Interpretation of the abdominal radiograph: 1

Introduction

Abdominal symptoms are a common presenting complaint in casualty departments and constitute a significant percentage of emergencies. The abdominal radiograph is still the commonest initial imaging investigation to exclude obstruction. Since many conditions may present with abdominal pain a rigorous analysis of the abdominal radiograph is essential to avoid missing important diagnostic radiological signs. This is the first of two articles which provide a systematic approach to interpreting the abdominal film and describe the common emergency conditions requiring abdominal radiographs along with radiological signs.

Interpretation of the abdominal radiograph

Technical factors

Supine film: This is the standard view. The erect chest radiograph (CXR) is an integral part of the assessment of the acute abdomen as it is the most sensitive radiograph for the detection of pneumoperitoneum. An erect abdominal film is hardly ever performed as it seldom adds further diagnostic information to the supine abdomen and erect chest films.

Systematic radiological assessment

The patient's name, date of birth and date on the film should always be checked.

Film quality: The supine abdominal radiograph should include from the diaphragms to the hernial orifices.

The normal abdominal radiograph has a wide variation in normal appearances. The properitoneal line (flank stripe) extends from the lateral liver margin to just below the iliac crest. It is caused by the presence of a thin layer of extraperitoneal fat between the parietal peritoneum and the inner muscle layer (transversalis). The ascending and descending colon is seen in the flanks adjacent to the properitoneal stripes (*Figure 1*).

Calcifications: Inspect for renal tract calculi (90% are radio-opaque), gallstones (10–15% are radio-opaque), pancreatic calcification (*Figure 2*), appendoliths and calcified aortic aneurysms. Renal tract calcification may be caused by calculi, nephrocalcinosis, prostatic calcification, tuberculosis and tumours. Most calcifications are not significant (phleboliths, lymph nodes, arterial walls, fibroids and costal cartilage).

Bowel gas pattern: Gas is normally seen in the stomach (as characteristic gastric rugae) and colon. There are a number of features that can be used to distinguish small from large bowel (*Table 1*). Small amounts of air may be seen in the small bowel which can be distinguished from colon by the presence of valvulae conniventes which cross the whole small bowel loop. Haustral folds of the colon are usually seen extending only across part of the large bowel lumen and are thicker and further apart than valvulae conniventes. Dilatation of the bowel occurs in obstruction, paralytic ileus, ischaemia and inflammatory bowel disease. Look for intramural gas. Linear intramural gas is seen in ischaemic bowel whereas cystic intramural gas is a feature of the benign condition pneumatosis intestinalis.

Ectopic gas: Look for pneumobilia, portal venous gas and gas in the genitourinary tract. Gas may be seen in the gallbladder and urinary bladder in diabetes mellitus as a result of emphysematous infections.

Viscera: The liver, spleen, kidneys and psoas silhouettes may normally be seen as they are silhouetted by fat. Retroperitoneal pathology will result in loss of the psoas silhouette (*Figure 3*).

Pelvic masses and bowel masses: These may be the bladder or gynaecological lesions.

Bones: The lower ribs, lumbar spine and pelvis should be inspected for focal lesions and injury. If fractures are present associated visceral injury to the liver, spleen and kidneys should be excluded.

Rigorous radiological assessment may help to avoid common interpretative errors encountered in casualty (*Table 2*).

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Figure 1. Normal abdominal radiograph with annotations.

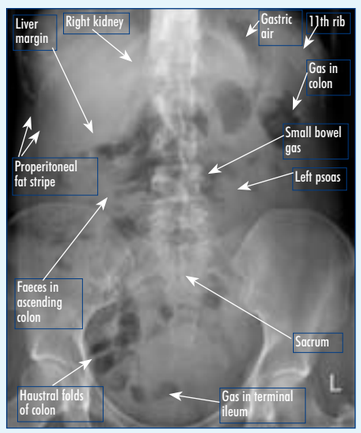

Figure 2. Pancreatic calcification (arrows) is present consistent with chronic pancreatitis.

Table 1. Distinguishing features of the small and large bowel

	Small bowel	Large bowel
Haustra	Absent	Present (maybe absent in sigmoid)
Valvulae conniventes	Present (jejunum)	Absent
Number of loops	Many	Few
Distribution of loops	Central	Peripheral
Radius of curvature	Small	Large
Diameter of loop	2.5–3 cm	5cm +
Solid faeces	Absent	Present

Table 2. Common errors

Wrong patient/date
Erroneous diagnosis of pneumoperitoneum. Conditions which mimic pneumoperitoneum include Chilaiditi syndrome (interposition of colon between the liver and diaphragm), subphrenic abscess, subdiaphragmatic fat, basal curvilinear atelectasis, uneven diaphragm, distended abdominal viscus, subpulmonic pneumothorax and cysts in pneumatosis coli
Mistaking pelvic phleboliths for ureteric stones. Phleboliths have a central lucency surrounded by a radio-opaque halo
Skin lesions or foreign bodies (buttons) mistaken for abdominal lesions
The properitoneal line may be mistaken for a pneumoperitoneum especially in the decubitus position
Calcified costal cartilage or healing rib fracture mistaken for liver lesions, gallstones or renal calculi

Figure 3. There is loss of the normal right psoas outline with an area of increased density over the right flank (arrow) as a result of retroperitoneal haemorrhage in a patient with haemophilia. The normal left psoas silhouette can be seen (arrowheads).

Pneumoperitoneum

The erect CXR is the most sensitive radiograph for the detection of pneumoperitoneum (*Figure 4*). Detectable free gas is seen in 70–90% of perforations. As little as 1 ml of free gas can be detected but the patient should remain in position for 5–10 minutes before taking the CXR to allow any air to rise. If the patient is too ill to allow an erect CXR to be performed then a left lateral decubitus radiograph can be substituted to look for a pneumoperitoneum (*Figures 5a* and *b*). However, it is important to recognize the signs of free intraperitoneal gas on the supine film as the patient may be too ill to obtain other films (*Table 3*) (*Figure 6*).

In about 56% of patients with a pneumoperitoneum the gas may be detectable on a supine film. Approximately 60% of all post-laparotomy patients have evidence of a pneumoperitoneum and this may take up to 24 days to be reabsorbed dependent on body habitus. In the obese patient the gas is more rapidly absorbed and normally there is no residual gas after the fourth postoperative day. An increase in gas postoperatively may indicate an anastomotic leak or perforation.

Figure 4. Pneumoperitoneum with free subdiaphragmatic gas bilaterally.

Bowel obstruction

Dilatation of the bowel is the hallmark of obstruction but also occurs in paralytic ileus, ischaemia and inflammatory bowel disease.

Small bowel obstruction

Small bowel loops are considered dilated when they exceed 3 cm in diameter (*Figure 7*) (*Table 4*). The radiological features of small bowel obstruction include:

- Multiple central dilated small bowel loops 3–5 hours after the onset of obstruction

Figure 5. A 68-year-old woman was admitted with severe epigastric pain. a. The supine abdominal radiograph is unremarkable. b. As there was a high index of suspicion for a perforated viscus a left lateral decubitus film was performed which revealed free intraperitoneal gas lateral to the liver and in the flank (arrows). A perforated duodenal ulcer was found at laparotomy.

Table 3. Signs of free intraperitoneal gas on the supine radiograph

Rigler's sign – air outlining both sides of the bowel wall (*Figure 6*). This usually requires more than a litre of gas
Air outlining the falciform ligament (*Figure 6*)
Inverted 'V' sign – air outlining the umbilical ligaments
Lateral flank sign – air interposed between the colon and properitoneal fat stripe
Football sign – a central collection of gas anterior to loops of bowel
50% of patients with free gas will have a collection of air adjacent to the liver lying in the subhepatic space, parahepatic (gas lateral to right edge of liver) and hepatorenal space (Morison's pouch)
Triangular-shaped gas collections are suspicious of free gas as they do not conform to normal bowel gas patterns
Urachus sign – air outlining the middle umbilical ligament
Cupola or saddlebag sign – gas trapped below the central tendon of diaphragm

- 'Stepladder appearance' in low small bowel obstruction
- Sparse/absent colonic gas in complete small bowel obstruction after 12–24 hours
- Multiple fluid levels on the erect film. This is a non-specific sign occurring in a number of conditions such as ileus, gastroenteritis and ischaemia
- 'String of beads' sign (virtually pathognomonic): this is seen on the erect film and occurs when dilated small bowel loops are almost completely full of fluid and small gas bubbles become trapped between the valvulae conniventes
- Stretch sign: valvulae conniventes completely encircle the bowel lumen.

When the bowel loops are completely fluid filled obstruction may be missed.

Figure 6. Pneumoperitoneum as a result of biopsy-induced perforation of the sigmoid colon. There is free intraperitoneal gas throughout the abdomen seen as gas either side of the large (arrows) and small bowel wall (Rigler's sign). The falciform ligament (open arrows) is outlined by gas. There is also free gas (F) in the subhepatic space outlining the gallbladder and liver.

Large bowel obstruction

The colonic calibre is variable but is dilated when the diameter is greater than 5 cm and the caecum is considered to be dilated when it exceeds 8 cm. The commonest cause of large bowel obstruction is carcinoma (sigmoid or rectosigmoid) (*Figure 8*), followed by diverticular disease and volvulus. In the presence of a competent ileocaecal valve colonic dilatation alone occurs with risk of caecal perforation when >10 cm in diameter. When the ileocaecal valve is incompetent the small bowel also becomes dilated.

Figure 7. There is small bowel obstruction secondary to a strangulated left inguinal hernia (arrow). No gas is seen in the large bowel.

Table 4. Causes of small bowel obstruction in adults

Adhesions (49%)
Hernia (21%) (hernial orifices must be inspected on the film for evidence of soft tissue masses)
Gallstone ileus
Intussusception
Tumour
Volvulus

Pseudo-obstruction

This is a functional disorder that mimics obstruction but no obstructing lesion is present. Causes include electrolyte imbalance, sepsis, drugs, intra-abdominal inflammation, autonomic neuropathy and cardiac failure. A true organic obstruction must be excluded usually by a contrast enema. Perforation may be a complication of this condition.

Ileus

This is a stasis of bowel as a result of a functional abnormality of peristalsis (decreased or absent) with failure of distal propulsion of intestinal contents. An ileus may be localized or generalized. A localized ileus is seen as a persistent dilated segment of bowel adjacent to a focal inflammatory process such as pancreatitis or pyelonephritis. There are a large number of causes (*Table 5*). The degree of dilatation may vary considerably and when generalized cannot be distinguished radiologically from a low large bowel obstruction. The clinical features usually allow differentiation.

Figure 8. There is large bowel obstruction secondary to a distal sigmoid carcinoma. The caecum is markedly dilated and at risk of perforation. There is a small amount of gas in the small bowel indicating a competent ileocaecal valve.

Conclusions

This article provides a systematic approach to the interpretation of the abdominal radiograph. In the next article important emergency conditions that may be diagnosed on abdominal radiographs will be discussed. BJHM

Table 5. Causes of ileus

Pancreatitis
'Pendicitis
Peptic ulcer
Perforation
Postoperative
Peritonitis
Potassium deficiency
Pyelonephritis

Figure 2 *is reproduced with permission from Harvey et al. Radiology. A Casebook for MRCP. Oxford University Press 1999;* Figures 3 *and* 6 *are reproduced with permission from Harvey et al. Self-Assessment Cases in Surgical Imaging. Oxford University Press 2005;* Figure 5 *is reproduced courtesy of Dr William Partridge.*

Further reading

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KEY POINTS

- Always check the name, age and date.
- Assess film quality. The supine abdominal radiograph should include from the diaphragms to the hernial orifices.
- Check for free intraperitoneal gas on erect chest X-ray, supine abdominal film and lateral decubitus view if necessary.
- Analyse the bowel gas pattern. This must always be done with full knowledge of the clinical presentation. Does the bowel gas pattern equate with obstruction, ileus, pseudo-obstruction, ischaemia or inflammatory bowel disease?
- Look for abnormal calcification.
- Look for ectopic gas.

Mammography in symptomatic women attending a rapid diagnosis breast clinic: a prospective audit

Abstract

Objective

The authors undertook an audit to determine whether it is safe to avoid mammograms in a group of symptomatic women with a non-suspicious history and clinical examination.

Method

Symptomatic women aged 35 years or over newly referred to a rapid diagnosis breast clinic had a mammogram on arrival, reported on by a breast radiologist. An experienced clinician, unaware of the mammogram findings, examined the patient and decided whether a mammogram was indicated or not. Mammogram findings were then provided to the clinician and any change in management recorded.

Results

In two thirds (67%) of 218 patients the clinician felt a mammogram was indicated. Half (46%) of these mammograms showed an abnormality, which was malignant in 41%. Among the third (n=71) of mammograms felt not indicated, three showed abnormalities of which two were breast cancer.

Discussion

A significant proportion of patients attending a symptomatic breast clinic have a non-suspicious history and clinical examination. However, avoiding mammograms in this group risks missing clinically occult breast cancers, the incidence of which is 2.8% in this study. This is much higher than that in the screening population as a whole (0.7%).

Conclusion

The safest approach is to offer mammograms to all symptomatic women aged 35 years or over. BJHM

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