Investigation of colonic disease

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Bowel cancer awareness among the general public has heightened in recent years. The promotion of prompt referral and the pressure on early diagnosis will alter our previous strategies on colonic evaluation. This article gives an overview of the colonic investigations currently available.

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The escalation in colorectal referrals has prompted the birth of a new category of clinicians known as the coloproctologists. The advent of colon cancer screening will no doubt induce the growth of colonic investigations, but a sound knowledge of these examinations is prudent to reduce unnecessary testing and duplication. The advent of state-of-the-art scanners, the boom in computer technology and the rapid evolution of software have led to the inception of new colonic investigations. Reconstruction of images in two dimensions, and more recently in three dimensions, may permit a higher level of accuracy to be acquired in the diagnosis of colonic diseases.

TABLE 1.
Common investigations performed on stools

Investigation	Comments
Faecal occult blood (FOB)	Patients with iron deficiency anaemia without any dietary cause or frank bleeding may have an occult bleeding source in the colon, particularly from the right colon, e.g. caecal carcinoma
	Presence of blood can be detected from the stools using various devices, e.g. Haemoccult
	A large multicentre trial has used FOB as a screening tool for colonic cancer (Hardcastle et al, 1996)
Ova and parasites/culture	Although most bacterial enteritis affects the small bowel mucosa, organisms can cause mucosal destruction and mucosa cell deaths of the large intestinal, hence preventing fluid reabsorption
	Microscopy is more useful in detecting protozoan and helminth infections than those of bacterial nature
	Selective culture media (agar) are used to distinguish the pathogens. Broth enrichment can identify specific pathogens
Clostridium difficile and other enterotoxins	Patients with *C. difficile* infection, their clinical states can vary from simple diarrhoea, bleeding and mucus per rectum as in pseudomembranous colitis, to those with toxic megacolon presenting with an acute abdomen
	Toxins (cytotoxin-toxin A and enterotoxin-toxin B) produced by the organisms are present in stools
	Other enterotoxins can also be detected using ELISA techniques

BASIC INVESTIGATIONS

Stools

This is the cheapest and the most traditional test for colonic diseases (*Table 1*). Stools are examined to identify the culprits which cause diarrhoea and confirm the presence or absence of blood.

Abdominal X-rays or plain film of the abdomen

The plain film of the abdomen is an inexpensive and easy means of viewing the abdomen. This modality is used most frequently in the emergency setting to investigate patients with non-specific abdominal complaints and those suspected of bowel obstruction or perforation. Although the radiological signs may not be specific to colonic pathologies, these tests are helpful as first-line investigations. The standard examination is performed supine but additional films can be taken with the patient in an upright (erect) or lateral (decubitus) positions. Fluid can pool within the lumen of the bowel as seen in obstruction, giving an appearance of multiple horizontal air/fluid levels (*Figure 1*).

In patients who are unfit to sit upright or stand, the left lateral decubitus film is the projection that allows a small pneumoperitoneum to be visualized (Levine et al, 1991). Rigler in 1941 described the double wall sign which is indicative of pathological or traumatic perforation of a hollow viscus, although once again it is not specific to the large bowel (*Figure 2*). It is important to interpret some films with caution. Residual air within the peritoneal cavity can be mistaken for bowel perforation, as seen after open or laparoscopic procedures (Draper et al, 1997; Nielsen et al, 1997). The obliteration of fat lines such as the loss of the psoas shadow often

suggests the presence of fluid or inflammatory exudate in these regions, e.g. intraperitoneal fluid in the case of colonic perforation or a psoas abscess secondary to diverticulitis or posterior perforation of colonic tumours.

X-rays are also useful in monitoring the progress of bowel obstruction, whether it is paralytic, mechanical or pseudo-obstruction. The diameter of the caecum or colon can be measured to guide the timing of surgery and prevent colonic perforation in those presenting with large bowel obstruction (Novy et al, 1975). The absence of air in the distal colon and/or rectum is suggestive of proximal obstruction with complete occlusion of the bowel lumen. They can be also used to monitor the transit of ingested radioopaque foreign bodies in the colon or, on rare occasions, diagnose patients who have misplaced a foreign object in their rectum (*Figure 3*).

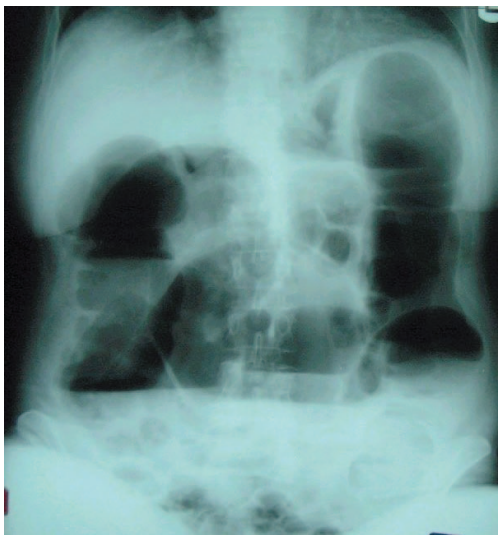

Figure 1. Large bowel obstruction with fluid levels.

Figure 2. Rigler's sign (bowel wall clearly visualized on both sides) as seen in bowel perforation.

CONTRAST STUDIES

Barium enema

This is the commonest study used to identify mucosal lesions of the colon (*Figure 4*). Adequate cleansing of the colon is the most important factor influencing the quality of examinations. Faecal residue could potentially mask colonic lesions and give rise to misinterpretation, colonic polyps being the commonest false positive diagnosis (*Figure 5*). Most regimens involve approximately 48 hours of dietary restriction and purgation. A barium sulphate and water mixture is administered through a rectal catheter by gravity.

In recent times, the double contrast study has superseded the single contrast study as the standard examination of the colon, giving an improved definition of the colonic mucosa (Peterson and Miller, 1978). Barium is allowed to progress to the mid-transverse colon before air is introduced with rotation of the patient, until the whole colon is coated with the media (Rubesin et al, 2000). Spasm of the colon can be overcome by intravenous relaxants.

Infrequently, barium examination is performed per colostomy. However, this necessitates the occlusion of the stoma, which can be achieved internally with the insertion of a Foley catheter.

Figure 3. Foreign object in the rectum.

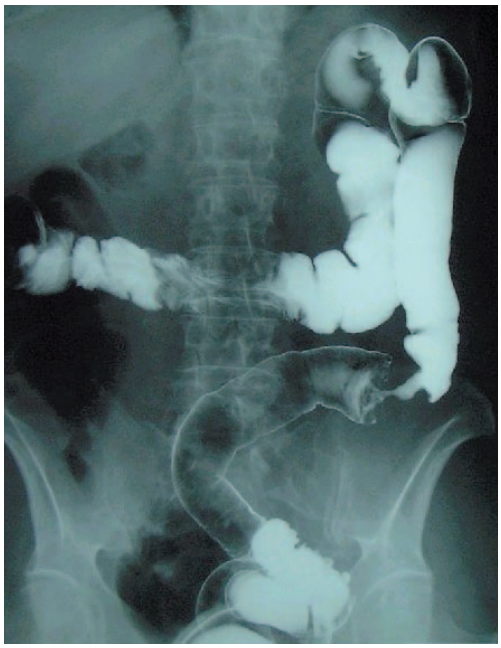

Figure 4. Double contrast barium enema demonstrating three concurrent colonic pathologies — apple core lesion from sigmoid colonic carcinoma, lead-piping from longstanding ulcerative colitis and diverticular disease of the sigmoid.

Gastrograffin enema

Gastrograffin is a water-soluble contrast medium, diluted 1 in 3 with water. It is hyperosmolar and has a tendency to draw fluid into the lumen of the bowel. It is used to check the patency and integrity of bowel anastomoses but the timing of this study is controversial (Akyol et al, 1992). It can also demonstrate the level and extent of large bowel obstruction (*Figure 6*). In patients who present with suspected pathological or iatrogenic perforation of the colon without any gross radiological signs on chest or abdominal X-ray, it is useful in demonstrating the localized or contained perforation which may not necessitate immediate surgical correction (McKee et al, 1993).

Figure 5. Faecal residue mimicking colonic polyps.

SONOGRAPHY AND TOMOGRAPHY

Ultrasound

Sonography is one of the least invasive investigations in detecting colonic problems and their associated complications. It is rapid and non-invasive but its accuracy can be very much operator dependant. It is particularly useful in ascertaining intra-abdominal free fluid (ascites and exudate), fluid collections (haematoma or abscess) and liver metastasis from colonic primary. Inflammatory processes such as appendicitis, acute diverticulitis and diverticular abscesses can also be visualized.

In experienced hands, percutaneous aspiration of peritoneal fluid, placement of drainage catheters into abscess cavities or even biopsy of intraperitoneal masses can be performed. Impalpable colonic lesions can be a surgical dilemma but a report shows that they can be picked up by intraoperative ultrasound (Luck et al, 1999). Per-rectal ultrasound can be used to stage rectal carcinoma, identifying the extent of local invasion including lymphadenopathy in this region (Adams et al, 1999).

Computerized axial tomography

Computed tomography (CT) scanning can be used to stage colonic tumours and may demonstrate tumour invasion into the pericolic fat, encroachment of adjacent structures and lymphadenopathy (*Figure 7*). The lumen of the bowel is usually opacified with oral or rectal contrast medium. Images are taken in slices in a choice of planes and thickness, and reconstruction of these images can be produced. CT is also useful in identifying liver metastasis from colonic primary (sensitivity and specificity

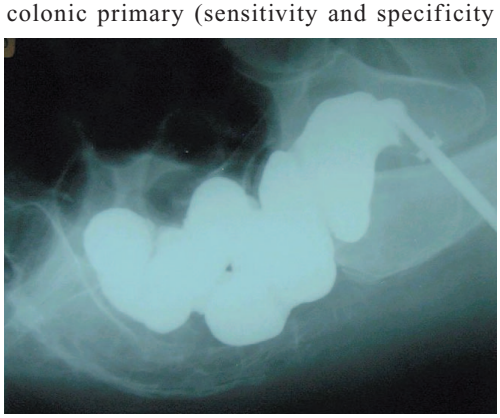

Figure 6. Gastrograffin enema instilled via a rectal tube demonstrating a rectosigmoid junction obstruction.

supersede sonography) and detecting recurrence of tumour in the pelvis following an anterior resection or abdominoperineal resection of a rectal carcinoma (Giess et al, 1998).

In some centres, in the absence of radiological findings on plain films, CT has become the investigation of choice in identifying the source of unknown acute abdominal pain of presumably colonic origin. Demonstration of localized inflammatory disease or a small sealed perforation enables these conditions to be managed conservatively, whereas free intraperitoneal air and fluid may indicate a perforation or a disease entity significant enough to warrant surgical intervention (*Figure 8*). Once again, percutaneous drainage of fluid or biopsy can be performed under the guidance of CT.

ENDOSCOPY

Rigid sigmoidoscopy

This has become the gold standard of outpatient examination, the preliminary investigative tool for colonic complaints. Any patient with anorectal or colorectal symptoms should undergo a rigid sigmoidoscopy examination (*Figure 9*).

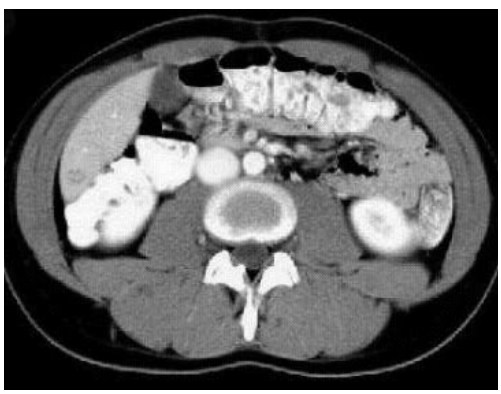

Figure 7. Widespread metastasis from a previously resected colonic primary.

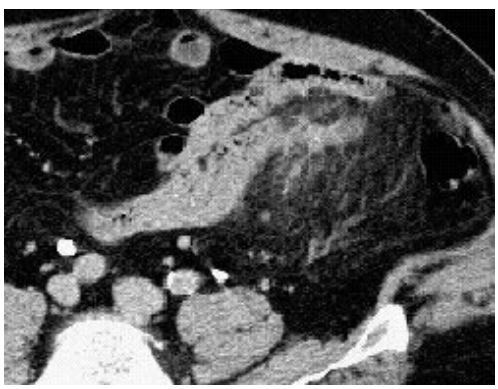

Figure 8. Intraperitoneal free air from perforated sigmoid diverticulum.

Flexible sigmoidoscopy and colonoscopy

These instruments have been modified over the years; the reflective lens technology is replaced by fibreoptics, allowing these tools to acquire their flexible characteristics (*Table 2*). Modern camera and video technology now permit images to be viewed on a monitor rather than from an eyepiece, the older technique of using an adaptor as a teaching piece is no longer required in most centres (*Figures 10a* and *b*). As the number of open-access endoscopy rises, some of these procedures are now performed by specially trained nurse practitioners (Duthrie et al, 1998).

ADVANCED INVESTIGATIONS

Arteriography

Originally, arteriography was used to demonstrate ischaemic disease of the colon, particularly in elderly arteriopaths with chronic abdominal discomfort. Its application in colonic diseases is now restricted to the investigation of acute lower gastrointestinal bleeding of presumably colonic origin (*Figures 11a* and *b*). It is a skilled procedure requiring sedation and infiltration of local anaesthesia to the patient, and its local complications at the site of catheterization can sometimes be devastating.

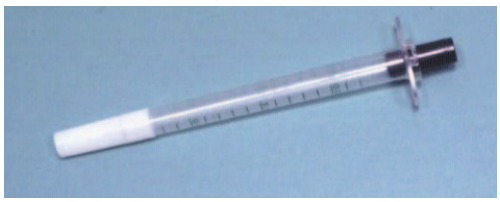

Figure 9. Disposable rigid sigmoidoscope.

TABLE 2.
Different characteristics of rigid and flexible sigmoidoscopy

	Rigid sigmoidoscopy	Flexible sigmoidoscopy
Type	Hollow tube, rigid	Fibreoptic scope, flexible
Length	25 cm	35 cm and 60 cm
Usability	Disposable and reusable	Reusable
Air insufflation	Bellow (hand pump) — via viewing channel	Built-in (air insufflator) — separate channel
Irrigation	No	Yes — separate channel
Attachment	Portable light source and bellow	Stack system with camera, light source and air insufflator (+/- couplet to link to monitor)
Biopsy	Yes — via viewing channel (but results in air leak)	Yes — separate channel
Functions	Mainly diagnostic but polypectomy (piecemeal) is possible	Diagnostic and therapeutic — polypectomy, sclerotherapy, laser coagulation
Cost	Cheap	Moderately expensive
Portability	Easy	Moderate to difficult

It is important to remember that any residual contrast from barium study may render angiography unsatisfactory. In order to demonstrate the site of extravasation, the rate of bleeding has to be 1–2 ml/min or more. Nowadays, radiologists can perform therapeutic embolization of any bleeding vessel under fluoroscopic control (Luchtefeld et al, 2000).

Scintigraphy: radionucleotide imaging

Nuclear imaging plays a lesser role in the investigation of colonic diseases. The emitted radiation demonstrates the uptake, distribution and turnover of the agent within the colon, confirming the physiological abnormalities. Scintigraphic studies of colonic transit using solid particles and liquids are used to confirm idiopathic constipation (Stivland et al, 1991). The radiation exposure is less than half that of radiographic methods using radiopaque markers.

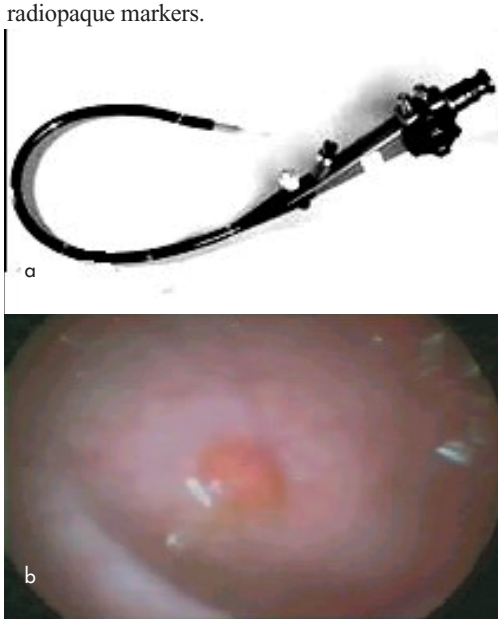

Figure 10. a. Flexible sigmoidoscope. b. Polyp in the ascending colon as viewed from flexible sigmoidoscope.

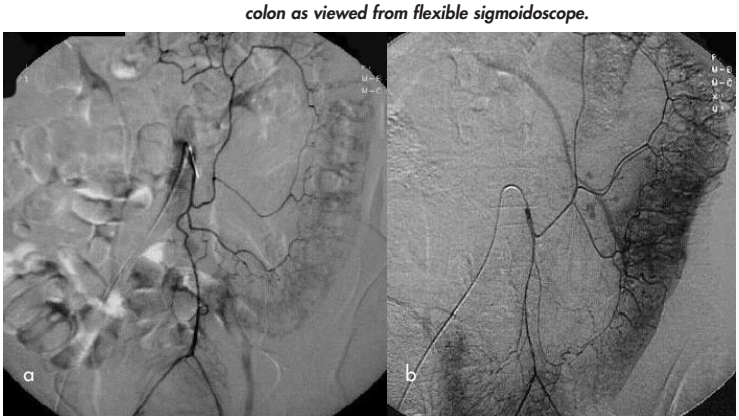

Figure 11. a. Arteriography of the left colon showing cannulation of the inferior mesenteric vessel. b. Arteriography of the left colon showing diverticular disease.

Technetium 99m-labelled colloid or red blood cells are occasionally used for the localization of acute colonic bleeding. The rate of bleeding can be as low as 1 ml/min so long as the patient is actively bleeding during the first few minutes after the injection of the labelled material (Dusold et al, 1994). The presence of abscesses from inflammatory conditions of the large bowel sometimes require confirmation with labelled white cell scans but the anatomical information is probably more accurately obtained by other imaging techniques.

Magnetic resonance imaging

The use of this imaging technique has a number of advantages. It has no ionizing radiation and anatomical images can be generated in multiple planes. The absence of signal from bone eliminates the streak artefacts commonly seen on CT, making this technique particularly useful in pelvic imaging. In cases of rectal neoplasm, information obtained on the degree of local disease can potentially alter the management of these conditions, e.g. neoadjuvant radiotherapy may become necessary before surgical intervention (Kwok et al, 2000). The use of surface and endoanal coils can improve visualization of the pelvic and anorectal anatomy, allowing high or complicated anal fistulae to be identified before treatment.

Defaecating protography

This is a specialized investigation in which interpretation of the findings can be done either in real-time or from a video recording. Barium is mixed to a 'mashed potato' consistency, introduced into the rectum and then the patient is required to defaecate under fluorosocopy. Conditions such as rectal prolapse, rectocoele and anismus can be identified (Agachan et al, 1996). The advent of real-time magnetic resonance imaging permits visualization of other pelvic structures during the process of defaecation, allowing other anomalies to be simultaneously detected without having to put patients through another investigation at a later date (Lamb et al, 2000).

Colonic transit study

Scintigraphy can demonstrate problems in colonic motility including difficulty with evacuation, functional rectosigmoid obstruction and colonic inertia. Another type of transit study involves the patient ingesting a series of radioopaque markers, and plain abdominal films are taken sequentially to follow the paths and rate of progression of these targets (Metcalf et al, 1987).

CONCLUSIONS

The range of investigations for colonic disease is vast. It is not always easy to select an imaging technique without pondering over the advantages and disadvantages of one over another. One must not forget basic investigations before embarking on more advanced procedures, nor must one neglect to discuss with radiological colleagues before making decisions on using expensive examinations that frequently yield equivocal results.

The arrival of new technology permits imaging of an 'imaginary' nature to materialize. Novel reconstruction technique fits in well with an increase in the elderly population. The use of CT pneumocolon is already alleviating the need for invasive investigations to determine the colonic status of the symptomatic aged. Studies on cadeveric colons and resected human colonic specimens will allow us to learn about large bowel reconstruction using various imaging modalities. As we speak, the dawn of the virtual colon is already in the making (*Figure 12*). HM

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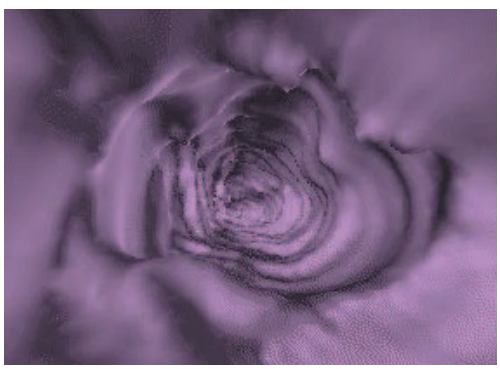

Figure 12. Virtual colon.

KEY POINTS

- The introduction of colon cancer screening will herald an increase in colonic investigations.
- New investigations have arisen as a result of advancement in computer technology, especially in the area of three-dimensional reconstruction.
- Endoscopy has emerged as a leading contender for colonic investigation.
- Basic investigations should not be neglected in favour of those 'in vogue'.
- The choice of investigations is vast but a sound knowledge of each and the collaboration with radiology may alleviate the placement of unnecessary, expensive or repetitive tests.
- Advanced investigations can provide valuable information for diagnostic dilemmas but many of these are restricted to specialist centres.
- Virtual colonic testing may become the non-invasive investigation of choice especially in the elderly population.