WK Leung 梁偉強
SSL Fung 馮淑玲
MY Wong 黃美燕
JJY Sung 沈祖堯

Wireless capsule endoscopy in Chinese patients with suspected small bowel diseases

使用無線膠囊內窺鏡替懷疑患上小腸疾病的華裔病者檢查

Objective. To evaluate the use of wireless capsule endoscopy in Chinese patients.
Design. Retrospective analysis.
Setting. University teaching hospital, Hong Kong.
Patients. Twenty-eight patients who had undergone wireless capsule endoscopy between December 2002 and December 2003.
Main outcome measures. Diagnoses according to findings of capsule endoscopy and complications from the procedure.
Results. The mean age of the 28 patients (15 men and 13 women) was 60.0 (standard deviation, 18.3) years. The indications for capsule endoscopy were obscure gastro-intestinal bleeding (n=16), unexplained iron-deficiency anaemia (n=9), and recurrent abdominal pain (n=3). Half of the patients had abnormal endoscopy findings that may account for their presenting symptoms. The most common abnormality was angioectasia of the small bowel. Small bowel ulcers and erosions were also noted in three patients with obscure bleeding. In contrast, none of the patients with recurrent abdominal pain had abnormal capsule endoscopy. No complications arose from the procedure.
Conclusions. Wireless capsule endoscopy is a safe and useful mode of investigation for the diagnosis of obscure gastro-intestinal bleeding in Chinese patients.

目的：評估使用無線膠囊內窺鏡替華裔病者檢查的成效。
設計：回顧研究。
安排：大學教學醫院，香港。
患者：在2002年12月至2003年12月期間，28位曾接受無線膠囊內窺鏡檢查的病人。
主要結果測量：根據膠囊內窺鏡檢查所得而作出的診斷結果，以及檢查過程中出現的併發症。
結果：28位病者中，男性15位，女性13位，平均年齡為60.0歲（標準差為18.3）。其中16位有胃腸小出血，9位患上原因不明的缺鐵性貧血，餘下3位腹痛不斷復發，因而需要接受膠囊內窺鏡檢查。檢查發現，有一半病者的內窺鏡檢查結果異常，並可能從中診斷出病因，最常見的異常徵狀是小腸angioectasia，此外，有3位出現小出血的病者小腸潰瘍和糜爛。所有腹痛不斷復發的病人，都沒有發現異常的內窺鏡檢查結果。檢查過程中，並無病人出現併發症。
結論：使用無線膠囊內窺鏡替懷疑出現胃腸小出血的華裔病者檢查，既安全也有效。

Key words:
Chinese;
Endoscopy, gastrointestinal;
Equipment design;
Gastrointestinal hemorrhage

關鍵詞：
華裔；
內窺鏡，胃腸；
儀器設計；
胃腸出血

Hong Kong Med J 2004;10:179-83

Endoscopy Centre, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, Hong Kong
WK Leung, MD, FRCP
SSL Fung, BN
MY Wong, RN
JJY Sung, MD, FRCP

Correspondence to: Dr WK Leung (e-mail: wkleung@cuhk.edu.hk)

Introduction

The first report on miniature wireless endoscopy was a conceptual study by Gong et al in 1994.[1] Five years later, the first wireless capsule endoscope was used in a human volunteer,[2] and since then, there has been remarkable progress in this field. In August 2001, the wireless capsule endoscope was approved for clinical use by the United States Food and Drug Administration. The instrument is now used widely to diagnose small bowel disease; it is estimated that more than 80 000 have been used worldwide.

The currently available capsule endoscope measures 11 mm in diameter and 26 mm in length, and weighs less than 4 g (Fig 1a). With a field of view of 140°,

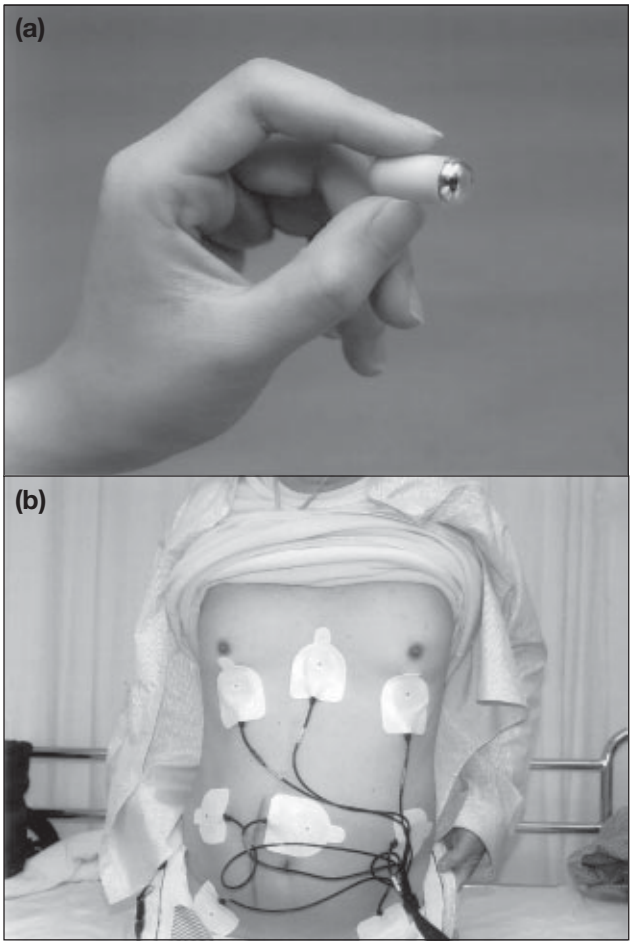

Fig 1. (a) The video capsule endoscope; and (b) the sensor array, attached to the anterior chest and abdominal wall

the endoscope can take approximately 57 000 images at a rate of two frames per second for about eight continuous hours. Whereas conventional small bowel imaging, such as enteroclysis, is generally considered to be suboptimal, wireless capsule endoscopy provides the best non-invasive platform for the direct visualisation of the small bowel mucosa. Several comparative studies have demonstrated the superiority of wireless capsule endoscopy over conventional small bowel enteroclysis or push enteroscopy.[3-6]

Although many small bowel diseases—for example, coeliac disease and Crohn's disease—are less prevalent in the Chinese population than in western populations,[7,8] evaluation of the small bowel is still frequently needed. One particular indication for small bowel evaluation is obscure gastro-intestinal bleeding which is frequently encountered in Chinese patients. In this article, we report our initial experience with capsule endoscopy in Hong Kong Chinese patients with suspected small bowel diseases.

Methods

Patients with suspected small bowel pathology who underwent capsule endoscopy at the Prince of Wales Hospital between December 2002 and December 2003 were included in this retrospective study. Indications for capsule endoscopy included obscure gastro-intestinal bleeding, unexplained iron-deficiency anaemia, and recurrent abdominal pain. Patients with suspected small bowel stricture, intestinal obstruction, or swallowing difficulties were excluded, as were patients with pacemakers and pregnant women.

Capsule endoscopy was performed after patients had fasted overnight. Eight aerials, which were connected to a battery-powered portable data recorder, were attached to the chest and abdominal wall before the procedure (Fig 1b). Patients were then asked to swallow the capsule endoscope (M2A capsule; Given Imaging, Yoqneam, Israel) with plenty of water mixed with simethicone to eliminate small bubbles in the gastro-intestinal tract. A normal diet was allowed 4 hours later. The sensor array and recorder were removed after 8 hours of recording, and recorded images were downloaded to a computer workstation and viewed using RAPID software (Given Imaging, Yoqneam, Israel). The capsule was passed out of the body naturally and patients were contacted at 1 week for any potential discomfort and the timing of spontaneous passage of capsule. Patients who were uncertain of the natural passage of the capsule were called back for abdominal X-ray to check for possible retention.

All capsule images were viewed independently by a trained nurse and a gastro-enterologist. Discrepant findings were resolved through discussion. Lesions were classified as positive if they allowed a clear-cut explanation of the clinical situation, or as suspicious if their relationship with presentation was uncertain.[9]

Results

Patient characteristics

During the 13-month study period, 28 patients (15 men and 13 women) were examined. Their mean age was 60.0 (standard deviation [SD], 18.3) years. The indications for capsule endoscopy were obscure gastro-intestinal bleeding (n=16), unexplained iron-deficiency anaemia (n=9), and recurrent abdominal pain (n=3).

All patients had previously undergone gastroscopy and colonoscopy, which failed to account for their presenting symptoms. Among the 25 patients with obscure gastro-intestinal bleeding or iron-deficiency anaemia, 10 had received a small bowel enema, six had normal mesenteric angiograms, and five had normal red blood cell scans. Four patients had previously undergone colectomy for obscure bleeding, but bleeding persisted after surgery. One patient had intra-operative entersocopy, which failed to identify the source of bleeding. The mean haemoglobin level of these 25 patients was 84 (SD, 26) g/L; 17 patients had previously received blood transfusions. Three of the 25 patients had a recent history of non-aspirin

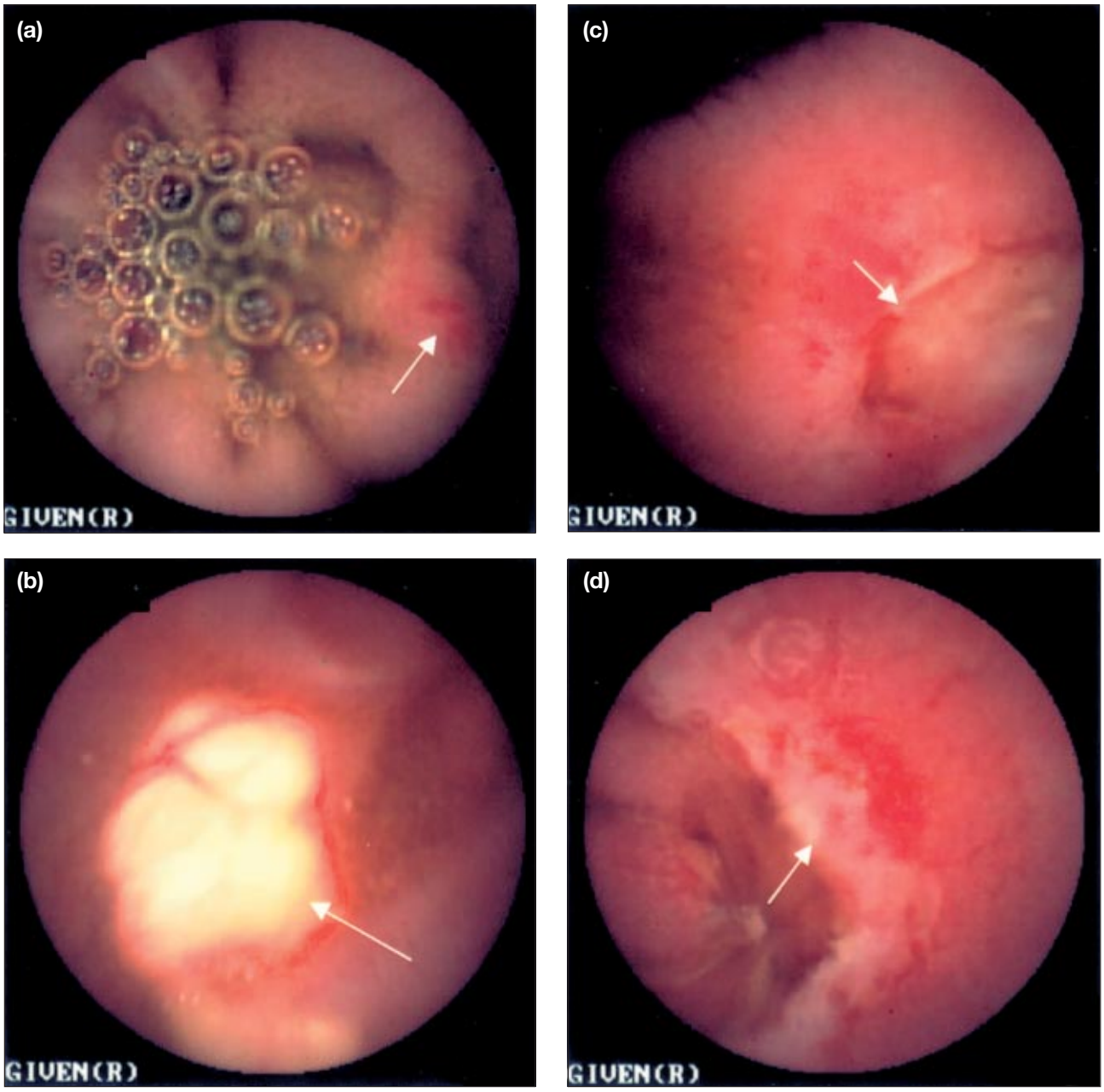

Fig 2. Representative abnormal findings from endoscopy of the small bowel
(a) Angioectasia in a patient with recurrent obscure gastro-intestinal bleeding
(b) A jejunal polyp in a patient with recurrent anaemia
(c) and (d) Small bowel erosion and ulceration in a patient with obscure gastro-intestinal bleeding

non-steroidal anti-inflammatory drug (NSAID) use, whereas the other eight had a history of aspirin use, and two were currently taking an oral anticoagulant. One patient was receiving chemotherapy for adenocarcinoma of the appendix.

Capsule endoscopy findings

The mean total recording time for the 28 patients was 7.6 (SD, 1.1) hours. The mean gastric emptying time was 20.5 (29.7) minutes. Small bowel examination was complete in 26 cases, with a mean small bowel transit time of 3.7 (1.8) hours. The reasons for two incomplete examinations were technical failure and delayed gastric emptying.

Capsule endoscopy findings were normal in half of the patients, including all three with recurrent abdominal pain. In the 14 patients with abnormal capsule endoscopy findings, the most common abnormality (n=8) was small bowel angioectasia (Fig 2). Small bowel ulcers or erosions were found in three patients, two of whom had small bowel polyps. The remaining patient was suspected to have a cavernous haemangioma in the small bowel.

All patients passed out the capsule spontaneously and without complications, after a median of 1 day. Although one patient could not recall when the capsule was eliminated, an abdominal X-ray at 1 week failed to detect it.

Table. Summary of indications and capsule endoscopy findings

Indications	Diagnosis	No. of patients
Iron-deficiency anaemia (n=9)	Angioectasia	5
	Small bowel ulceration	1
	Normal	3
Obscure gastro-intestinal bleeding (n=16)	Gastric erosion	1
	Angioectasia	3*
	Small bowel erosion	1
	Small bowel ulcer	1
	Small bowel polyp	2*
	Cavernous haemangioma	1
	Normal	8
Recurrent abdominal pain (n=3)	Normal	3

* One patient had both a jejunal polyp and small bowel angioectasia

Outcome after capsule endoscopy

Three patients were referred for push enteroscopy for suspected jejunal pathology after the capsule endoscopy, but one refused the procedure. In an 85-year-old man who underwent push enteroscopy, jejunal angiodysplasia was identified and was ablated by thermocoagulation. There was no bleeding at the time of writing this report, ie up to 3 months after endoscopy. Both push enteroscopy and mesenteric angiography failed to identify any lesion in a patient who had suspected cavernous haemangioma. A patient with a suspected bleeding polyp in the small bowel refused surgical intervention, and a patient with both small bowel polyp and angioectasia was not operated on because of co-morbidity. Although no patient was referred for surgery because of abnormal capsule endoscopy findings, a 56-year-old woman underwent a second laparotomy for significant obscure bleeding 10 months after the initial capsule endoscopy examination. However, the second laparotomy and on-table enteroscopy failed to locate the bleeding site, and the source of bleeding remained undetermined (Table).

Discussion

Because of the length and tortuous nature of the small bowel, lesions in the small bowel are difficult to visualise by conventional examinations such as endoscopy and radiological imaging. The availability of capsule endoscopy has enabled the visualisation of the small bowel, which could be examined only by surgical exploration in the past. Several studies of relatively small samples of patients have demonstrated the superiority of capsule endoscopy over push enteroscopy and computed tomography (CT) enteroclysis.[3-6] In particular, capsule endoscopy diagnoses more luminal abnormalities, such as angioectasia and ulcers, than do barium studies and CT. A recent pooled analysis, which included 32 independent studies with a total of 691 patients, compared capsule endoscopy with other modalities and showed that the former had a diagnostic yield of 71% whereas all other modalities together had a total diagnostic yield of only 41% (personal communication). In addition, recent data show that the early use of capsule endoscopy in patients with obscure bleeding may reduce the number of unnecessary investigations and could result in a prompt diagnosis within a shorter period.[9]

Although capsule endoscopy is now generally considered to be the investigation method of choice for small bowel disease, most of the published data are from western countries, and there are considerable geographical variations in disease patterns between western and eastern countries. For example, Crohn's disease and coeliac disease are more prevalent among Caucasians than among the Chinese population.[7,8] In our series, which comprised ethnic Chinese patients only, the most frequent indications for capsule endoscopy were obscure gastro-intestinal bleeding and unexplained iron-deficiency anaemia. Accordingly, the most common abnormality detected among the patients was angioectasia. Of the eight patients who had angioectasia, one received a subsequent therapeutic endoscopic intervention to abort bleeding. Moreover, small bowel ulcers or erosions were found in three patients, two of whom were using aspirin or another NSAID. The withdrawal of these offending drugs may have prevented subsequent bleeding in these patients. The remaining patient with small bowel ulceration and erosion was receiving chemotherapy for adenocarcinoma of the appendix. Because the patient refused further endoscopic intervention, the exact aetiology of the small bowel disease remained undetermined.

Three patients underwent capsule endoscopy for recurrent abdominal pain, but none of these patients were suspected to have Crohn's disease or malabsorption, and all three had normal capsule endoscopy findings. In keeping with this result, previous studies show that the diagnostic yield of capsule endoscopy is lower in patients with abdominal pain than in bleeding patients[10-12]—particularly for regions with a low prevalence of Crohn's disease or malabsorption due to small bowel diseases. Thus, we expect that the diagnostic yield of capsule endoscopy will be much lower than conventional endosocopy or radiological imaging in the investigation of recurrent abdominal pain in Chinese patients.

Capsule endoscopy is a very simple procedure and, apart from fasting, there is no special preparation required. Some clinicians recommend the use of a prokinetic agent to speed up gastric emptying or the use of a bowel-cleansing agent to improve the visualisation of the small bowel and colon. However, it is imperative to note that the video capsule is designed for use in the small bowel only, and examination of other parts of the gastro-intestinal tract is not recommended. Our initial experience with capsule endoscopy in the oesophagus and stomach has been unsatisfactory. Passage of the capsule through the oesophagus usually takes only a few seconds, whereas the gastric emptying time varies widely among different individuals. The lack of air distension, suboptimal illumination, and

the failure to control the movement of the capsule in the stomach make detailed gastric mucosal examination impossible. On the other hand, colonic examination is usually incomplete because of the short battery life (usually <8 hours), lack of bowel preparation, and extremely variable colonic transit time.

In this series, there was no complication from capsule endoscopy, and all capsules were passed out naturally. Nonetheless, we estimated that the capsule would become lodged in the intestinal tract in less than 1% of all cases, even though patients with suspected small bowel stricture or stenosis were excluded. The usual reasons are unexpected stricture or obstruction of the gastro-intestinal tract due to, for example, tumour, Crohn's disease, or NSAID use. These patients usually require surgery for removal of the capsule and the definite management of the obstructive lesions.

The average time to review a wireless capsule endoscopy study was about 60 to 90 minutes; the viewing time can be shortened further with experience. Moreover, there is a suspected blood indicator function that identifies the presence of red images in order to enhance detection of blood and increase the sensitivity for actively bleeding lesions in the small bowel.[13]

The list price for the capsule endoscopy workstation, software, and accessories in the United States is about US$21 000, whereas a single wireless capsule costs about US$500.[14] In the United States, patients can have reimbursable access to capsule endoscopy for suspected small bowel bleeding and Crohn's disease. However, this investigation is currently not available in public hospitals in Hong Kong, which means that patients or insurance providers have to pay for this investigation. As yet, it is imperative to recognise that small bowel bleeding poses a major diagnostic challenge for clinicians. Patients with small bowel bleeding usually require more diagnostic procedures and blood transfusions, remain in hospital longer, and have a higher hospitalisation expenses than patients with colonic bleeding and upper gastro-intestinal bleeding.[15] Although there has so far been no formal cost-effectiveness analysis of wireless capsule endoscopy, it is the only investigation currently available that can visualise the small bowel and could potentially reduce the cost of other unnecessary investigations and hospitalisation in patients with small bowel bleeding.

Conclusion

Our initial experience with wireless capsule endoscopy has demonstrated the safety and usefulness of this investigation in Chinese patients. The diagnostic yield appears to be higher in patients with obscure small bowel bleeding than in patients with abdominal pain, and wireless capsule endoscopy should be considered early in the course of investigation of patients with obscure gastro-intestinal bleeding.

References

1. Gong F, Swain CP, Mills TN. An endorobot for gastrointestinal endoscopy. Gut 1994;35(Suppl):52S.
2. Swain P. Wireless capsule endoscopy. Gut 2003;52(Suppl 4):48S-50S.
3. Ell C, Remke S, May A, Helou L, Henrich R, Mayer G. The first prospective controlled trial comparing wireless capsule endoscopy with push enteroscopy in chronic gastrointestinal bleeding. Endoscopy 2002;34:685-9.
4. Costamagna G, Shah SK, Riccioni ME, et al. A prospective trial comparing small bowel radiographs and video capsule endoscopy for suspected small bowel disease. Gastroenterology 2002;123: 999-1005.
5. Mylonaki M, Fritscher-Ravens A, Swain P. Wireless capsule endoscopy: a comparison with push enteroscopy in patients with gastroscopy and colonoscopy negative gastrointestinal bleeding. Gut 2003;52:1122-6.
6. Hara AK, Leighton JA, Sharma VK, Fleischer DE. Small bowel: preliminary comparison of capsule endoscopy with barium study and CT. Radiology 2004;230:260-5.
7. Sung JJ, Hsu RK, Chan FK, Liew CT, Lau JW, Li AK. Crohn's disease in the Chinese population. An experience from Hong Kong. Dis Colon Rectum 1994;37:1307-9.
8. Freeman HJ. Biopsy-defined adult celiac disease in Asian-Canadians. Can J Gastroenterol 2003;17:433-6.
9. Pennazio M, Santucci R, Rondonotti E, et al. Outcome of patients with obscure gastrointestinal bleeding after capsule endoscopy: report of 100 consecutive cases. Gastroenterology 2004;126:643-53.
10. Sriram PV, Rao GV, Reddy DN. Wireless capsule endoscopy: experience in a tropical country. J Gastroenterol Hepatol 2004;19:63-7.
11. Ang TL, Fock KM, Ng TM, Teo EK, Tan YL. Clinical utility, safety and tolerability of capsule endoscopy in urban Southeast Asian population. World J Gastroenterol 2003;9:2313-6.
12. Bardan E, Nadler M, Chowers Y, Fidder H, Bar-Meir S. Capsule endoscopy for the evaluation of patients with chronic abdominal pain. Endoscopy 2003;35:688-9.
13. Liangpunsakul S, Mays L, Rex DK. Performance of Given suspected blood indicator. Am J Gastroenterol 2003;98:2676-8.
14. Ginsberg GG, Barkun AN, Bosco JJ, et al. Wireless capsule endoscopy: August 2002. Gastrointest Endosc 2002;56:621-4.
15. Prakash C, Zuckerman GR. Acute small bowel bleeding: a distinct entity with significantly different economic implications compared with GI bleeding from other locations. Gastrointest Endosc 2003;58: 330-5.