ABSTRACT

Objective: To determine the feasibility of hepatobiliary iminodiacetic acid in the evaluation of small bowel obstruction in adults.

Patients and Methods: This was a pilot study of the feasibility of technetium 99m hepatobiliary iminodiacetic acid in the evaluation of small bowel obstruction. A total of 8 patients clinically suspected to have small bowel obstruction were recruited in this study from November 2002 to July 2004. Correlation with water-soluble follow-through study and clinical outcome of the patients was evaluated.

Results: A total of 8 patients had hepatobiliary iminodiacetic acid scan for small bowel obstruction; 5 patients had follow-through examination. Of 4 patients with delayed small bowel transit time shown on small bowel hepatobiliary iminodiacetic acid scan, 3 had surgery with the final operative diagnosis of gallstone ileus or intestinal adhesions and 1 was too frail for operation (with the intestinal obstruction diagnosed on small bowel hepatobiliary iminodiacetic acid scan only), but responded to conservative treatment. Four patients had normal small bowel transit time and were managed conservatively with uneventful clinical outcome.

Conclusions: Preliminary results show that hepatobiliary iminodiacetic acid study is feasible in the evaluation of small bowel obstruction in adults. The initial results are promising, correlating with those of the follow-through study. In selected patients, hepatobiliary iminodiacetic acid small bowel transit scan can potentially serve as an alternative to follow-through in the investigation of small bowel obstruction.

Key Words: Intestinal obstruction, Radionuclide imaging, Tc-99m diethylidode-HIDA

INTRODUCTION

Small bowel obstruction is a common surgical emergency, which is divided broadly into mechanical obstruction and small bowel ileus. Small bowel follow-through has proven a useful tool in the management of patients with small bowel obstruction, but has important drawbacks, including poor patient tolerability of the large oral volume and a risk of aspiration of contrast material.

Hepatobiliary iminodiacetic acid (HIDA) scan is traditionally used to evaluate the hepatobiliary system. The tracer is entrapped by hepatocytes and excreted into the biliary system and eventually into the small bowel, thereby making it a potential agent to study small bowel transit.1

This study sought to determine the feasibility of HIDA scan in the evaluation of small bowel obstruction in addition to the traditional water-soluble contrast follow-through study.

PATIENTS AND METHODS

This was a pilot study of patients admitted to the surgical unit with acute small bowel obstruction over a period of 20 months starting in November 2002. Exclusion criteria of the study included: patients with peritonitis; patients with irreducible hernia; patients with rapid resolution of signs and symptoms within 4 hour of hospital admission; patients with terminal malignancy or peritoneal carcinomatosis; patients who develop small bowel obstruction during their hospital admission for other abdominal surgery; and patients with known biliary obstruction or severe hepatic dysfunction.

All patients had written consent for both HIDA scan and water-soluble contrast follow-through examination. A total of 8 patients (3 females, 5 males) were included...
in the study, of age range 58 to 89 years (median 79 years), and 5 (63%) of them had a history of previous abdominal operation.

**Small Bowel HIDA Scan**
All patients were fasted for more than 6 hours for suspected acute small bowel obstruction. 5 mCi technetium 99m mebrofenin was injected intravenously. Anterior planar imaging was done in 128 x 128 matrix size using low-energy high-resolution parallel collimator with 1.33 magnification factor. Immediate postinjection anterior planar dynamic acquisition in 1 frame per minute was done for 60 minutes. Delayed examination was carried out only if satisfactory biliary excretion into the duodenum occurred. Delayed supine planar images were acquired after 1, 2 and 4 hours. Further delayed images could be acquired if the radiologist was uncertain whether the endpoint of the study had been reached. The starting point of the transit time was defined as radioactivity appearing in the second part of the duodenum, which was identified visually as 2 times the background scintigraphic activity. The transit time ending point was determined as the caecal or right-sided colonic activity. The transit time was considered to be prolonged if it was more than 4 hours.

**Water-soluble Contrast Follow-through Examination**
Water-soluble contrast follow-through examination was used for correlation which was performed on the same day as the small bowel HIDA scan. The follow-through study was done by oral intake or Ryle’s tube infusion of 200-300 mL water-soluble contrast solution (e.g., Gastrografin). An initial control abdominal radiograph was taken followed by serial films up to 4 hours.

**RESULTS**
A total of 8 patients had HIDA scan for small bowel obstruction. Five patients had follow-through examination for correlation. Three patients either refused at the time of follow-through examination or were unable to tolerate the follow-through study.

Four patients with delayed small bowel transit time shown on small bowel HIDA scan (among which 2 patients had correlating follow-through study which showed concurring result), 3 had surgery with the final operative diagnosis of gallstone ileus (n = 1) [Figure 1] and intestinal adhesions (n = 2) [Figures 2 and 3]; 1 was too frail for operation, with the intestinal obstruction responding to conservative treatment (Table 1).

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**Figure 1.** An 81-year-old lady with multiple medical problems presented with abdominal distension and repeated vomiting. (a) Abdominal radiographs reveal dilated proximal small bowel. (b) Hepatobiliary iminodiacetic acid scan clearly demonstrated tracer accumulation in the proximal small bowel with lack of distal small bowel and colonic activity, which exactly correlated with markedly dilated loops of jejunum shown on small bowel follow-through study. This patient was diagnosed to have gallstone ileus at operation with a gallstone impacted at the mid-jejunum causing obstruction.
Four patients had normal small bowel transit time and were managed conservatively with uneventful clinical outcome (Figure 4).

**DISCUSSION**

Small bowel follow-through has been tried with success in the management of patients with small bowel obstruction. It could differentiate mechanical obstruction from paralytic ileus and in some instances it could even give clues to the underlying etiology of the obstruction. However, it suffers from a number of disadvantages, namely poor patient tolerance of large volume of oral contrast even if the contrast was introduced through a nasogastric catheter. In the presence of obstruction, contrast introduced may induce vomiting and aspiration of hyperosmolar contrast which is notorious to cause pulmonary oedema. In addition, the gastric emptying of patients was unpredictable. The quality of the follow-through images may not be satisfactory due to dilutional effect by small bowel content.

Our study confirms that the HIDA tracer is not affected by water-soluble contrast given simultaneously or any significant dilution by intestinal fluid. In addition, the background is relatively clear, as it was not obscured by other body structures. Although the anatomical

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<th>Table 1. Outcome of hepatobiliary iminodiacetic acid (HIDA) scan in patients with small bowel obstruction.</th>
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<td><strong>HIDA</strong></td>
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<td>Prolonged transit time (&gt;4 hours)</td>
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<td>Normal bowel transit (&lt;4 hours)</td>
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Figure 4. An 81-year-old patient who had palliative bypass surgery performed for carcinoma of the pancreas. Hepatobiliary iminodiacetic acid scan showed initial tracer activity in the small bowel at the centre of the abdomen, which progressed to the ileal and caecal activities at the right lower quadrant of the abdomen at 4 hours. A further 21-hour delay scan was performed to confirm the presence of colonic tracer activity. The patient was managed conservatively with an uneventful recovery.

detail provided by the HIDA scan is less informative than that by follow-through study, the main purpose of small bowel obstruction evaluation is to determine any significant obstruction and this can be confidently achieved by HIDA scan with comparable result shown on corresponding follow-through study.

In conclusion, HIDA small bowel transit scan is a safe procedure in patients with small bowel obstruction and is free of the potential risk of contrast aspiration. The image quality is not affected by any dilutional effect of intestinal fluid or underlying bony structures. Although our study is of a small series and not all patients have follow-through study for correlation, the initial results are promising, correlating well with follow through study. In selected groups of patients; e.g., those known to have repeated aspirations, gastro-oesophageal reflux, or unable to tolerate oral contrast, HIDA small bowel transit scan can potentially serve as a more comfortable alternative to follow-through in the investigation of small bowel obstruction. HIDA scan has been tried with success in the diagnosis of patients with afferent loop syndrome and mechanical obstruction of the afferent loop of a gastrojejunostomy. With further large-scale studies, HIDA small bowel transit scan could have a role in clinical management and decision making in patients suspected of having small bowel obstruction.

REFERENCES