PICTORIAL REVIEW

Ultrasound detection of colonic polyps: perspective

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ABSTRACT. Colorectal cancer is often preventable if the precursor adenoma is detected and removed. Although ultrasound is clearly not one of the widely accepted screening techniques, this non-invasive and radiation-free modality is also capable of detecting colonic polyps, both benign and malignant. Such colon lesions may be encountered when not expected, usually during general abdominal sonography. The discovery of large colonic polyps is important and can potentially help reduce the incidence of a common cancer, whereas detection of a malignant polyp at an early stage may result in a curative intervention. This pictorial review highlights our experience of sonographic detection of colonic polyps in 43 adult patients encountered at our institutions over a 2-year period. 4 out of 50 discovered polyps were found to be malignant lesions, 3 polyps were hyperplastic, 1 polyp was a hamartomatous polyp and the rest were benign adenomas. The smallest of the detected polyps was 1.3 cm in diameter, the largest one was 4.0 cm (mean 1.7 cm; median 1.6 cm). In each case, polyps were discovered during a routine abdominal or pelvic examination, particularly when scanning was supplemented by a brief focused sonographic inspection of the colon with a 6–10 MHz linear transducer. In this paper, we illustrate the key sonographic features of different types of commonly encountered colonic polyps in the hope of encouraging more observers to detect these lesions, which may be subtle.

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Colorectal cancer is the second most frequent cause of cancer-related death in North America and western Europe [1]. Each of us is thought to have a 6% chance of developing colorectal carcinoma—yet it is preventable in the majority of individuals if the precursor adenoma is detected and removed [2–5]. Although several screening techniques already exist with varying capability and invasiveness, a large percentage of the population remains unscreened, largely due to poor patient acceptance of routine colorectal screening [6].

Ultrasound is not one of the widely accepted screening techniques for detecting colonic polyps. However, transabdominal ultrasound has been shown to demonstrate benign colonic polyps of significant size in both children and adults, with a reported sensitivity of 28.6% and specificity of 99.4% for detection of polyps greater than 10 mm diameter in the adult population [7, 8]. With the use of hydrocolonic sonography, as described by Limberg, an accuracy of 91% for detection of colonic polyps greater than 7 mm diameter may be achieved [9]. As a screening tool, however, neither conventional nor hydrocolonic ultrasound has gained wide clinical acceptance.

This pictorial review highlights our experience of sonographic detection of 50 colonic polyps in 43 adult patients encountered at our institutions over a 2-year

period (June 2009–June 2011). All polyps were subsequently confirmed by endoscopic removal and histological examination. Four out of fifty discovered polyps were found to be malignant lesions, three polyps were hyperplastic, one polyp was a hamartomatous polyp and the rest were benign adenomas. The smallest of the detected polyps was 1.3 cm in diameter and the largest was 4.0 cm (mean 1.7 cm; median 1.6 cm). In each case, polyps were discovered during a routine abdominal or pelvic examination when scanning was supplemented by a 2–3 min focused sonographic inspection of the colon with a 6–10 MHz linear transducer, as described below. All polyps were an incidental finding identified when the colon was accessible to ultrasound evaluation. This was not a purposeful study to evaluate performance of routine ultrasound in colonic polyp detection and thus endoscopy was not performed to confirm normality. Our intention, with hindsight, was to try and maximise the usefulness of conventional sonography.

Similar to other observers, we found that colonic polyps greater than 1.0 cm diameter can be discovered on conventional ultrasound. We did not use hydrosonography or any special preparation prior to ultrasound. In our experience, the proximal sigmoid and distal descending colon were a frequent site of sonographically detectable polyps because these colon segments were often accessible to ultrasound without any special preparation. However, we also noted that the full length of the colon was not confidently visualised in at least half of our patients, which underlines the inherent limitations

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of conventional ultrasound. The most frequent blind areas of the colon to ultrasound were rectosigmoid, splenic and hepatic flexures, largely because these areas were faecally filled while not amenable to transducer compression owing to their anatomical position.

Nevertheless, detection of a large colonic polyp is clearly important—once a polypoid lesion is discovered, the approach is obvious: endoscopic localisation and removal of the lesion with subsequent histological assessment. Uncovering a polypoid lesion with apparent malignant features will also expeditiously warrant a staging evaluation by CT.

This article aims to illustrate the typical sonographic features of different types of commonly encountered

polyps and to emphasise the potential role of conventional ultrasound in colonic polyp detection.

Morphology

A “polyp” is defined as any macroscopic circumscribed tumour or mucosal elevation that projects above a surrounding flat epithelial surface. Although often used to mean adenoma, the term has no specific histological implication. Polyps smaller than 5 mm diameter are most often inflammatory or metaplastic lesions that have no malignant potential. Medium (6–9 mm) and large (10 mm and more) polypoid lesions

Figure 1. Normal appearances of descending and sigmoid colon. (a) Transverse colour Doppler view of left iliac fossa shows cross-section of empty distal descending colon with minimal air outlining the lumen (open arrow). Three sonographic layers, from outer to inner are muscularis propria (1), submucosa (2) and mucosa (3). The taeniae coli are seen as focal thickening in muscularis propria (arrowheads), as in this individual. (b) Cross-section of semi-filled distal descending colon allows visualisation of anterior wall, whereas posterior wall (open arrow) is obscured. (c) Oblique view of the left iliac fossa shows sigmoid colon (arrows) containing some echogenic but non-shadowing residue hence posterior wall is visible. (d) Coronal extended view image of left lower flank-left iliac fossa shows distal descending (arrowheads) in continuity with sigmoid (arrows) colon.

Figure 2. Normal appearances of caecum and ascending colon. (a) Cross-section of caecum filled with gassy residue allows visualisation of anterior wall (arrowheads); posterior wall is mostly obscured. Note normal appendix (arrow). (b) Transverse view of the right iliac fossa with transducer compression shows nearly empty caecum in cross-section. Taeniae coli are seen as focal thickening in muscularis propria (arrowheads). (c) Longitudinal extended view image of right flank shows ascending colon filled with gassy residue. Haustra (curved arrows) are visualised as echogenic shadowing sacculations alternating with haustral clefts (arrowheads) on the wall next to transducer.

are frequently neoplastic polyps, most often adenomas. Other non-neoplastic polyps that occur in the colon are hamartomatous polyps. Juvenile polyps may be single or multiple, and may be found in children and adults.

Figure 3. A 70-year-old male with colonic diverticulosis. Sonogram of left iliac fossa shows cross-section of sigmoid colon with mildly thickened hypoechoic wall (arrowhead) and diverticulum (arrow).

Hamartomatous polyps are found in the Peutz-Jeghers syndrome and inflammatory polyps in the Cronkhite-Canada syndrome.

Adenomatous polyps are common with the prevalence of 5–10% in asymptomatic individuals older than 40 years of age [3, 4]. Since the risk of malignancy rises with the increase in polyp size, a term “advanced adenoma” has been introduced to emphasise the significance of polyps >10 mm diameter, whereas small polyps (<10 mm) are frequently considered inconsequential [5, 10–11].

Adenomatous polyps are sharply circumscribed, sessile or pedunculated lesions that tend to arise more frequently in the rectosigmoid region, with a similar distribution of carcinomas [12].

Sonographic techniques and normal appearances

Much of the large bowel can be imaged with conventional ultrasound [13]. Small-footprint curvilinear and linear 5–10 MHz transducers are preferred because they can be pressed to the maximum depth, bringing the cross-section of the colon into focus and displacing the faecal residue from the area of interest.

The distal descending colon is recognised due to its fixed position in the left iliac fossa just above the iliac vessels. It is then traced downwards where it continues as a sigmoid colon looping into or away from the pelvis, depending on the sigmoid configuration. The descending colon wall is then followed upwards to the splenic flexure, and further along the transverse and ascending colon, through to the caecum.

The normal colonic wall is usually 3–4 mm in thickness. Visualisation of five wall layers can be achieved under optimal scanning conditions, although three main layers of mucosa, submucosa and muscularis propria are usually seen (Figure 1a) [14]. Focal longitudinal

Figure 4. Appearances of two adenomatous sigmoid polyps with high-grade dysplasia proven histologically. (a) Colour Doppler view of left iliac fossa in 61-year-old male shows a cross-section of sigmoid colon (arrowheads) and 18 mm polyp (curved arrow). (b) Cross-section view of sigmoid colon in 60-year-old male reveals polyp (curved arrow) with convoluted surface outline, which measured 15 mm.

thickening in the muscularis propria, usually three, indicate the taeniae coli (Figure 1).

The appearance of the colon largely depends on its physiological state. When it is empty, the whole circumference of the colonic wall may be seen in detail (Figure 1). In a semi-filled colon, the posterior wall may be partially obscured by the shadowing residue (Figure 2a). In such a case, transducer compression may bring colonic walls in opposition and improve visualisation (Figure 2b). When filled with a large amount of non-compressible stool, the colon is visualised as a continuous haustral pattern with only the wall next to the transducer being visible (Figure 2c). In individuals with diverticulosis, the sigmoid colon is readily seen owing to thickened muscularis propria (Figure 3).

Colonic polyps: sonographic morphology

Direct display of colonic polyps relies on demonstration of a spherical or ovoid hypoechoic lesion arising within colonic lumen (Figure 4). The hallmark for sonographic identification, in our experience, is the presence of demonstrable vascularity within such a lesion on Doppler.

When visible, colonic polyps usually lend themselves well to evaluation. On close inspection with a 6–10 MHz linear array transducer, surprisingly detailed views of the polypoid lesions can be achieved (Figure 5). The polyp pedicle is visualised as a prolongation of the mucosa, with a submucosal muscularis layer connecting the head of the polyp to the colonic wall (Figure 5d). Feeding vessels may also be seen. Adenomatous polyps may have smooth, or slightly convoluted, or lobular surface contour.

Even when the colonic lumen contains some echogenic residue, the polyps may be conspicuous owing to their low reflectivity (Figure 6). Echogenic faecal residue may also be moved away from the polyp by gentle compression with the transducer, which will improve visualisation.

Sessile polyps may be recognised when the lesion lies closely related to the colonic wall. Differentiation between pedunculated, sessile and flat polyps, however, is difficult unless the vascular stalk is readily visualised. When vascularity within the lesion is uncertain on inspection with colour Doppler, spectral Doppler analysis can confirm the presence of true vasculature (Figure 7). When no vascularity within the lesion is identified, then constant position, shape and size of such a lesion throughout the examination may suggest a polyp (Figure 8). Clearly, the observed lesion is unlikely to represent a polyp if it is avascular on Doppler and has moved with the transducer compression or in the course of the examination.

Discovery of a colonic polyp in a young individual will usually call for a targeted work-up for a polyposis syndrome. Hamartomatous polyps, classically associated with Peutz-Jeghers polyposis syndrome, may occasionally occur as isolated lesions (Figure 9).

Inflammatory polyps represent areas of elevated inflamed or normal mucosa. These may be sessile or pedunculated and are usually seen in patients with inflammatory disorders of the colon such as ulcerative colitis, Crohn's disease and dysenteric colitis. The term "pseudopolyp" is sometimes used to emphasise the non-neoplastic aetiology of these lesions [15]. Inflammatory polyps are similar to mucosa in echotexture, and thus recognised as extensions of the

(a)

(b)

(c)

(d)

Figure 5. A 55-year-old male with two confirmed benign adenomas in sigmoid colon. (a) Coronal extended-view image of left flank–iliac fossa shows distal descending (black arrowheads) and proximal sigmoid colon (white arrowheads) with polyp consisting of head (curved arrow), which measured 20 mm, and pedicle (black arrow). (b) The same polyp (curved arrow) seen in cross-section of colon (arrowheads). (c) 19 mm second polyp in the sigmoid colon with internal vascularity demonstrated by colour flow Doppler. (d) Close inspection of the second polyp discloses head with convoluted contour (curved arrow) and pedicle (open arrowheads), which is seen as prolongation of echogenic submucosa with a hypoechoic stripe of submucosal muscularis extending from colonic wall (arrowheads) to polyp head. Note feeding vessels in pedicle.

mucosa (Figure 10). Other changes indicating inflammatory bowel disease are usually present aiding differentiation.

Lipomas are also seen as intraluminal polypoid lesion, but can be recognised on ultrasound owing to their characteristic echogenic appearance.

The presence of malignancy may not be possible to estimate on ultrasound due to lack of reliable features. However, an apparent loss of wall stratification at the base of a large sessile polypoid lesion can suggest a carcinoma (Figure 11). The presence of a gas pocket retained within a large polyp indicates ulceration and is

Figure 6. Two benign adenomatous pedunculated sigmoid polyps in a 65-year-old female. (a, b) Left iliac fossa sonograms show two different polyps (curved arrows) with pedicles (black arrows) outlined with echogenic residue (F) within lumen of colon (arrowheads) seen in cross-sections. Each polyp measured 13 mm in diameter.

usually seen in malignant lesions (Figure 12). Detection of these features may warrant further CT investigation in addition to flexible sigmoidoscopy or colonoscopy.

Potential pitfalls

Several pitfalls that may lead to false-positive findings should be kept in mind when imaging the colon with ultrasound. These, in our experience, may be related to

several factors, including a deficient scanning technique (such as tangential imaging), peculiar appearance of the colon owing to prominent convergent and bulbous haustral folds, presence of undigested food pieces and foreign bodies, and impacted diverticulum.

Tangential ultrasound imaging of the colonic wall in transverse plane, particularly in the areas of haustral folds, often results in false polypoid projections, which may be confusing (Figure 13a,b). This pitfall is avoided by multiplanar scanning of the colon with liberal

Figure 7. Appearances of 23 mm sigmoid polyp that proved to be villous adenoma harbouring intramucosal carcinoma in an asymptomatic 67-year-old female. (a) Oblique colour Doppler view of sigmoid colon (arrowheads) in left iliac fossa depicts intraluminal lesion (open arrow) with probable vascularity. (b) Spectral Doppler analysis of colour signal in the same lesion (open arrow) confirms presence of arterial flow.

Figure 8. 60-year-old male with adenomatous polyp in ascending colon. Longitudinal image of right flank shows 15-mm polyp as hypoechoic lesion with undulating outline (curved arrow) outlined by echogenic residue underneath anterior wall of colon (arrowheads). The lesion maintained constant position, shape and size throughout the examination, although no colour Doppler signal was detected.

transducer angulations that allow obtaining three-dimensional information.

Care should be taken not to confuse bulbous and complex haustral folds with polyps when the colon is imaged in longitudinal plane (Figure 13c). The linear, elongated nature of folds will aid differentiation in that circumstance. Another pitfall is to visualise a focal bulge in the colonic wall in cross-section that is present owing

Figure 9. A 24-year-old female investigated for suspected ovarian cyst. Transverse colour Doppler view of paraumbilical area depicts 13-mm hypoechoic vascular polyp (curved arrow) underneath anterior wall (arrowheads) of transverse colon. Opposite colonic wall (arrows) is seen posterior to polyp and over the aorta (A). The lesion proved to be a single hamartomatous polyp, and no other gastrointestinal polyps were found with targeted studies. The patient did not have any relevant family history, but was found to have characteristic mucocutaneous pigmentations, which suggested occult Peutz-Jeghers syndrome.

to prominent taenia coli imaged during their contraction (Figure 14a).

Fragments of undigested food, pills or capsules and other foreign bodies may be occasionally encountered in the colon, but these are identified owing to their

(a)

(b)

Figure 10. A 55-year-old male with ulcerative colitis. (a) Cross-section of distal descending colon shows thickened mucosa and prominent mucosal projection (curved arrow) suggesting inflammatory polyp. (b) Extended-view image of lower left flank shows longitudinal section of the same descending colon, with corresponding mucosal elevation (curved arrow). A useful differentiating feature is found by observing that echotexture of “pseudo polyp” is similar to that of thickened mucosa.

Figure 11. Sagittal sonogram of right upper quadrant in a 60-year-old asymptomatic male reveals 4.0 cm broad-based intraluminal mass (open arrow) in transverse colon shown in cross-section (arrowheads). Note loss of stratification and indistinct outline in colonic wall underlying base of polypoid mass (arrows), which suggests invasion through muscularis propria. Subsequent CT suggested T3 (modified Dukes B2) stage of the disease and surgical resection confirmed transverse colon adenocarcinoma penetrating into subserosal fat.

mobility, lack of vasculature and peculiar geometry, incompatible with that of polyps. The use of graded compression whereby the anterior and posterior walls of

the bowel are opposed is helpful in displacing faeces and foreign bodies. A polyp may be reliably differentiated from faeces by the presence of continuation of mucosa and echogenic submucosa connecting the head of the polyp to the colonic wall (Figure 5d). The presence of a vascularised pedicle is also confirmatory of a polyp. In addition tiny cysts may be seen in the head of the polyp corresponding histologically to glands containing mucus [7].

Impacted diverticulae can be a potential source of confusion when they bulge prominently into the colonic lumen, but are readily recognised on ultrasound owing to the presence of trapped gas and inspissated stool (Figure 14b).

Fortunately, pitfalls leading to false-positives are usually avoided with careful technique. We did not encounter any false positive studies, which is in line with other observers reporting very high specificity of 99.4% for colonic polyp detection [7, 8]. Of course, low sensitivity for detection of colonic polyps is a weakness of conventional ultrasound. Perhaps future advances in ultrasound imaging may someday permit this radiation-free non-invasive modality to play a much greater role in this area of colorectal imaging.

Conclusion

When integrated into routine scanning, brief sonographic examination of the accessible colon can reveal unsuspected large colonic polyps, which appear as spherical or ovoid, well-defined hypoechoic lesions

(a)

(b)

Figure 12. A 60-year-old male with unsuspected colonic carcinoma. (a) Sagittal epigastric view depicts a 3.0 cm polypoid lesion (asterisk) containing ulceration seen as a pocket of gas (open arrow) in transverse colon (arrowheads). The full circumference of the colonic wall muscularis propria is well visualised (arrowheads). (b) Analysis of the lesion with colour Doppler reveals abundant vascularity reinforcing suspicion that the lesion is malignant. Subsequent CT suggested T2 (modified Dukes B1) stage of the local disease. Polypoid adenocarcinoma in transverse colon invading muscularis propria was confirmed at histological examination.

Figure 13. Potential pitfalls. (a) Cross-section of distal descending colon shows broad-based polypoid projection (arrow), which may be mistaken for plaque-like polypoid lesion. (b) Longitudinal view of the same colonic segment with the probe now rotated at the right angle demonstrates that the lesion in (a) is in fact not real but the result of tangential imaging of steep haustral fold (arrow). Cross-sectional image in (a) was made through the plane indicated by the arrow. (c) Longitudinal coronal view of the distal descending colon shows prominent bulbous haustral fold (arrow), which may simulate small polyp.

within colonic lumen. Demonstration of vascularity within such lesions on Doppler is confirmatory. This may maximise the usefulness of conventional ultrasound

and potentially help reduce the incidence of a common cancer since colonic polyps may harbour an early carcinoma or lead to malignancy.

Figure 14. Potential pitfalls. (a) Cross-section of proximal sigmoid colon shows focal bulge in colonic wall (arrow), which is due to prominent taenia coli. (b) Cross-section of proximal sigmoid colon in a different patient shows two impacted diverticulæ (arrows) containing echogenic shadowing stool.

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