

Seminars in NUCLEAR MEDICINE

Imaging of Gastrointestinal Bleeding: An Update



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Imaging of gastrointestinal bleeding crucial in the diagnosis of occult gastrointestinal bleeding. Gastrointestinal bleeding scintigraphy is a well-established study to aid localisation of gastrointestinal bleeding site. This article discusses about the use of gastrointestinal bleeding scintigraphy in its current practice with emphasis on radiopharmaceutical, imaging techniques, interpretation and pitfalls. There is also discussion on the use of Single Photon Emission Computed Tomography-Computed Tomography (SPECT-CT) within this method of scintigraphy. Meckel's diverticulum is known to be a frequent source of bleeding, mainly in children. It is also know that nuclear medicine imaging can help with Meckel's diverticulum identification. This article also discusses about the technique, imaging, interpretation and SPECT-CT usage for Meckel's diverticulum imaging. Semin Nucl Med 53:766-776 Crown Copyright © 2023 Published by Elsevier Inc. All rights

G astrointestinal bleeding can be a life-threatening emergency which needs early identification of the site of bleeding. It is estimated to result in an annual hospitalization rate of approximately 25 per 100,000 in the United States.¹ Gastrointestinal bleeding may occur from either the upper or lower gastrointestinal tract. Upper gastrointestinal bleeding is classified as bleeding source from a site proximal to the ligament of Treitz whilst lower gastrointestinal bleeding occurs when the site of bleeding is distal to the ligament of Treitz. Gastrointestinal bleeding can also be classified as obscure or occult when the site of bleeding is unknown. Upper gastrointestinal bleeding can normally be diagnosed with upper gastrointestinal endoscopy. However, it can be sometimes difficult to distinguish between upper or lower gastrointestinal bleeding based on clinical history and examination.

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Gastrointestinal bleeding scintigraphy is a noninvasive test that is normally performed in patients with suspected occult gastrointestinal bleeding. As occult gastrointestinal bleeding is normally intermittent, scintigraphy provides the possibility of continuous monitoring to localize the site of bleeding throughout the entire gastrointestinal tract. Based on the

Address reprint requests to Chen Sheng Low, MBChB, MSc, MD, MRCP, FRCR, University Hospitals Coventry and Warwickshire NHS Trust, Clifford Bridge Road, Coventry, CV2 2DX, United Kingdom. Tel: +44 2476964000. E-mail: chenlow@doctors.org.uk Society of Nuclear Medicine and Molecular Imaging (SNMMI) and European Association of Nuclear Medicine (EANM) guidelines, the goal of scintigraphy is to determine if patient is actively bleeding, to localize the bleeding bowel segment and to estimate the rate of blood loss.² Gastrointestinal scintigraphy can detect bleeding at low flow rates (0.04 mL/min in an animal model), which is a distinct advantage over angiography which only detects bleeding with a minimal blood flow rate of 0.5-1 mL/min.³⁻⁴

The gastrointestinal bleeding scintigraphy was originally described in 1977 by Alavi et al. based on the method using ^{99m}Tc-sulfure colloid.⁵ Miskowiak et al. have also described the use of ^{99m}Tc-human serum albumin in 1977 for gastrointestinal bleeding scintigraphy.⁶ It was only in 1979 when Winzelberg et al. demonstrated the use of ^{99m}Tc-erythrocytes for gastrointestinal bleeding scintigraphy.⁷

Radiopharmaceuticals for Gastrointestinal Bleeding Scintigraphy

99mTc-Sulfur Colloid

First radiopharmaceutical to be used for gastrointestinal bleeding scintigraphy.⁵ It has a short circulating half-life of 3 min and demonstrate quick extraction by the reticuloendothelial

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system (liver, spleen and bone marrow).⁸ ^{99m}Tc-sulfur colloid extravasates into the bowel lumen at the site of active hemorrhage following intravenous injection. There is good target to background ratio due to increasing intraluminal activity from each recirculation and rapid extraction of the radiopharmaceutical by reticuloendothelial cells. The study is normally performed in approximately 30 min. Unfortunately, the disadvantage of this method is that patient must be actively bleeding at the time of study. There is also limitation in evaluation of both hepatic and splenic flexures due to high uptake within liver and spleen.

On the contrary however, ^{99m}Tc-sulfur colloid has the advantage of early detection of acute bleeding due to the high extraction rate. This can be useful in patients demonstrating active gastrointestinal bleeding at presentation to the emergency department whereby early imaging would be beneficial. In such a situation, ^{99m}Tc-sulfur colloid becomes a suitable radiopharmaceutical as the imaging can be acquired within 30 minutes with good results.

^{99m}Tc-Labelled Red Blood Cells

It is currently the most commonly used method. It is important to label red blood cells with ^{99m}Tc pertechnetate with high efficiency to produce optimal and artifact free images. There are 3 methods available in labelling red blood cells:

- 1. In Vivo method: The technique involved the injection of stannous pyrophosphate intravenously which is then followed by 99mTc pertechnetate injection 15 minutes later. The 99mTc intracellularly is reduced by stannous ion which then binds to hemoglobin. The labelling yield is at best 75%. Therefore, the presence of free 99mTc pertechnetate may degrade image quality. It is however a rapid and simple to administer method.
- 2. Modified In Vivo (In Vitro) method: This is first performed with stannous pyrophosphate being injected intravenously. After 15 mins, 3-5 mL of blood is then withdrawn through the intravenous line into a lead-shield syringe which contains 99mTc pertechnetate with a small amount of anticoagulant. The syringe is then agitated gently for 10 minutes before reinjecting the contents back into the patient. The labelling efficiency is 85%.
- 3. In Vitro method: Previously, this method involves drawing of patient's blood, centrifuging and the radiolabeling of the red blood cells before reinjecting into the patient. Currently, this technique can be performed with a commercial kit which uses patient's whole blood and do not need centrifugation. The patient's blood is added to the reaction vial which contains stannous chloride within that diffuses across the red blood cells membrane. 99mTc pertechnetate is then added to the vial and mixture is then injected into the patient after 20 mins of incubation. This method also prevents extracellular reduction of 99mTc pertechnetate, hence ensuring only red blood cell radiolabeling. This method has the advantage of high labelling efficiency of 98% although it is more expensive.

Both in vivo and modified in vivo methods labelling can be affected by various drugs such as heparin, chemotherapy, methyldopa, calcium channel blocker, iodinated contrast material and quinidine to name a few, although this list is not exhaustive. There are also other factors which can affect poor ^{99m}Tc-red cell labelling, such as presence of circulating antibodies, too much or too little stannous ion, too short of interval to allow penetration of stannous into red blood cells, too short of incubation time and also presence of carrier for ^{99m}Tc.

Other Radiopharmaceuticals

^{99m}Tc-labelled albumin is one of the earliest intravascular agents used for gastrointestinal bleeding scintigraphy which has been taken over by more reliable labelling techniques.^{6,9} ^{99m}Tc-labelled heat-damaged red blood cells have also been used.¹⁰ Alternatively, ¹¹¹In (Indium) labelled red blood cells have also been used to increase the imaging time due to increased half-life of ¹¹¹In.^{11,12} Unfortunately, these techniques are disadvantage by the increased cost and radiation burden, therefore not widely used.¹³

^{99m}Tc-labelled red blood cells have been found to be the preferred method over ^{99m}Tc-sulfur colloids to the other remaining radiopharmaceuticals described above. A prospective multicenter study involving 100 patients demonstrated an increased sensitivity of using ^{99m}Tc-labelled red blood cells with 38 patients found to have bleeding sites compared to only 5 patients imaged with ^{99m}Tc-sulfure colloid.¹⁴ This study showed a sensitivity of 95%, specificity of 93% and overall accuracy of 94% for ^{99m}Tc-labelled red blood cells compared to ^{99m}Tc-sulfur colloid which demonstrates only a sensitivity of 12%, specificity of 100% and overall accuracy of 62%. There are also other studies which demonstrated the superiority of using ^{99m}Tc-labelled red blood cells.¹⁵⁻¹⁶

Ponzo and colleagues however have demonstrated similar efficacy between ^{99m}Tc-sulfur colloid and ^{99m}Tc-labelled red blood cells in detection of lower gastrointestinal bleeding sites when scanning time is limited to 1 hour.¹⁷ They have suggested that ^{99m}Tc-sulfur colloid is a simpler and cost-effective method.

Imaging Method

Planar imaging acquisition remains the most common imaging method for gastrointestinal bleeding scintigraphy.² This is normally performed in supine position with anterior images of the abdomen and pelvis acquired. A minimum image matric of 128×128 is recommended.

The initial imaging is known as the angiographic phase which consists of rapid image acquisition at a rate of 1 frame per 1-3 s for 60s. This is performed in order to visualize distribution of vascular structures which can help to differentiate between bleeding and blood pool activity.

Dynamic imaging should then be performed after the angiographic phase. The recommended frame rate should not exceed 1 frame per 60s. This is to reduce the temporal resolution to minimize inaccuracy in detecting the source of



Figure 1 (A) Normal tracer distribution on the dynamic images for 99mTc-labelled red blood cells scintigraphy.

(B) Normal tracer distribution on the delayed images for 99mTc-labelled red blood cells scintigraphy at 1-6 hours at 1-hour interval and at 24-hour.

bleeding. A frame rate of 1 frame per 10-20s allows better localization of the gastrointestinal bleeding site due to rapid bowel peristalsis and movement of blood from bleeding site.¹⁸ On the contrary, slow gastrointestinal bleeding will be difficult to identify on fast frame rates and this can be overcome by reformatting acquired studies into longer frames.¹⁹ Initial imaging for a minimum of 60 mins is usually recommended if no gastrointestinal bleeding is identified.²⁰⁻²²

When no bleeding site is identified up to 60 or 90 mins, delayed static images are usually required, typically up to 24 hours at certain time intervals, such as at 2-hour, 4-hour, 6-hour and 24-hour after injection.²³⁻²⁵

Image Interpretation and Pitfalls

Prior to interpretation of the gastrointestinal bleeding scintigraphy using ^{99m}Tc-labelled red blood cells, the normal distribution of the tracer within cardiac blood pool, vasculature, liver, spleen as well as within kidneys and urinary bladder should be understood (Fig 1).

The diagnosis of gastrointestinal bleeding should fulfil 4 criteria⁸:

- Focus of extravascular activity should start in the region where there was no abnormal activity before.
- Should increase in intensity over time.
- Should move either in an antegrade or retrograde direction.
- Should conform to the bowel.

It is normally feasible to distinguish between small bowel and large bowel bleeding. Small bowel bleeding normally demonstrates a rapid curvilinear movement and usually within the central abdomen or pelvis. Large bowel bleeding on the other hand, has a more linear pattern and typically drapes around the periphery of the abdomen (Fig 2 – demonstrating bleeding within the transverse colon), although it can also demonstrate S-shaped pattern in the central pelvis which conforms to the rectosigmoid colon shape. The origin of the site of the gastrointestinal bleeding should be reported as the location of the initial site of detected activity rather than the most intense, largest, or most proximal site of activity.

There have been numerous reported interpretation pitfalls within the literature. Free ^{99m}Tc pertechnetate is a common pitfall which demonstrates uptake within active gastric mucosa (Fig 3). It can also move from stomach to small bowel over time. However, the presence of activity within thyroid and salivary glands should indicate the presence of free ^{99m}Tc pertechnetate, hence indicative of imaging artefact.

Activity within the kidneys and urinary tract are normally static throughout the image acquisition. It can be confusing if there are ectopic kidney, pelvic kidney or presence of a transplanted kidney (Fig 4). In addition, previous urinary tract surgery, such as presence of urinary diversion with ileal conduit can also cause misinterpretation. Therefore, prior information on anatomical variant or previous surgery should be obtained to avoid reporting errors.

Other reported potential pitfalls include accessary spleen,²⁶ unexpected rupture of spleen,²⁷ bleeding around peritoneal dialysis catheter in abdominal²⁸ wall as well as



Figure 2 Positive gastrointestinal bleeding scintigraph study with tracer seen within the large bowel (arrows) only on the 24-hour images.

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Figure 3 Physiological uptake (arrow) within the gastric mucosa due to free 99mTc pertechnetate seen even on the early images and persisted towards the end of the study with no changes in intensity and distribution.



Figure 4 Uptake seen in the right iliac fossa (arrow) seen throughout the study with no changes is consistent with activity with the transplanted kidney.

gluteal haematoma.²⁹ Abdominal varices can also mimic acute gastrointestinal bleeding.³⁰⁻³¹ There have also been reported pitfalls from uptake in other structures or pathologies which reduces specificity such as left ovarian vein,³² dilated abdominal aorta,³³ ischaemic bowel,³⁴ hepatic haemangioma,³⁵ diverticular abscess and uterine leiomyoma.³⁶ Recent bowel or other abdominal surgery can also demonstrate prominent activity related to post-operative hyperaemia.

Single Photon Emission Computed Tomography–Computed Tomography (SPECT and/or SPECT-CT)

SPECT-CT provides the opportunity to increase the sensitivity and the specificity of the study, similar to the usage of SPECT-CT in all other aspects of nuclear medicine. SPECT itself is known to increase contrast resolution over conventional planar imaging and hence the ability to detect even smaller volume of gastrointestinal bleeding.

Schialli et al. demonstrated more precise interpretation on SPECT-CT when compared to SPECT images on a wide variety of conditions, of which 2 patients within the series are for gastrointestinal bleeding scintigraphy.³⁷ Subsequent study from Schialli et al. demonstrated a positive impact on 7 of 19 patients (36.8%) with gastrointestinal bleeding using SPECT-CT to precisely localize the site of hemorrhage, whereby 6 of the patients, the bleeding site could not be identified on planar imaging.³⁸

Soyluoğlu et al have evaluated the use of SPECT-CT for gastrointestinal bleeding patients, particularly in previously operated patients and demonstrated good utilization and potentially guide the surgeon through more accurate localisation.³⁹ Otomi et al. have compared the imaging of gastrointestinal bleeding between planar, planar + SPECT and planar + SPECT-CT acquisition.⁴⁰ They demonstrated that planar + SPECT-CT imaging has the highest diagnostic ability in detecting the site of gastrointestinal bleeding.

Similarly, SPECT-CT can also help to distinguish abnormal activity within the abdomen which may be due to vasculature variant or abnormal physiology from true gastrointestinal occult bleeding. This is well-depicted on Fig 5 which demonstrated activity within abdominal varices due to know liver cirrhosis and portal hypertension.

Summary

Gastrointestinal bleeding scintigraphy, mainly with ^{99m}Tclabelled red blood cells technique remained an important imaging modality to detect site of bleeding during investigation of occult gastrointestinal bleeding, although the technique as remained similar over the decades. It still has an important role in well-selected patients for assessment of gastrointestinal bleeding. The addition of SPECT and SPECT-CT has demonstrated improved sensitivity and specificity of the technique with greater accuracy. Although a few radiopharmaceutical tracers have been utilized, ^{99m}Tc-labelled red blood cells remain the most widely accepted tracer for imaging with good success. ^{99m}Tc-sulfur colloid scintigraphy can be considered in certain situations as an alternative to ^{99m}Tc-labelled red blood cells.

New gamma camera design such as the 3-dimensional solid-state SPECT-CT gamma camera enabling dynamic SPECT acquisition may further enhance the utility in gastro-intestinal bleeding scintigraphy and further research is awaited.

Meckel's Diverticulum

Meckel's diverticulum is one of the most common congenital anomalies of the gastrointestinal tract, occurring in approximately 2% of the population, although several studies quantify this between 0.14 and 4.5%.⁴¹⁻⁴⁵ It occurs due to the incomplete obliteration of the vitelline intestinal duct during early embryonic development. This represents a true diverticulum containing all three layers of the gastrointestinal tract and can reliably be located on the antimesenteric border of the distal ileum, 90 cm from the terminal ileum in 90% of case.⁴⁶ Although often asymptomatic, not unlike diverticula seen elsewhere in the colon, this can lead to various complications, including intestinal obstruction, inflammation, and gastrointestinal bleeding. Although acute gastrointestinal hemorrhage from Meckel's can occur in adults, it is more common in children.⁴⁷ Hemorrhage often occurs due to peptic ulcerations and subsequent bleeding from ectopic gastric mucosa in 10%-60% of cases.⁴⁸⁻⁵¹ This can clinically manifest as a spectrum from asymptomatic anemia and iron deficiency to acute hypovolaemic shock. This section covers the former presentations, the latter being more amenable to Red Cell labelling or more drastic interventions, including explorative laparotomy.

Scintigraphy plays a crucial role, and utilizing Technetium-99m pertechnetate has proven to be highly accurate in diagnosing Meckel's diverticulum, with reported sensitivities of 85% and specificity of 95% and overall accuracy of 90% in pediatric cohorts.⁵² The sensitivity falls to 63% and specificity to 9% in adults.⁵¹ Free pertechnetate has a Chloride like effect, secreted by both parietal and mucin-secreting cells.⁸ This fact is exploited for preoperative localization as a Meckel's scan is performed to detect ectopic gastric tissue instead of a labelled red blood cell (RBC) study, utilized when active bleeding localization is required.²

Technique

Although not vital, fasting 3-4 hours before injecting/scanning can improve sensitivity and reduce gastric mucosal activity/uptake.



Figure 5 (A) Increased activity is seen at the central of the abdomen (arrow) in the early dynamic images and persisted towards the end of the study with no change.

5B, 5C. SPECT-CT was performed in this patient with axial and coronal images demonstrated the central abdominal focal activity corresponds to blood activity within dilated varices (arrow) as this patient is known to have liver cirrhosis. (Color version of figure is available online.)

Stopping medications or avoiding procedures that cause gastric stimulation or irritation is common, ideally 2-3 days before scanning.² Some of these include procedures such as endoscopy or colonoscopies which directly cause mucosal irritation and increase local uptake of Pertechnetate. Medications such as enemas or cathartics equally should be avoided 2-3 days before the study.⁵³

Potassium perchlorate, used to block thyroid uptake, can also block gastric mucosal uptake in both native and ectopic tissue.⁸ It is therefore advisable that thyroid block-ade should be avoided to facilitate washout from physiological thyroid uptake and hence helps to reduce localized thyroid dose.⁵³

It should be noted that Stannous ions from cold pyrophosphate in vivo RBC labelling can decrease sensitivity as freeroaming ^{99m}Tc-pertechnetate will bind preferentially to these as opposed to the native or ectopic gastric mucosa.

Any recent barium studies can cause attenuation artefact and should be avoided 3-4 days before the scan.

To improve sensitivity, the addition of Histamine H2 blockers (such as Cimetidine) or Proton pump inhibitors can be utilised to reduce secretions from native gastric parietal cells.⁵⁴⁻⁵⁷

Glucagon has been used to reduce small bowel motility by relaxing intestinal smooth muscle, and hence transit of any secreted pertechnetate, reducing small bowel activity that may hinder interpretation.^{52,58-61}

Pediatric dosage calculated from the 2012 North American consensus guidelines is 1.85 MBq/kg (0.05 mCi/kg)^{99m}Tc-pertechnetate (minimal dosage 9.25 MBq (0.25 mCi/kg)).

The adult dose is 300 Mbq (8 mCi - range 300 to 400Mbq (8-12 mCi).⁶²

Image Acquisition

As ^{99m}Tc-pertechnetate is renally excreted, the bladder should be voided prior to starting the study.

The patient is supine, with a large field of view (FOV), adapted for patient size. A gamma Camera with low energy, a high-resolution collimator is used, centered over the right lower abdomen to include both the xiphisternum and pubic symphysis to ensure adequate coverage.

 128×128 matrix with photopeak at 140 keV.

At our institution, we acquire dynamic planar images over 2 minutes over 30 minutes. This can be extended to 60 minutes if high clinical suspicion remains.² Static oblique or lateral images can be obtained if there are diagnostic queries from artefactual activity, particularly renal, bladder or small bowel.

Consideration for SPECT / SPECT-CT

Single photon emission computed tomography-CT (SPECT-CT) has been utilized to gain a more diagnostically accurate localization of gastric mucosal activity. This provides better anatomical detail and helps distinguish artefactual activity from Meckel's diverticulum. This can be especially beneficial for scenarios such as ectopic or pelvic kidneys. In a study by Liu et al., whilst sensitivity for detection was approximately the same (91.67%), specificity and accuracy were improved using the combined technique.⁶³ There is limited evidence for using SPECT CT in negative studies, particularly since the radiation dose cannot be justified. On average, for example in the pediatric population, 99mTc pertechnetate would cause an effective dose of less than 0.05 mSv. The addition of low-dose CT, often used for attenuation correction as well as localization, would add an additional 2 mSv. In contrast, a standard dose CT would cause much higher exposures between 10-20 mSv.⁶⁴

Interpretation

Knowledge of the normal distribution of ^{99m}Tc-pertechnetate can avoid misinterpretation. Typical distribution sites include cardiac, pulmonary, hepatic, and splenic activity (Fig 6). The former two are not necessarily in the FOV, but the latter two can be visualized. Some of the measures described previously can reduce stomach activity; however, excretion through the renal tract can hamper interpretation. Activity in the diverticulum tends to have a similar temporal relation to stomach activity, maximally around 10-15 minutes,² albeit to varying degrees of intensity depending on the amount of gastric mucosa present within (Fig 7). This focal nature often helps differentiate pathological activity, particularly when localized to the right iliac fossa, from other structures. The diagnosis can be uncertain when ureteric activity,

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Figure 6 Normal distribution of Meckel's scintigraphy demonstrating physiological activity within liver (Li), heart (H), veins(V) and within lungs (Lu).



Figure 7 Positive Meckel's scintigraphy study with uptake within the Meckel's diverticulum (solid arrow) seen at the same time as uptake within stomach mucosa (dash arrow).

due to inherent peristalsis or an ectopic/pelvic kidney, can mimic pathology. Secreted activity in the small bowel tends to occur more slowly but can still produce a diagnostic dilemma. Utilizing multiplanar views or SPECT-CT can diminish doubt; renal tract structures are located more posteriorly within the abdominal cavity.⁶⁵

Limitations

False positive and negative results occur either to overlaying physiological activity, anatomical variants, or various pathological conditions.

As noted above, physiological activity in the renal tract can lead to misinterpretation. If no previous imaging is available, certain conditions can also lead to false positives, including ectopic or pelvic kidneys, extra renal pelvises, vesicoureteral reflux, or an obstructed renal tract.⁶⁶⁻⁶⁷

Physiological vascular activity should produce a predictable pattern of progressive activity within the aorta and major branches distally. However, certain vascular anomalies such as arteriovenous malformations, haemangiomata and highly vascular tumors can produce false positive results.⁶⁷

False positive results can be attributed to ectopic gastric mucosa produced in other locations within the gastrointestinal tract and solid organs such as the pancreas, small bowel, and lower esophagus, specifically within Barret's epithelium.⁸

Tumors of the GI tract can produce similar results, including carcinoid tumors and lymphoma of the small bowel.⁶⁸ Colonic pathology, both inflammatory and neoplastic, can lead to false positives, including colonic cancer, inflammatory bowel disease (Crohn's, ulcerative colitis), inflammation in the upper or lower GI tract and obstruction. Appendicitis, also being in the right iliac fossa, can be challenging to interpret; however, the clinical presentation of acute periumbilical pain radiating to the iliac fossa with associated symptoms should not cloud the clinical picture.

False negatives can be attributed to poor patient selection and preparation, such as no appreciable or insufficient quantities of gastric mucosal cells in the diverticulum or increased gastric motility.⁶⁹

Other Modalities

Meckel's scans have lower accuracy and sensitivity in adult patients compared to the pediatric population.⁵¹ This has been ascribed to the dilution effects of rapid bleeding, inadequate or insufficient gastric mucosal cells, and local or systemic vascular compromise.⁵⁵ Other modalities may be more beneficial in these scenarios, including CT and/or fluoroscopic angiography and capsule endoscopy.

Angiographic studies can detect bleeding rates of >0.5 ml/min and have the advantage of detecting sites of hemorrhage and other vascular pathology, as well as the ability to perform therapeutic procedures in the same sitting to control the hemorrhage.⁷⁰

Capsule endoscopy (CE) directly visualizes endoluminal bleeding but is an entirely passive procedure based on gut motility, and visualization may be obscured by the rapid bleeding rates.⁷¹ Capsules can become lodged within the diverticula or impeded by strictures. However, these are usually avoided by pre-emptive 'patency capsules', which dissolve in pooled luminal secretions if there are strictures and hold up.

A promising technique is a Balloon assisted enteroscopy (BAE), which involves retrograde intubation of the distal small bowel to depths of up to 150 cm. It should be sufficient to demonstrate most Meckel's diverticula, given their predictable length of 90 cm.⁷² Hong et al. report diagnostic accuracies of up to 85% (95% CI, 61.1-96.0%) and diagnostic yields of 95% (95% CI, 73.1-99.7%) when compared to Meckel's scan (21.4% and 21.4% respectively) and capsule endoscopy (35.7% and 78.6%).⁷³

Summary

Patient preparation is critical in improving the sensitivity and diagnostic accuracy of demonstrating Meckel's Diverticulum.

Patients presenting with gastrointestinal hemorrhage and subsequently undergoing nondiagnostic upper and lower gastrointestinal endoscopy should have an investigation of the small bowel to locate a source. In pediatric patients, a Meckel's Diverticulum would be high on the clinical index of suspicion, and hence a Meckel's scan would be appropriate. Planar imaging in various positions may be utilized to improve diagnostic clarity. SPECT CT can be reserved for challenging cases, given the increased radiation burden and may be more beneficial in adults where important differential diagnoses may present concurrently.

Although Meckel's scans can still have a role in adults, they are less sensitive and accurate due to the multiple factors described. Other modalities, such as conventional CT/CT angiography, are considerations. Novel techniques such as capsule endoscopy and BAE are also becoming more available in the arsenal of diagnostic tools to complement a thorough history and examination, ultimately leading to timely diagnosis and treatment.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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