



Research article

Bleeding meckel's diverticulum: A study of the accuracy of pertechnetate scintigraphy as a diagnostic tool



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ABSTRACT

Background: The reported accuracy of pertechnetate scintigraphy (Meckel scan) in investigating children with a bleeding Meckel's diverticulum has increased steadily since it was first introduced into clinical practice in 1970. Recent studies have indicated that the examination has a sensitivity of up to 94% and a specificity of up to 97% in this scenario. There have also been several misleading reviews from Departments of Surgery, suggesting that the Meckel scan has a poor predictive value, and should not be relied upon to exclude a bleeding Meckel's Diverticulum (MD).

Objective: The aim of this study was to assess the accuracy of pertechnetate scintigraphy performed at Our Lady's Hospital for Sick Children, Crumlin (OLCHC) on children with clinical suspicion of a bleeding MD.

Method: This was a retrospective study of all the Meckel scans performed over a 10 year period (2005–2015) in OLCHC, 144 in total.

Results: Of the total 144 scans performed, 22 were considered to be positive, and all patients were found to have a MD at surgery. 122 were negative, and in 53 of these patients, an alternative cause for symptoms was found, often at endoscopy. In the remaining 69 patients, no cause was found, despite full medical work-up. In all of these cases, symptoms resolved, and have not yet recurred, making MD very unlikely.

Discussion: Pertechnetate scintigraphy, when performed using meticulous technique, can provide up to 100% sensitivity CI [85.1, 100.0] and 100% specificity CI [93.2, 100.0] in diagnosing a bleeding MD in a paediatric population. This examination is seldom of value in children with no history of rectal bleeding.

1. Introduction

Meckel's Diverticulum was first described by Johann Meckel in 1812. It is a vestigial remnant of the omphalomesenteric duct. Also known as the vitelline duct, this provides nutrition to the embryo in the early stages of gestation, and connects the midgut to the yolk sac. It is usually obliterated around week 6 of gestation, but its incomplete breakdown leaves an outpouching in the bowel wall. It is the most common gastrointestinal congenital anomaly, occurring in 2–3% [1] of the population. It is found on the antimesenteric border of the small bowel, within 100 cm of the ileocaecal valve.

Most cases of MD remain asymptomatic throughout life, and are encountered as an incidental finding during abdominal surgery. However complications do occur in approximately 15% of cases, including haemorrhage, obstruction, diverticulitis and perforation. Haemorrhage is usually due to the presence of ectopic gastric mucosa within the MD, which causes ulceration of the bowel wall and results in rectal bleeding and/or anaemia. In 50% of cases this occurs within the

first 2 years of life.

Pertechnetate scintigraphy (Meckel scan) is performed when there is clinical suspicion of bleeding from a MD. It is a non-invasive examination with a low radiation burden. Intravenous Technetium-99m pertechnetate is taken up by the mucoid cells of gastric mucosa, and subsequently excreted into the bowel lumen. Normal uptake is seen in the stomach, and to a lesser extent in the proximal small bowel. Activity is excreted mainly through the renal tract, but also through the bowel. In cases of a bleeding MD, a focus of abnormal uptake is usually visualised in the right lower abdomen, which occurs in synchrony with the normal gastric uptake, and does not change in appearance on sequential images.

Abnormal uptake can also be seen in other conditions, such as duplication cysts containing ectopic gastric mucosa, angiodysplasia, intussusception, or inflammatory bowel disease. However, the uptake in a bleeding MD is characteristically more focal and intense (Fig. 1).

The aim of this study was to assess the accuracy of Meckel scans performed at OLCHC on children with clinical suspicion of a bleeding

Abbreviations: MD, meckel's diverticulum; OLCHC, our Lady's Hospital for Sick Children, Crumlin

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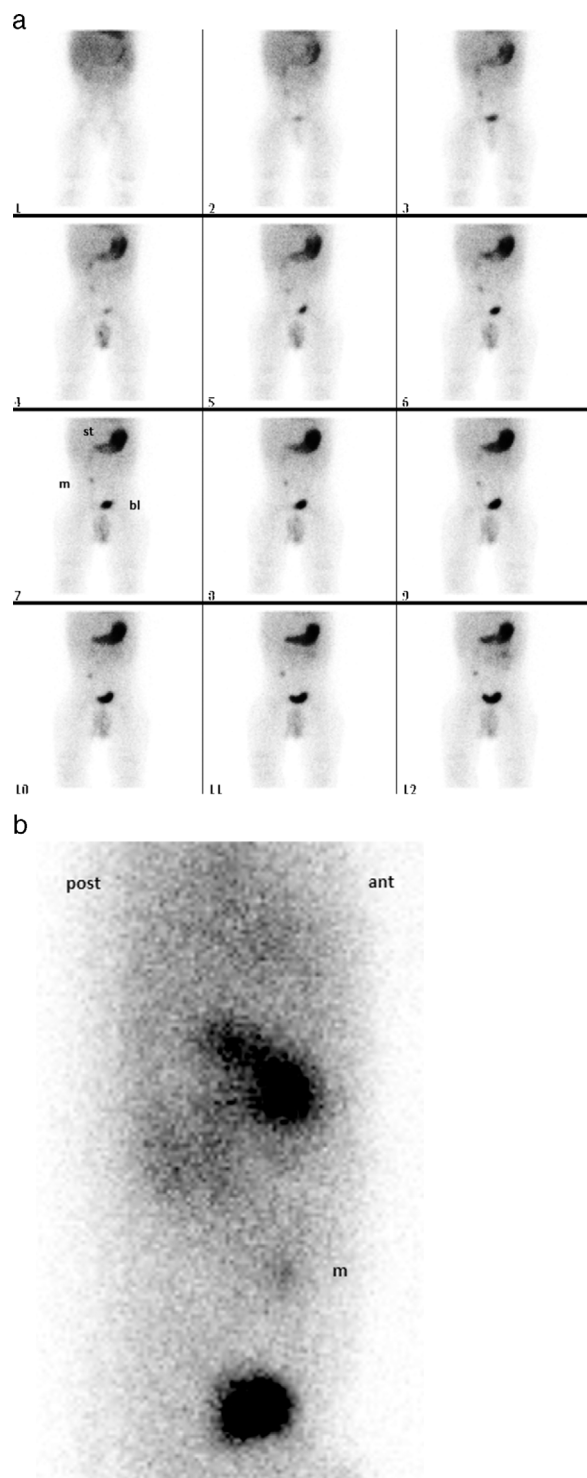


Fig. 1. (a) Positive Meckel scan (anterior image) with a well-defined focus of abnormal uptake in right lower abdomen, which appeared at the same time as the stomach, and remained unchanged on subsequent images. St = stomach, bl = bladder, m = Meckel's diverticulum. (b) Meckel's diverticulum is projected in the anterior abdomen. Post = posterior, ant = anterior.

MD.

2. Method

This was a retrospective review of all the Meckel scans performed in OLCHC over a 10 year period (2005–2015). No cases were excluded from the study. We reviewed the examination requests and imaging

findings, and classified these as either positive or negative for a bleeding MD. We also gathered data from medical charts, including endoscopic and surgical findings, and any relevant haematology and histopathology reports. We recorded various parameters, including age, gender, symptoms and haemoglobin level. We calculated the confidence intervals using the Wilson interval.

The majority of referrals were from paediatric gastroenterologists. As OLCHC is the national centre for paediatric gastroenterology, many of these patients had been referred to the gastroenterology team by paediatricians from all over Ireland. There were also several referrals from paediatric surgeons.

All examinations were performed according to the OLCHC practice guidelines. All scans were interpreted by one of two Consultant Radiologists with experience in nuclear medicine imaging. Patients were not scanned while actively bleeding, as abnormal uptake can be washed out during active haemorrhage. Patients received pre-medication with a H2-receptor antagonist for 24 hours prior to the scan. We currently use Ranitidine, with the dose adjusted to the child's weight, and administered in 2 divided doses. Children were kept fasting for 3 hours prior to scanning, in order to reduce the size of the stomach. We do not use a thyroid-blocking agent such as Potassium perchlorate, as this could interfere with uptake by the ectopic gastric mucosa. Tc-99m pertechnetate was administered intravenously, and an anterior planar image of the abdomen and pelvis was obtained immediately and every 5 min for a period of 45 min. Scan parameters included 350 K counts for each image, a 256 × 256 matrix, with age-appropriate zoom, using a low-energy general purpose collimator. A lateral image was also obtained to aid in localizing activity to a renal pelvis, with a further anterior image following micturition where there was concern that abnormal uptake might be obscured by a full bladder.

There have been several publications in recent medical literature discussing the value of SPECT/CT in Meckel scanning [2–4]. The fused images facilitate the precise anatomic location of a focus of uptake. This can reduce the number of false-positive Meckel scans due to activity in the urinary track or vascular anomalies adjacent to bowel loops. In negative examinations it can potentially reveal other causes for abdominal pain and bleeding. We are currently prospectively studying the benefits of using SPECT/CT in the paediatric population.

3. Results

A total of 144 examinations were performed during the 10 year period: there were 87 boys (60%) and 57 girls (40%). Their ages ranged from 0 to 16 years, with a mean age of 4.82 years. 22 children (15.3%) had positive scans, and 122 (84.7%) were negative, of whom 4 showed a vague area of abnormal uptake, which was not felt to be typical for a MD (Fig. 2). Therefore these children were not automatically referred for explorative surgery. Although their scans were not considered to be positive, 2 of these patients subsequently underwent laparoscopy for investigation of ongoing symptoms, and neither was found to have a MD. Following further investigation, 3 of these patients were found to have *Campylobacter* colitis, Crohn's disease and anal fissure respectively. In the fourth patient, no diagnosis was reached and symptoms resolved.

All patients with a positive scan went on to have either laparoscopy or laparotomy. These were all found to have a MD, which was excised. All 22 cases contained gastric mucosa on histology and 2 also contained pancreatic tissue. In this group there were no false positive cases.

Among the 122 patients with negative scans, an alternative diagnosis was reached in 53 patients following further investigations, including endoscopy (Table 1).

In the remaining 69 patients, despite extensive medical investigation, no diagnosis was made. However, in all these cases the symptoms resolved. We reviewed these charts up to the present day, in order to ensure that symptoms had not recurred. There was no evidence of symptom recurrence during a follow-up period which ranged from

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