ORIGINAL ARTICLE

Small bowel enema use in an Asian population: our eleven years of local experience

WH Luk 陸永恆
Peter SM Yu 余燊明
Andrea WS Au-Yeung 歐陽為珊
Adrian XN Lo 羅煦寧
Lily KM Wong 黃嘉敏

Objective To retrospectively analyse the outcome of patients who underwent investigation by small bowel enema in a local centre.

Design Case series.

Setting Regional hospital, Hong Kong.

Patients All patients referred for small bowel enema in a local hospital from 1 January 1999 to 31 December 2009 were identified; respective findings from imaging and clinical records were reviewed.

Results A total of 341 patients were referred for small bowel enema, of whom 289 successfully completed the examination. There were 211 patients whose small bowel enema findings were considered normal and 78 were regarded as abnormal. The sensitivity of this investigation was 73% and its specificity was 91%. The respective positive and negative predictive values were 66% and 93%.

Conclusions The selection of patients by clinicians with specific indications for small bowel enema is essential for making effective use of small bowel enema as an investigative tool.

New knowledge added by this study

- Acceptable clinical indications for small bowel enema include: (1) unexplained gastro-intestinal bleeding, (2) follow-up of suspicious computed tomographic abdomen or colonoscopy findings, and (3) subacute intestinal obstruction.

Implications for clinical practice or policy

- Selection of patients with specific indications enables effective use of small bowel enemas.

Introduction

The prevalence and spectrum of small bowel diseases differs vastly in western and eastern populations. Disease entities such as celiac disease and Crohn's disease are much less common in Asians. To our knowledge, this is the first series to address the effectiveness of small bowel enemas (SBEs) in the evaluation of small bowel pathology in an Asian population. Despite the advances in computed tomography (CT) and magnetic resonance (MR) enteroclysis, conventional SBE remains a valuable diagnostic modality for patients with suspected small bowel pathology. Common indications include iron-deficiency anaemia of unknown cause, obscure gastro-intestinal bleeding (GIB), Crohn's disease, recurrent abdominal pain, subacute small bowel obstruction, and evaluation of suspicious findings on CT or colonoscopy. It is undoubtedly an invasive and uncomfortable examination. Catheter insertion to the duodenojejunal junction and introduction of a large amount of contrast into the small bowel within a short period is necessary to achieve optimal images. The average effective radiation dose is approximately 14 mSv,[1] which amounts to a substantial exposure. There are studies suggesting that SBEs are unnecessary for non-specific indications,[2] while others support their use in screening for small bowel disease.[3,4] This study aimed to evaluate the value of SBE in patients who underwent the examination for suspected small bowel pathology over an 11-year period from 1999 to 2009. Respective referral indications, SBE findings, and clinical outcomes of the patients were reviewed.

Methods

This retrospective study was approved by the local institutional review board. All patients referred for SBE in our hospital from 1 January 1999 to 31 December 2009 were identified. Patients who refused the enema or failed to tolerate the examination

Key words
Enema; Intestinal obstruction; Intestine, small; Sensitivity and specificity

Hong Kong Med J 2011;17:286-91

Department of Diagnostic Radiology and Organ Imaging, United Christian Hospital, Kwun Tong, Hong Kong
WH Luk, MB, BS, FHKCR
PSM Yu, MB, ChB
AWS Au-Yeung, BMBCh, FRCR
AXN Lo, MB, ChB, FRCR
LKM Wong, MB, ChB, FRCR

Correspondence to: Dr WH Luk
Email: lukwinghang@gmail.com

were excluded from the study, as were those who defaulted follow-up. Patients with known small bowel disease and referred only for monitoring by SBE were also excluded from the analysis.

亞洲人口中小腸灌腸造影的使用情況：十一年本地經驗

目的 回顧分析本地一所醫院內接受小腸灌腸造影的病人的結果。

設計 病例系列。

安排 香港一所分區醫院。

患者 回顧由1999年1月1日至2009年12月31日期間在本院接受小腸灌腸造影的病人的造影結果及臨床紀錄。

結果 共341位病人被轉介至本院放射診斷科進行小腸灌腸造影，其中289人成功完成造影檢查。當中211人的小腸灌腸造影結果屬正常，其餘78人的造影結果呈異常。結果也發現小腸灌腸造影的敏感度為73%，特異性為91%；陽性預測值和陰性預測值分別為66%及93%。

結論 要加強小腸灌腸造影的有效性，醫生必須選擇性地為有特定臨床情況的病人安排進行小腸灌腸造影。

Imaging study

In our centre, for 2 days before the study patients were instructed to take a low-residue diet without vegetables or fruit as well as 10 mg bisacodyl (Dulcolax tab; Synco, Hong Kong) at night. Cannulation of the proximal jejunum was achieved by using a 10Fr Bilbao-Dotter catheter (Biorad Medisys, India), with the tip of the catheter advanced to the duodenojejunal junction under intermittent fluoroscopic guidance (Philips Diagnost 76 Plus system; Philips Medical Systems, Andover [MA], US or Siemens Artis zee Multi-purpose system, Muenchen, Germany). Double contrast was produced by infusion of 200 mL of 250% w/v barium followed by 500 mL to 1000 mL of 0.5% methylcellulose. Spot films were taken of the barium column and its leading edge at the region of interest until the colon was reached. Additional spot compression radiographs were also taken at regions of interest.

Diagnostic criteria

Patients who withdrew from the procedure after detailed explanation were classified as refusing. Failure of placement of catheter tip at the duodenojejunal junction, or significant patient discomfort resulting in termination of the study was classified as a failed procedure. Suboptimal study was defined as a completed study but poor coating of the contrast rendering interpretation of images difficult. Any abnormal findings including filling defect, focal outpouching, bowel loop separation, or fistula formation etc, was classified as a positive study finding. For positive SBE cases, follow-up was performed either radiologically with CT or repeat SBE, or endoscopically with a wireless capsule. The clinical outcomes of these patients were reviewed. The gold standard for diagnosing or excluding small bowel pathologies were based on any one or a combination of the findings in the subsequent imaging (CT or MR imaging), endoscopic results, histological findings, together with clinical follow-up. The clinical follow-up period was 1 year or more after the first SBE. This gold standard was applicable for all the different conditions encountered. Those with abnormal SBE findings accounting for their clinical problems were classified as having true-positive SBE. Abnormal findings or any incidental findings in the SBE that were not related to the clinical problems were labelled as false-positive SBE. Patients with normal SBE findings and who remained normal at follow-up were identified as true negative, and those with normal SBE results but found to have underlying small bowel pathology subsequently were defined as false negative.

Statistical analysis

The success and failure rates of the procedure were determined. The sensitivity, specificity, positive

TABLE 1. Results of small bowel enema (SBE)

Results	Sex		Mean age (years)	No. (%) of patients
	Male	Female		
Results				
Total referrals	163	178	56	341
Refused/failed procedure	30	22	56	52 (15%)
Successful study	133	156	56	289 (85%)
SBE results				
Normal SBE	97	114	56	211/289 (73%)
Abnormal SBE	36	42	56	78/289 (27%)
Suboptimal study	18	25	57	43/289 (15%)

TABLE 2. Indications of the small bowel enema (SBE) with the clinical outcome

Indication	No. of referrals	No. of refusal	No. of failure study	No. with SBE performed	No. (%) of normal SBE
Obscure gastro-intestinal bleeding	124	15	3	106	83 (78)
Iron-deficiency anaemia	59	7	3	49	43 (88)
Anaemia (non-iron deficiency)	32	2	3	27	21 (78)
Subacute intestinal obstruction	20	1	1	18	11 (61)
Abdominal pain	10	1	1	8	7 (88)
Constipation	3	1	0	2	2 (100)
Diarrhoea	10	2	0	8	7 (88)
Protein losing enteropathy	6	0	1	5	4 (80)
Suspicious finding in CT	11	2	0	9	4 (44)
Suspicious lesion in colonoscopy	14	6	0	8	5 (63)
Suspected amyloidosis	2	0	0	2	2 (100)
Others*	5	0	2	3	3 (100)
Crohn's disease monitoring	32	0	1	31	13 (42)
Known disease for monitoring†	13	0	0	13	6 (46)
Total	**341**	**37 (11%)**	**15 (4%)**	**289**	**211 (73%)**

* Others: malabsorption, steatorrhoea, and weight loss

† Known small bowel disease for monitoring: Behçet's disease, small bowel gastro-intestinal stromal tumour, lymphoma, Cronkhite-Canada syndrome, and familial adenomatous polyposis

predictive value (PPV) and negative predictive value (NPV) of SBE and 95% confidence intervals (CIs) for these parameters were determined.

Results

Over the period of 11 years, a total of 341 patients were referred for SBE. Fifteen patients refused the test after explanation and in 37 the procedure failed due to difficulty inserting the Bilbao-Dotter catheter into the duodenojejunal junction. A total of 289 patients successfully underwent the examination and all attended follow-up (Table 1). Of these 289 patients, 211 were reported to have a normal SBE and in 78 it was considered abnormal. There were 43 patients (37 with normal and 6 with abnormal SBEs) in whom the examination was suboptimal (less than optimal contrast coating on a short segment of small bowel) [Table 1]. In all, 44 patients with known small bowel disease and referred for monitoring by SBE were excluded from the statistical analysis. In the remainder, the overall sensitivity and specificity were 73% (95% CI, 58-84%) and 91% (95% CI, 86-94%), respectively. The PPV and NPV were 66% (95% CI, 52-78%) and 93% (95% CI, 88-96%), respectively.

The various reasons for referrals for SBE are summarised in Table 2. The most frequent was for stool occult blood positive with negative upper endoscopy and colonoscopy findings. These were

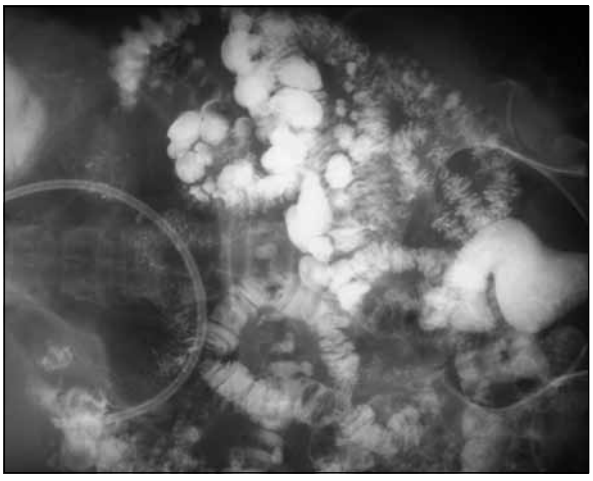

FIG 1. The small bowel enema of a 69-year-old woman with gastro-intestinal bleeding showing small bowel diverticulosis

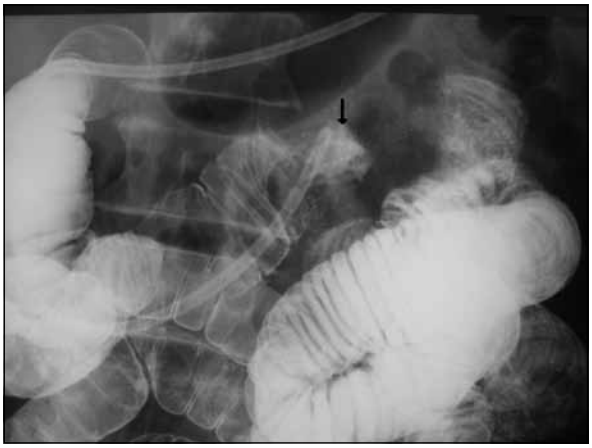

FIG 2. The small bowel enema of a 75-year-old man with occult gastro-intestinal bleeding, showing a constant filling defect at the proximal jejunum (arrow); biopsy confirmed carcinoma of the jejunum

No. (%) of abnormal SBE	True positive	False positive	True negative	False negative	Sensitivity (%) [95% confidence interval]	Specificity (%) [95% confidence interval]
23 (22)	19	4	76	7	73 (52-88)	95 (87-98)
6 (12)	0	6	43	0	Not applicable	Not applicable
6 (22)	3	3	18	3	50 (14-86)	86 (63-96)
7 (39)	4	3	11	0	100 (40-100)	79 (49-94)
1 (13)	1	0	7	0	100 (6-100)	100 (56-100)
0	0	0	2	0	Not applicable	Not applicable
1 (13)	0	1	7	0	Not applicable	Not applicable
1 (20)	1	0	1	3	25 (1-78)	100 (5-100)
5 (56)	4	1	4	0	100 (40-100)	80 (30-99)
3 (38)	3	0	5	0	100 (31-100)	100 (46-100)
0	0	0	2	0	Not applicable	Not applicable
0	0	0	3	0	Not applicable	Not applicable
18 (58)	-	-	-	-	-	-
7 (54)	-	-	-	-	-	-
78 (27%)	**35**	**18**	**179**	**13**	**73 (58-84)**	**91 (86-94)**

termed obscure GIB, for which the PPV was 83%; notably 78% (18/23) of such positive cases were due to diverticular disease (Fig 1) and one was due to small bowel carcinoma (Fig 2). Non-specific filling defects were identified in 17% (4/23) of cases but were no longer detected on subsequent follow-up examinations. These were termed false-positive cases. On the other hand, 8% (7/83) of patients with normal SBEs were found to have small bowel lesions in subsequent studies, including small bowel lymphoma, angiodysplasia, gastroepiploic artery aneurysm and melanosis. These were termed false-negative cases.

Iron-deficiency anaemia (with stool occult blood being negative) was another common indication for SBE, but none turned out to be true positives. False-positive cases were due to incidental findings (Fig 3), inability to explain iron deficiency, or suspicious filling defects not substantiated by subsequent follow-up investigations. In all, 30% (13/43) of patients with normal SBEs were later found to have an underlying cause for iron deficiency unrelated to small bowel. As their pathologies were outside the small bowel, they could not be detected by SBEs and hence these tests were not regarded as false negatives. The prevalence of small bowel pathology to explain iron deficiency was therefore zero in this group. The remaining patients with unknown causes were nevertheless treated with iron supplement with good results.

There were only three true-positive SBEs in the anaemic (non-iron deficiency) patients. They included one patient with a malignancy (Fig 4a) and two with diverticular disease of the small bowel (Fig 4b). Also, there were three patients with false-negative SBEs, the responsible lesions being: jejunal

FIG 3. Small bowel enema of an 80-year-old man with iron-deficiency anaemia, showing herniation of a loop of ileum into the right scrotal sac, compatible with a right inguinal hernia (arrow), which was an incidental finding. The patient was treated with iron supplements with good response

tumour, Crohn's disease, and enteritis. The sensitivity of SBE in the further investigation of suspicious abnormalities on CT or colonoscopy were both 100%. The prevalence of other small bowel pathology (to explain constipation, diarrhoea and a suspicion of small bowel amyloidosis) were all zero. There were four true-positive cases in patients with subacute intestinal obstruction, the causes being intestinal mal-rotation, a food bolus, and two patients with mesenteric metastasis.

One patient with abdominal pain had a positive SBE that revealed colitis with terminal ileum involvement. Another true-positive case was related to protein-losing enteropathy due to underlying systemic lupus erythematosus, for which the sensitivity of SBE was 50%.

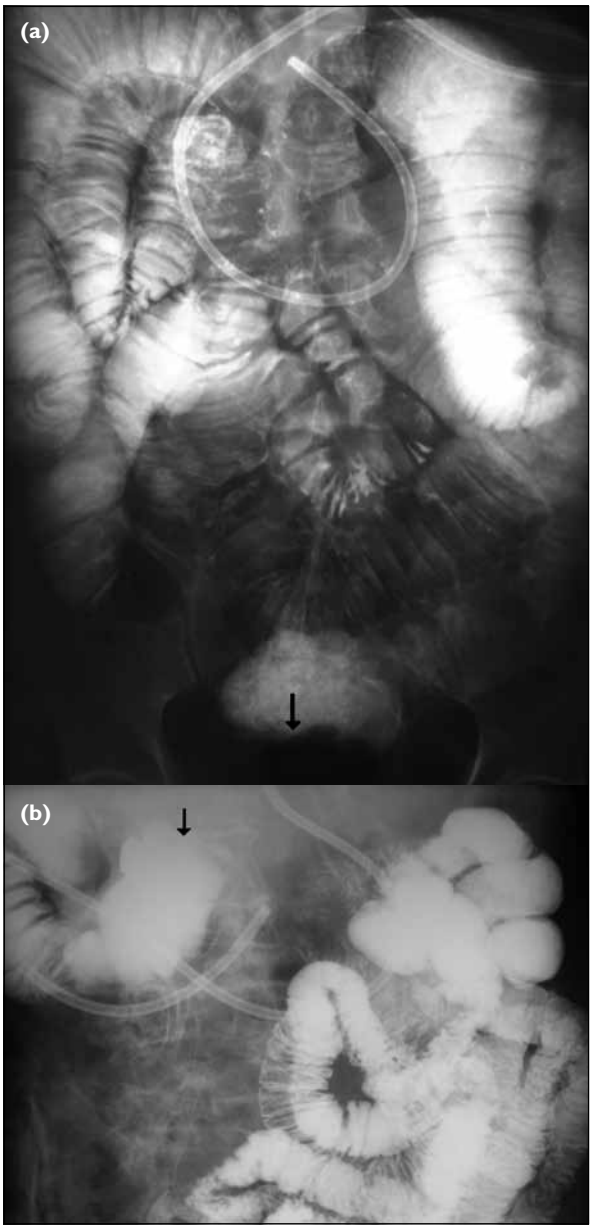

FIG 4. (a) Small bowel enema of a 55-year-old man presenting with subacute intestinal obstruction showing small bowel dilatation up to the ileum where there was an obstruction and mucosal irregularity (arrow). Carcinoma of the ileum was proven. (b) A 92-year-old woman with anaemia whose small bowel enema showed a large diverticulum at the fourth part of duodenum (arrow)

Discussion

Small bowel enema is one of the more invasive and uncomfortable procedures for the evaluation of small bowel pathology. The suboptimal detection rate of 15% was not small, and might be due to the fact that SBE is performed by both inexperienced and expert radiologists. In some western country's studies, enteroclysis is regarded as a reliable means for excluding small bowel disease, which has both high sensitivity and high specificity.[4,5] The relatively low overall sensitivity in our study may be related to different spectrum of disease referrals. In this respect, patient selection based on clinical indications is of paramount importance in determining the effectiveness of SBE.[2,3,6]

Our study suggests that SBE has a different yield in different indications. Small bowel enema is indicated in gastro-intestinal haemorrhage of unknown source,[7,8] for which the sensitivity in our study was only 73%. Capsule endoscopy is another option that is more sensitive and specific for the investigation of underlying obscure GIB.[9-11] Similarly, a recent study showed that capsule endoscopy was useful in the investigation of subacute intestinal obstruction,[12] and CT enteroclysis was more reliable for ruling out small bowel strictures prior to capsule endoscopy, so as to avoid capsule retention.[13] For patients with anaemia not due to iron deficiency, in our study the sensitivity was only 50%. This is therefore a doubtful indication.

More than half of our patients with known Crohn's disease had positive findings on SBE, which is also useful in monitoring disease progression.[14] As illustrated in our study, monitoring of other small bowel diseases by SBE may also be promising. Nowadays, there is an increasing role for CT enteroclysis in the diagnosis and monitoring of Crohn's disease, due to recent advances in multidetector CT technology,[15] and MR enteroclysis is useful in young patients out of consideration of the factor of radiation.[16] Screening by SBE for small bowel involvement in familial adenomatous polyposis is also indicated, as there is significant chance (50-75%) of detecting such lesions.[17]

The value of SBEs in some of the other indications is questionable. In our study, there was no positive case related to iron-deficiency anaemia; notably the small bowel rarely accounts for underlying iron-deficiency anaemia,[18,19] for which small intestinal investigation is actually controversial.[20] Thus, SBEs should generally be reserved for patients with persistent gastro-intestinal symptoms or those who

fail to respond to appropriate therapy,[21] for whom capsule endoscopy may also be useful.[22] In the patients with abdominal pain, CT may be more useful.[23] In our patients with diarrhoea and constipation, the utility of SBEs was doubtful; there being no positive results in our series. The SBE-positive rate for non-specific indications is also very low.[2] On the other hand, the use of human serum albumin scintigraphy is more useful than SBE for diagnosing protein-losing enteropathy.[24] The utility of SBE in the investigation of small bowel amyloidosis is also uncertain.[25]

The main limitation of our study was its retrospective nature. The gold standard was not blinded to the result of SBE. There was no fixed frequency and duration for the follow-up studies. Although histological proof was not obtained in every patient with a positive SBE, follow-up of these patients was achieved either radiologically (with CT) or repeat SBE, or endoscopically with a wireless capsule. Finally, the number of cases of some disease conditions was very low, such that the CIs for the parameters were wide.

Conclusion

Our findings suggest that acceptable clinical indications with high sensitivity and specificity for SBE include: (1) unexplained GIB, (2) follow-up of suspicious findings identified by CT abdomen or colonoscopy, and (3) subacute intestinal obstruction. Small bowel enema is also useful for further investigation for known small bowel diseases, but not for the investigation of iron-deficiency anaemia, diarrhoea, and constipation.

References

1. Ruiz-Cruces R, Ruiz F, Pérez-Martínez M, López J, Tort Ausina I, de los Ríos AD. Patient dose from barium procedures. Br J Radiol 2000;73:752-61.
2. Fried AM, Poulos A, Hatfield DR. The effectiveness of the incidental small-bowel series. Radiology 1981;140:45-6.
3. Nolan DJ, Traill ZC. The current role of the barium examination of the small intestine. Clin Radiol 1997;52:809-20.
4. Dixon PM, Roulston ME, Nolan DJ. The small bowel enema: a ten year review. Clin Radiol 1993;47:46-8.
5. Narin B, Sungurlu F, Balci A, Arman A, Kurdas OO, Simsek M. Comparison of MR enteroclysis with colonoscopy in Crohn's disease—first locust bean gum study from Turkey. Saudi J Gastroenterol 2009;15:253-7.
6. Maglinte DD, Kelvin FM, O'Connor K, Lappas JC, Chernish SM. Current status of small bowel radiography. Abdom Imaging 1996;21:247-57.
7. Moch A, Herlinger H, Kochman ML, Levine MS, Rubesin SE, Laufer I. Enteroclysis in the evaluation of obscure gastrointestinal bleeding. AJR Am J Roentgenol 1994;163:1381-4.
8. Antes G, Neher M, Hiemeyer V, Burger A. Gastrointestinal bleeding of obscure origin: role of enteroclysis. Eur Radiol 1996;6:851-4.
9. Leung WK, Fung SS, Wong MY, Sung JJ. Wireless capsule endoscopy in Chinese patients with suspected small bowel diseases. Hong Kong Med J 2004;10:179-83.
10. Rockey DC. Occult and obscure gastrointestinal bleeding: causes and clinical management. Nat Rev Gastroenterol Hepatol 2010;7:265-79.
11. Rondonotti E, Soncini M, Girelli C, et al. Small bowel capsule endoscopy in clinical practice: a multicenter 7-year survey. Eur J Gastroenterol Hepatol 2010;22:1380-6.
12. Yang XY, Chen CX, Zhang BL, et al. Diagnostic effect of capsule endoscopy in 31 cases of subacute small bowel obstruction. World J Gastroenterol 2009;15:2401-5.
13. Maglinte DD, Sandrasegaran K, Lappas JC, Chiorean M. CT Enteroclysis. Radiology 2007;245:661-71.
14. Saibeni S, Rondonotti E, Iozzelli A, et al. Imaging of the small bowel in Crohn's disease: a review of old and new techniques. World J Gastroenterol 2007;13:3279-87.
15. Engin G. Computed tomography enteroclysis in the diagnosis of intestinal diseases. J Comput Assist Tomogr 2008;32:9-16.
16. Zamboni GA, Raptopoulos V. CT enterography. Gastrointest Endosc Clin N Am 2010;20:347-66.
17. Matsumoto T, Esaki M, Yanaru-Fujisawa R, et al. Small-intestinal involvement in familial adenomatous polyposis: evaluation by double-balloon endoscopy and intraoperative enteroscopy. Gastrointest Endosc 2008;68:911-9.
18. Niv E, Elis A, Zissin R, Naftali T, Novis B, Lishner M. Iron deficiency anemia in patients without gastrointestinal symptoms—a prospective study. Fam Pract 2005;22:58-61.
19. Rockey DC, Cello JP. Evaluation of the gastrointestinal tract in patients with iron-deficiency anemia. N Engl J Med 1993;329:1691-5.
20. Kepczyk T, Kadakia SC. Prospective evaluation of gastrointestinal tract in patients with iron-deficiency anemia. Dig Dis Sci 1995;40:1283-9.
21. Rockey DC. Occult gastrointestinal bleeding. Gastroenterol Clin North Am 2005;34:699-718.
22. Riccioni ME, Urgesi R, Spada C, et al. Unexplained iron deficiency anaemia: Is it worthwhile to perform capsule endoscopy? Dig Liver Dis 2010;42:560-6.
23. Hayes R. Abdominal pain: general imaging strategies. Eur Radiol 2004;14 Suppl 4:L123-37.
24. Takeda H, Takahashi T, Ajitsu S, et al. Protein-losing gastroenteropathy detected by technetium-99m-labeled human serum albumin. Am J Gastroenterol 1991;86:450-3.
25. Tada S, Iida M, Matsui T, et al. Amyloidosis of the small intestine: findings on double-contrast radiographs. AJR Am J Roentgenol 1991;156:741-4.