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Intra-operative localization of bleeding small intestinal lesions

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We prospectively studied 12 patients to compare fibreoptic enteroscopy and methylene blue injection through superselectively prepositioned angiographic catheters in intra-operative localization of bleeding small intestinal lesions. Four patients were excluded because the lesions were easily detected by gross examination. Eight patients were subjected to study by these two methods. As methylene blue injection required a positive angiography, it was possible only in five patients. In two of these five patients, non-bleeding lesions were present outside the intestinal segments localized by this method. Enteroscopy was simple, accurate and reliable in seven patients. Complete enteroscopy was impossible in one patient with advanced lymphoma because the intestine and its mesentery were matted together. Fortunately, the bleeding ulcers were still within the reach of the endoscope. Enteroscopy localized bleeding small intestinal lesions more exactly than methylene blue injection so that the length of gut resection could be shorter. We, therefore, conclude that enteroscopy is the better intra-operative localization procedure.

Keywords: Intra-operative enteroscopy, methylene blue injection, bleeding small intestinal lesions

Bleeding small intestinal lesions are notoriously difficult to diagnose and localize[1]. Owing to the length and mobility of the small intestine, most of it is inaccessible to the ordinary endoscope and, unlike the stomach, the duodenum and the colon which are relatively fixed anatomically, pre-operative localization with barium studies, isotope scans and selective angiography will at best give a hint of the site of the bleeding lesion. Exact localization is impossible and the lesion has still to be found at operation[1,2].

There are many intra-operative methods of localizing small intestinal lesions[2]. Gross examination by palpation and transillumination is unreliable for small lesions, especially vascular lesions. During the time when pre-operative and intra-operative localizations were not readily available, laparotomy and gross examination yielded a diagnosis in only 30 per cent of patients with gastrointestinal bleeding of obscure origin[3]. Multiple enterotomies with eversion of mucosa or sigmoidoscopy are messy and increase the operative risks[1,2]. In the past, intra-operative mesenteric angiography[4], intra-operative mesenteric venous pressure and PaO_2 determinations[5] and the intra-operative Doppler ultrasound flow detector[6] were used for the localization of intestinal arteriovenous malformations (AVMs). These methods are cumbersome and time consuming[4,5], require extensive dissection[5], are unreliable for small lesions[4–6] and are unhelpful in the identification of bleeding lesions other than AVMs[5,6]. The best available methods for localization of bleeding small intestinal lesions nowadays are fibreoptic enteroscopy[1,2,7–13] and injection of methylene blue through prepositioned angiographic catheters[14]. As there are advantages and limitations in both procedures and there is no study in which they are compared, we decided to undertake a prospective study to ascertain the better procedure.

Material and methods

From 1985 to 1987, 12 patients with proven bleeding small intestinal lesions were admitted to our unit. They presented with gastrointestinal bleeding of obscure origin which is defined as a failure to localize the bleeding source after conventional investigations[2]. These included at least one, and often more, emergency end- and side-view upper gastrointestinal endoscopies, barium meal, sigmoidoscopy, colonoscopy, and barium enema to exclude oesophagogastroduodenal and colorectal lesions. All these patients had massive, continuous or recurrent bleeding.

A careful history, including a good family history of gastrointestinal bleeding and a history of drug intake, was routinely taken. The facial stigmata of Peutz–Jeghers syndrome, blue rubber-bleb naevus syndrome[15] and skin telangiectasia of hereditary haemorrhagic telangiectasia[16] were specially looked for in the physical examination. Blood dyscrasia, clotting defects and other metabolic disorders were excluded by laboratory investigations. When conventional investigations failed to reveal the bleeding source, the patients were investigated with small bowel enema, ^{99m}Tc pertechnetate scan, ^{99m}Tc-labelled red blood cell scan and selective coeliac and mesenteric angiography[2]. As far as possible, we tried to localize the lesions before surgery. During investigation, the patients were monitored closely and were managed actively with blood transfusions.

If selective angiography demonstrated a bleeding small intestinal lesion, the angiographic catheter was advanced distally and a superselective angiography was carried out to delineate as short as possible a segment of gut containing the lesion. Patency of the catheter was maintained with intermittent syringe injection of heparinized saline and the patient was immediately transferred to the operating room.

All patients with gastrointestinal bleeding of obscure origin were operated in the lithotomy position with the abdomen and perineum draped so that the intra-operative enteroscopy, if required, could be performed[1]. At laparotomy, a careful search of the bleeding lesion by palpation and transillumination against a strong light was performed from the duodenojejunal flexure down to the ileocaecal valve. Care was taken not to displace the angiographic catheter, if present, during this

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examination. If a bleeding Meckel's diverticulum was found, no further intra-operative localization procedure was performed. For patients with a prepositioned angiographic catheter, 1 ml of methylene blue was injected through the catheter and the small intestinal segment stained blue was marked proximally and distally with silk stitches. Intra-operative enteroscopy was then performed. Whole gut irrigation was either done pre-operatively in elective operations or intra-operatively in emergency operations[17]. Our technique of enteroscopy has been reported[1]. In brief, we used an Olympus TCF-2L2 colonoscope (Olympus Optical Company Ltd, Japan) which has a working length of 1·6 m. The scope was inserted by an endoscopist through the anus and/or the mouth. The tip of the endoscope was guided up the colon or down the duodenum into the small intestine by the abdominal surgeon who telescoped the small bowel on to the endoscope. After full introduction of the endoscope into the intestine, the endoscope was gradually withdrawn. In segments of 10 cm, the lumen was examined by the endoscopist and the external surface of the transilluminated gut inspected by the abdominal surgeon. The sites of bleeding lesions were marked with silk stitches on the serosal surface. The gut was decompressed when the endoscope was withdrawn so that closure of the abdomen presented no problem.

Results

Seven male and five female patients had bleeding small intestinal lesions. Their ages ranged from 3 to 71 years (mean ±s.d.= 43·7±24·3 years). Recurrent bleeding occurred in ten patients; the last attack before diagnosis and surgery was massive in two patients, slowly continuous in three patients and stopped completely in five patients. Two patients presented with massive bleeding in the first attack. The median time from the first bleed to diagnosis was 1·6 years (range, 1 day to 5 years). Pre-operative blood transfusion ranged from 1·5 to 16 litres (mean ±s.d.= 5·9±3·8 litres).

Four patients with bleeding Meckel's diverticula presented no difficulty in pre-operative diagnosis or intra-operative localization and are not discussed further.

A comparison of the intra-operative localization procedures for the other eight patients by gross examination, injection of methylene blue through prepositioned angiographic catheters and enteroscopy is listed in *Table 1*. Gross examination was unreliable for small and superficial lesions. Injection of methylene blue was possible in five patients. However, in two of them, who had lymphoma with multiple small intestinal ulcers, several non-bleeding ulcers were present outside the intestinal segments that were stained blue. Intra-operative enteroscopy was easy, accurate and reliable in seven patients. Complete enteroscopy, however, was impossible in a patient with advanced lymphoma because the gut and its mesentery were matted together. Fortunately, the bleeding ulcers were within the reach of the endoscope so that the extent of gut resection could still be determined. Enteroscopy localized bleeding small intestinal lesions more exactly than methylene blue injection so that the length of gut resection could be shorter. We, therefore, conclude that enteroscopy is the better intra-operative localization procedure.

Two patients died postoperatively (17 per cent): one patient with polyarteritis nodosa died 15 days after operation because of uncontrolled chest infection, and another patient with lymphoma died 6 weeks after operation because of advanced disease.

The median follow-up for the ten patients that survived the operation was 16 months; there were no recurrences of gastrointestinal bleeding in these patients.

Discussion

Bleeding small intestinal lesions are notoriously difficult to diagnose pre-operatively and to localize intra-operatively[1]. Gross examination by palpation and transillumination is unreliable and it often fails to detect the bleeding lesions[1–3,7]. This is not surprising since it is now recognized that about 40 per cent of cases of chronic obscure gastrointestinal bleeding are due to AVMs[7] which are usually not readily visible or palpable at operation[18]. Occasionally, in patients with more than one possible bleeding lesion found intra-operatively, the exact bleeding site is uncertain unless bleeding has been directly observed either angiographically or endoscopically.

Injection of methylene blue requires a positive pre-operative selective angiogram[14,19]. For angiography to demonstrate a bleeding lesion, there must be active bleeding at a rate above 0·5 ml/min at the time of injection of the contrast material[20]. Gastrointestinal bleeding of obscure origin is generally an intermittent, highly variable occurrence and patients with normal angiography may still have actively bleeding lesions[7,21]. Some lesions like AVMs, haemangiomas, leiomyomas and Meckel's diverticula with ectopic gastric mucosa may occasionally be demonstrated in angiography in the absence of bleeding[18]. For unknown reasons, some intestinal vascular lesions may not be apparent on one examination and yet be obvious on another[22].

Table 1 *Details of patients with bleeding small intestinal lesions*

Pathology	Site of lesion	Intra-operative procedures		
		Gross examination	Injection of methylene blue	Enteroscopy
AVM	Jejunum	Not found	Localized to 30 cm of jejunum	Exact localization of lesion
AVM	Jejunum	Not found	Localized to 30 cm of jejunum	Exact localization of lesion
Non-specific ulcer (steroid-induced)	Jejunum	Not found	Localized to 10 cm of jejunum just distal to duodenojejunal flexure	Eact localization of bleeding ulcer
Lymphoma	Ileum	Multiple ulcers, bleeding site unknown	Segment of ileum, 40 cm, containing bleeding ulcers localized; non-bleeding ulcers outside localized gut segment	Bleeding and non-bleeding ulcers seen; this helped in deciding length of gut resection
Lymphoma	Jejunum and ileum	Small gut and its mesentery matted together, multiple ulcers found, bleeding site unknown	Segment of ileum, 45 cm, containing bleeding ulcers localized; non-bleeding ulcers outside localized gut segment	Complete enteroscopy impossible because gut and mesentery matted together; bleeding and non-bleeding ulcers were seen
Lymphoma	Ileum	Two ulcers found	Not possible because of negative angiography	Three ulcers close to one another seen
Jejunal diverticulum	Jejunum	Diverticulum found ?? bleeding	Not possible because of negative angiography	Bleeding from diverticulum seen
Polyarteritis nodosa	Jejunum	Spastic segment of jejunum	Not possible because of negative angiography	Punctate bleeding in spastic segment of jejunum seen

AVM, intestinal arteriovenous malformation

Athanasoulis and his associates reported an ingenious intraoperative localization procedure by injecting methylene blue through a superselectively prepositioned angiographic catheter[14]. They used two co-axial catheters and advanced the inner catheter, as distally as desired in the jejunal artery supplying the lesion, under fluoroscopy with image intensification and magnification. This was done electively in a second arterial catheterization just before surgery. We modified their techniques by performing a superselective angiography using a single preshaped catheter and advanced it as distally as possible in a single stage. This modification allows immediate surgery to be performed to stop bleeding, avoids a second arterial catheterization and eliminates the possibility that the lesion may not show up in the second angiogram because of slowing down of the bleeding.

Fibreoptic enteroscopy has been done with good results[1,2,7–13]. Because of the rarity of bleeding small intestinal lesions, most experiences on enteroscopy are based on reports of one to two cases[7–12], with only occasional reports of slightly larger series of patients[1,2,13]. Using the colonoscope, which is the longest and easily available fibreoptic instrument, complete visualization of the entire small intestine is possible[1]. It has the advantages of being simple, accurate and reliable. Lesions are exactly localized and are confirmed to be bleeding under direct vision. Moreover, by a complete examination of the whole intestine, the surgeon can decide on the extent of gut resection with a greater degree of confidence and he can be certain that no bleeding lesions are left undetected. The only limitation of enteroscopy is technical. In patients with advanced malignancies[2], and in patients with dense adhesions due to repeated operations[12], complete enteroscopy may, on rare occasions, be impossible. There may be concern that small vascular lesions are not visible endoscopically as these lesions are not visible in the resected specimens unless injected with barium gelatine[23] or silicone rubber[24]. It would seem logical that if a lesion causes bleeding, a mucosal defect should be present[25] and mucosal ulcerations are common in AVMs[26]. In living patients, vascular lesions are bright red and are easily visible through an endoscope[6,27]. Transillumination by strong light from the endoscope in the gut lumen through the wall increases the chance of detection of these vascular lesions[28]. We have been able to identify very small AVMs by enteroscopy in this study as well as in previous studies[1,2].

Based on our results, fibreoptic enteroscopy is the best intraoperative localization procedure and it should be freely used. In patients with a positive selective angiogram, however, we still recommend a superselective angiography and to leave the angiographic catheter *in situ*. This will give an additional assurance that the bleeding lesion can be localized by injection of methylene blue on the rare occasions when enteroscopy is technically impossible.

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