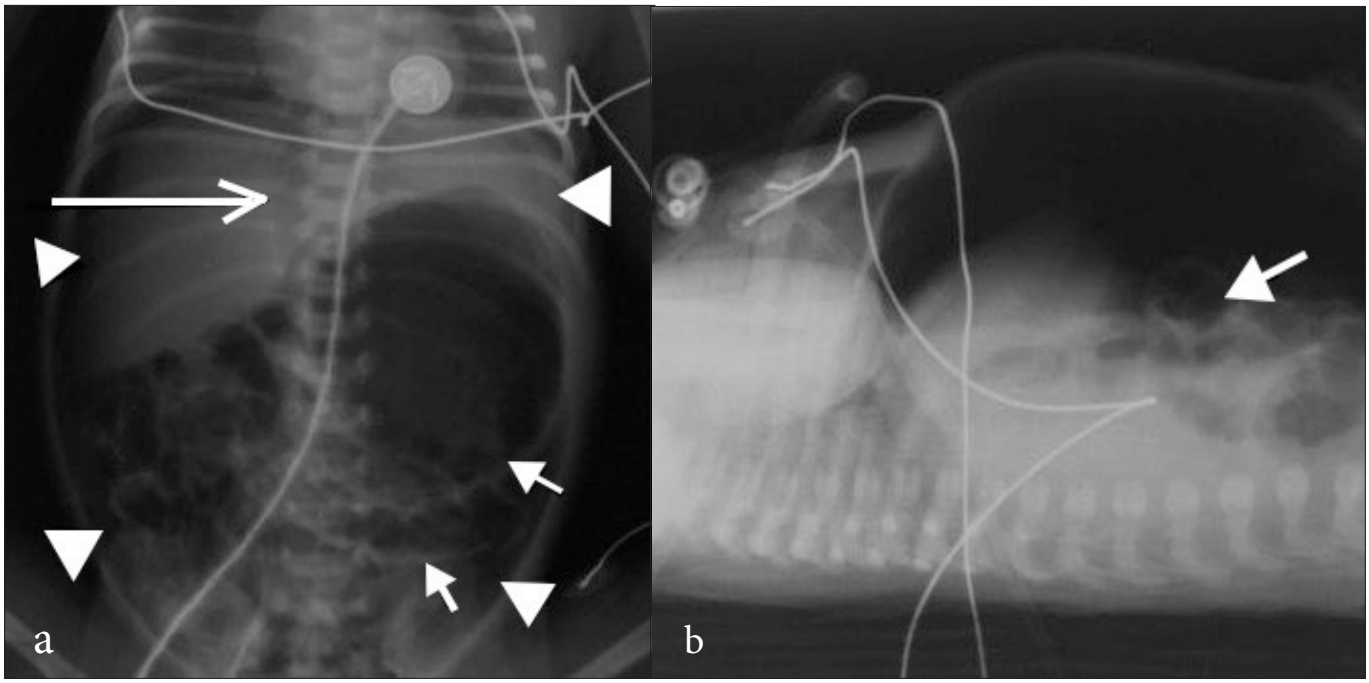

Fig. 1. (a) Supine abdominal radiograph demonstrating Rigler's sign (closed arrows) and the football sign (arrow heads) in a patient with iatrogenic gastric perforation. Rigler's sign is the visualisation of the inner and outer bowel wall owing to pneumoperitoneum, also known as the double-wall sign. The football sign is described as an oval radiolucency owing to pneumoperitoneum that resembles an American football. The vertical opacity of the falciform ligament (open arrow) represents the laces, and the remaining abdomen represents the reaming portion of an American football. (b) The lateral decubitus view confirms the pneumoperitoneum. Note Rigler's sign (closed arrow).

– 16% of all gastro-intestinal perforations in neonates.[8] Traumatic causes secondary to feeding tube placement or vigorous respiratory resuscitation are described.[8,9] Other factors include mechanical pressure by nasogastric or orogastric catheters and excessive gastric distension owing to positive pressure ventilation.[9] Drug-associated perforation has been associated with dexamethasone and indomethacin treatment.[10]

Conclusion

It is important for the radiologist to recognise the supporting signs of pneumoperitoneum such as Rigler's sign and the football sign on supine abdominal radiographs, especially in neonates and infants where erect chest/abdominal radiographs are not always possible.

1. Rigler L. Spontaneous pneumoperitoneum: A roentgenologic sign found in the supine position. Radiology 1941;37: 604-607.
2. Williams N, Everson NW. Radiological confirmation of intraperitoneal free gas. Ann R Coll Surg Engl 1997;79:8-12.
3. Lewicki AM. The Rigler sign and Leo G Rigler. RSNA 2004;233:7-12.
4. Chiu HS, Chung Ch. Pneumoperitonuem on supine abdominal X-ray: case report & review of the radiological signs. Hong Kong Journal of Emergency Medicine 2005;12: 46-49.
5. Miller RE. Perforated viscus in infants: A new roentgen sign. Radiology 1960;74:65-67.
6. Rampton JW. The football sgn. Radiology 2004; 31:81-82.
7. Hull A, Buckley P, Wills B. Massive pneumoperitoneum. Western Journal of Emergency Medicine 2010;11:91-92.
8. Holgersen LO. The aetiology of spontaneous gastric perforation of the newborn: reevaluation. J Pediatr Surg 1981;16:608-613.
9. Aydin M, Zenciroglu A, Hakan N, Erdogan D, Okumus N, Ipek MS. Gastric perforation in an extremely low birth weight infant recovered with percutaneous peritoneal drainage. Turkish Journal of Pediatrics 2011;3:467-470.
10. O'Neil EA, Chwals WJ, O'Shea MD, Turner CS. Dexamethasone treatment during ventilator dependency: possible life-threatening gastrointestinal complications. Arch Dis Child 1992;67:10-11.