COMPARATIVE EVALUATION BETWEEN CAPSULE ENDOSCOPY AND CT ENTEROCLYSIS IN THE STUDY OF OBSCURE GASTROINTESTINAL BLEEDINGS: OUR EXPERIENCE

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ABSTRACT

Purpose: To compare the diagnostic value of Capsule Endoscopy with Computed Tomographic enteroclysis through a retrospective evaluation of a group of patients consecutively submitted to both procedures.

Materials and methods: 68 patients (27 males and 41 females, average age 58.8) have been submitted first to Capsule Endoscopy of small and/or large intestine, and then to Computed Tomographic enteroclysis of small and/or large intestine.

Results: A clear diagnosis is reached in 80% of patients with the combined use of the 2 procedures. In 21% of cases disease has been exclusively detected by Capsule Endoscopy, while in 41% of the studied cases Computed Tomographic enteroclysis has found a gastrointestinal disease not identified by Capsule Endoscopy.

Conclusions: Capsule Endoscopy has shown a high diagnostic accuracy in detecting intestinal mucosal alterations as causes of obscure bleedings. Computed Tomographic enteroclysis, however, represents a procedure with high sensitivity and a good diagnostic accuracy for the identification not only of intestinal parietal diseases, but also of extraparietal and extraintestinal abnormalities. From this point of view, Capsule Endoscopy and Computed Tomographic enteroclysis could represent two complementary diagnostic procedures, especially by integrating the two for the diagnostic definition of obscure bleedings of the digestive tube.

Key words: Obscure gastrointestinal bleedings, capsule endoscopy, CT enteroclysis.

Introduction

Obscure Gastrointestinal Bleeding (OGIB) is defined as a chronic or recurring blood loss that originates from the digestive tract, where the source of bleeding remains unidentified despite an initial evaluation with traditional endoscopic procedures, which are esophagogastroduodenoscopy (EGDS) and colonoscopy.

OGIB causes 5% of digestive bleedings, and in 75% of cases it’s ascribable to a small intestine disease. In the remaining 25% of cases, the disease is located in the stomach, oesophagus, duodenum or colon, and cannot be detected with the initial endoscopic investigation.

OGIB can be clinically classified into:
- Occult Obscure Bleeding, in which the unique signs of bleeding are an iron-deficiency anemia (IDA) and/or positive fecal occult blood (FOB) test, without clinically evident signs of gastrointestinal blood loss.
- Evident Obscure Bleeding, which is defined by a macroscopically evident hemorrhage, with melena, hematochezia or hematemesis.

OGIB can also be classified into active or inactive depending on whether the bleeding is ongoing or resolved at the moment of initial diagnosis.

Causes of small intestine bleeding are multiple:
- Mucosal vascular malformations, the most common cause of small intestine bleeding, such as gastrointestinal angiodysplasia, gereditary hemorrhagic teleangectasia (also known as Osler-Weber-Rendu disease) and hemangiomas.
• Diverticula, including Meckel’s Diverticulum, the most frequent congenital malformation of the gastrointestinal tract and the most common cause of gastrointestinal bleeding in patients less than 30 years old.

• Vasculitis, such as polyarteritis nodosa (characterized by transmural necrosis of medium-sized arteries) and Takayasu’s disease (that affects aorta and its main branches).

• Neoplasms, including malignant tumors (adenocarcinomas, carcinoids, leiomyosarcomas and non-Hodgkin lymphomas) and metastases (sometimes clinically unknown and often lacking objective evidences).

• Inflammatory bowel diseases (IBD), which, in the various stages of the disease, can occur throughout all intestinal parietal layers and cause.

Considering the high initial miss rate and the expected diagnostic performance (35-75% of cases submitted to a new EGDS and 6% of cases to a second colonoscopy), it may be appropriate repeating EGDS and/or colonoscopy before proceeding to an evaluation of the small intestine.

Understanding etiology and site of obscure hemorrhages is an essential step in order to institute an appropriate and effective therapy. Therefore, if the traditional endoscopic procedures has failed to detect the source of bleeding, a focused study of the small intestine is necessary.

As it is known, the small intestine is the longest part of the gastrointestinal tract, and it extends for 6-7 meters from ligament of Treitz to ileocecal valve. Its length, its position within the digestive tract (it’s about 80 cm from the mouth and 150 cm from the anus) and its meandering tubular shape, make endoscopy difficult. In fact, up until some years ago a complete endoscopic exploration was possible only with the use of intraoperative endoscopy.

For this reason, in the past, small intestine evaluation was largely based on Conventional Radiologic procedures, especially on fluoroscopic techniques, performed by administering barium orally or via nasogastric tube. However, they have been proven to be less useful in case of suspected neoplastic disease, especially when used on OGIB patients. Their main weakness is the inability to “see beyond” the mucosa and to assess the involvement of visceral walls and extraparietal tissues, since they can only take advantage of indirect signs.

The current imaging techniques, such as Ultrasonography (US), Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) have downgraded the role of Conventional Radiology in the study of the small intestine. In fact, the latter examine not only thickness, parietal structure and extraluminal involvement degree, but also parenchymatous organs and other adjacent structures (vessels, lymphonodes, etc...).

The use of CT in the evaluation of gastrointestinal diseases has been encouraged by the advent of multidetector technology, which can study wide body volumes with a relatively low scan time and display high-space resolution multiplanar reconstructions.

Capsule Endoscopy (CE) and CT Enteroclysis are two new techniques that have been proven useful for the evaluation of the small intestine. CE, unlike conventional endoscopic procedures, is able to “navigate” within intestinal loops, detecting the mucosal surface of the small intestine and generating an elevate number of high-definition images.

CT Enteroclysis, in contrast to Conventional Radiologic procedures, offers an excellent evaluation of the intestinal wall and extraintestinal extrinsic processes that can sometimes be liable for intestinal manifestations. Moreover, thanks to the use of intravenous (i.v.) contrast agents (CA), CT Enteroclysis can - for example - detect a possible hypervascularuty of the intestinal mucosa, a sign of an active inflammation.

Otherwise, in patients suffering from massive and/or hemodynamically unstable bleeding, not eligible for direct endoscopy, the first diagnostic step is mesenteric angiography, even for its therapeutic potentials, including superselective mesenteric embolization. But angiography, like marked red cells scintigraphy, is little sensitive in the absence of an intense haemorrhage.

Purpose of our work is to compare the diagnostic value of CE with CT enteroclysis through a retrospective evaluation of a group of patients consecutively submitted to both procedures.

Informed consent was taken from all the patients before subjecting them to exams.

Materials and methods

68 patients (27 males and 41 females, average age 58.8), referred to our Department of Radiology in 36 months due to anemia and occult-obscure gastrointestinal bleeding, have been submitted first to Capsule Endoscopy of small intestine (65 patients), large intestine (2 patients) and small-large intestine
(1 patient), and then to CT enteroclysis of small intestine (6 patients) and small-large intestine (62 patients).

Clinical history has been learnt through patients’ medical records.

The results of CE and CT enteroclysis have been verified on the basis of a clinical 24 months follow-up, histologic report and - in patients subdued to surgical procedure - on post-surgery result.

CT enteroclysis has been performed with 64-detector row CT scanners.

All the patients followed a low-waste diet during the 3 days prior to the exam, while the previous day a cathartic preparation was performed with the assumption of an iso-osmolar watery solution (2'000 cc of 34.8 g Isocolan).

Furthermore, a 6 hours fast was taken before the exam.

Distension of small intestine loops has been performed with oral subministration of 1'500 cc of isotonic solution (1,5 packets of 34.8 g Isocolan), that was drunk 60 minutes before the exam and in a time of less than 15 minutes.

Water isn’t suitable because, since it’s absorbed during bowel transit, it causes hypovolemia and doesn’t distend adequately intestine loops, preventing detection of possible endoluminal lesions (false negatives).

For this reason isotonic watery solutions are preferable because, since they are iso-osmotic to extracellular fluids, they aren’t absorbed by bowel mucosa, and they can pass through all the small intestine without significant volume variations, distending more effectively intestine loops. Moreover, they lack side effects and stimulate peristalsis, reducing the procedure time.

To study the large intestine, before CT, the radiologist has performed retrograde distension through enteroclysis of 2'000 cc of lukewarm water, while the patient was in a left lateral decubitus, directly on CT tablet.

A few minutes before the procedure, a bowel antispasmodic agent (10 mg i.v. hyoscine N-butylbromide) has been administered to reduce bowel peristalsis, improve intestine filling and patient’s tolerability, and, finally, delay stimulus to defecation. Antispasmodic agent is contraindicated in case of hypersensitivity to the medication, acute angle closure glaucoma, prostatic hyperplasia (and other causes of urinary retention), gastrointestinal stenosis (such as pyloric stenosis), paralytic ileus, ulcerative colitis, megacolon, gastrointestinal atony in old men and debilitate patients, myasthenia gravis and cardiac tachyarrhythmias.

CT scans have been performed after administration of 2 cc/kg of water-soluble contrast agent (Iomeron 400) with a concentration of 4 mg I/ml, through an automatic injector with an infusion speed of 1,5 mg/Kg/s (equal to about 4 ml/s for each patient).

CT scan has been performed with a monophasic technique in portal phase, and contrast agent concentration in aorta has been monitored with the help of a bolus-tracking program. Regulations for intravascular contrast agent administration have been respected. Specifically, we have accomplished an accurate clinic-anamnestic analysis in order to exclude severe forms of liver, kidney or cardiovascular failure, clinically evident hyperparathyroidism, Waldenström’s paraproteinemia or multiple myeloma. In patients with proven allergic risk a premedication with cortisone and antihistamines has been performed before CT procedure.

Multiplanar reconstruction has been accomplished thanks to workstations with dedicated software.

For endoscopic procedure we have used a capsule of 11x26 mm and 4 g, which, once ingested, can naturally pass through the gastrointestinal tract. Illumination is guaranteed by 6 autonomous LEDs. CE is provided with a radio transmitter, a battery with a power life of 8 hours and a camera able to record 2 images per second (making a total of 50'000 images in the 8 hours of registration).

Along the way in the gastrointestinal tube, capsule catches and transmits video images to 9 sensors, located in the patient’s skin, that detect signals and send them directly to an outer recording device, called Data Recorder, that stores images; these images are later downloaded to a computerised workstation, where they can finally be analyzed for diagnostic purposes.

Procedure is well tolerated by the patients, who can return to their normal everyday activities after having ingested the capsule.

8 hour after the administration, patients go again to hospital to transfer the data obtained by capsule, that is usually expelled (in case of physiologic bowel motility) 24-40 hours after its administration. Absolute contraindications to capsule’s use include: bowel obstruction (supposed or known), pregnancy, stenoses or fistulas, pacemakers, defibrillators, other electro-medical devices and postactinic intestinal disease.
Relative contraindications comprise: big and/or multiple intestinal diverticula, Zencker’s diverticulum, severe intestinal motility disorders and dysphagia.

In case of suspected stenoses that may obstruct capsule’s transit after swallowing it, it’s appropriate to give patient a “patency” capsule, made of a lactose layer that’s able to degrade itself after about 40 hours of capsular retention (in the case the capsule isn’t expelled through feces).

Bowel preparation for this procedure exclusively consists of fast, starting from the evening before the exam.

CE procedure allows the operator to virtually navigate within intestinal loops, examining the morphological aspect of the entire mucosal surface. Using a less invasive technique compared to other endoscopic procedures, such as push enteroscopy (which is used only in thermosteal interventional therapy of bleeding lesions and in the follow-up/therapy of patients affected by Peutz-Jeghers’ syndrome) and double balloon enteroscopy (which, apart from a lesser diagnostic power compared to capsule endoscopy, it’s also characterized by an elevate number of complications: abdominal pain, pancreatitis and bleedings).

Statistic analysis of data has been conducted using spreadsheet software.

Results

With the combined use of the two procedures, in 54 of 68 patients (80%) a clear diagnosis of the disease is reached.

14 patients (20%) have been judged free from active gastrointestinal disease by the two procedures.

We observed that only in 12 of 54 patients positive for disease the two procedures have simultaneously detected an ongoing disease, though a diagnostic concordance was pointed-out just in 3 cases (equal to about 5% of patients) (inflammatory bowel disease, jejunal polyp and gastritis). In the remaining 9 patients (equal to about 18% of the patients positive for disease according to both procedures) CE and CT enteroclysis have given discordant results about diagnostic definition (see table 1).

In 14 patients (equal to 21% of the studied cases) disease has been exclusively detected by CE, which has enabled the diagnosis of mucosal lesions such as angiodysplasias and erosions, entirely silent when studied by CT (see table 2).

By contrast, in 28 patients (equal to 41% of the studied cases), CT enteroclysis has found a gastrointestinal disease not identified by CE and, specifically, diseases unrelated to mucosal layer (see table 3).

Table 1: Diagnostic discordance between the 2 procedures.

<table>
<thead>
<tr>
<th>#</th>
<th>CE diagnosis</th>
<th>CT enteroclysis diagnosis</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Lymphangiectasia and angiodysplasia</td>
<td>Diverticulosis of colon</td>
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<tr>
<td>2</td>
<td>Polyps</td>
<td>Other (collection of blood in pelvis)</td>
</tr>
<tr>
<td>3</td>
<td>Erosions</td>
<td>Periappendicular inflammation</td>
</tr>
<tr>
<td>4</td>
<td>Erosions</td>
<td>Gastric wall thickening and diverticulosis</td>
</tr>
<tr>
<td>5</td>
<td>Gastritis</td>
<td>Diverticulosis</td>
</tr>
<tr>
<td>6</td>
<td>Lymphangiectasia and angiodysplasia</td>
<td>Other (pancreatic cancer)</td>
</tr>
<tr>
<td>7</td>
<td>Lymphangiectasia and angiodysplasia</td>
<td>Other (endometriosis)</td>
</tr>
<tr>
<td>8</td>
<td>Follicular hyperplasia</td>
<td>Sigmoid wall thickening</td>
</tr>
<tr>
<td>9</td>
<td>Lymphangiectasia and angiodysplasia</td>
<td>Polyp</td>
</tr>
<tr>
<td>10</td>
<td>IBD</td>
<td>Hiatus hernia</td>
</tr>
<tr>
<td>11</td>
<td>GIST</td>
<td>Diverticulosis</td>
</tr>
<tr>
<td>12</td>
<td>Gastritis</td>
<td>Rectum wall hyperemia</td>
</tr>
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Table 2: Diseases found by CE but not by CT.

<table>
<thead>
<tr>
<th>#</th>
<th>CE diagnosis</th>
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<tbody>
<tr>
<td>4</td>
<td>Lymphangiectasia and angiodysplasia</td>
</tr>
<tr>
<td>2</td>
<td>Polyps (1 jejunal)</td>
</tr>
<tr>
<td>3</td>
<td>Erosions</td>
</tr>
<tr>
<td>1</td>
<td>Follicular hyperplasia</td>
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<tr>
<td>1</td>
<td>Gastritis</td>
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<tr>
<td>1</td>
<td>GIST</td>
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<tr>
<td>1</td>
<td>IBD</td>
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<tr>
<td>1</td>
<td>Coeliac disease</td>
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Discussion

The results of our study, according to the most recent literature, seem to suggest that CE is able to detect morphological alterations of intestinal mucosa, not identified by CT. In particular, CE has correctly documented an ongoing disease in 26 patients. Of the 42 patients considered not affected
by disease, 14 have resulted negative at CT too, while in 28 CT has detected an ongoing disease as cause of bleeding.

We have found particularly interesting the individuation, in 14 patients (equal to 26% of case of disease) with the CE, of lesions such as angiodysplasias and erosions as causes of gastrointestinal bleeding not detected by CT. Of the other 12 patients positive at CE, in 3 cases diagnosis has been confirmed by CT, while in the remaining 9 patients the two procedures have shown a diagnostic conflict, detecting different diseases at the same time.

So, the diagnostic performance (finding of lesions that unequivocally explain bleeding) of capsule endoscopy has been equal to 60%. The most frequently observed lesions have been angiodysplasias (29%), erosions (21%) and polyps (14%).

With CT enteroclysis it has been possible to detect an ongoing disease in 38 patients (equal to 70% of cases of disease). In particular, CT has been able to find the presence of intestinal (and not) diseases in 28 patients (equal to 50% of ill cases) without any disease evidence at CE, including 4 cases of neoplasm. In 14 of 30 patients considered free from disease by CT, CE had identified an ongoing disease anyway.

Therefore, CT enteroclysis’ diagnostic performance has been equal to 78%.

It’s necessary to say that CE allows to display intestinal lumen and analyze the entire morphological aspects of mucosa. It provides the procedure with an added value in the study of the gastrointestinal mucosa disease, especially concerning the most distal portions of the small intestine, which, as already stated, are hard to explore with the traditional endoscopic procedures. If patients hadn't submitted themselves to CE, a diagnosis could not have been found in 21 patients actually ill.

However, the CE’s impossibility to give a panoramic visualisation of structural components (parietal and extraparietal) of the abdominal organs, sometimes represents an important diagnostic limitation, especially when we need an evaluation of extraintestinal problems connected to the intestinal disease undergoing study.

CT enteroclysis allows a very rapid panoramic, standardised and high-sensitivity visualisation for parietal, extraparietal and extraintestinal diseases, while remaining aware of exposing patients to ionizing radiations and of the possible side effects linked to the necessary intravenous administration of contrast agent.

Conclusions

New endoscopic procedures as well as CT enteroclysis have improved the small intestine evaluation, enhancing the diagnostic power and, consequently, the therapy of potentially bleeding lesions. Diagnostic and therapeutic algorithm of obscure gastrointestinal bleeding has got better, giving the opportunity to manage the patient depending on his clinical presentation.

Our experience’s data, according to what has been extensively documented by literature, suggests a different diagnostic ability of the two procedures. In particular, CE, considered the gold standard for the study of obscure gastrointestinal bleedings, has shown a high diagnostic accuracy in detecting intestinal mucosal alterations as causes of obscure bleedings. CT enteroclysis, however, represents a procedure with high sensitivity and a good diagnostic accuracy for the identification not only of intestinal parietal diseases, but also of extraparietal and extraintestinal anomalies, which are often causes of obscure gastrointestinal bleeding, representing an important instrument for patients’ management.

Our evidence suggests that CE, if performed early in the diagnostic management of patients with obscure gastrointestinal bleeding (for example, immediately after a negative gastroscopy or colonoscopy), thanks to its high specificity, could decrease the time needed to keep diagnosis, avoiding many expensive procedures with a low diagnostic performance. Nevertheless, in front of a negative result given by the CE procedure, linked to its

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<tr>
<td>2</td>
<td>Hiatus hernias</td>
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<tr>
<td>6</td>
<td>Diverticulosis</td>
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<tr>
<td>4</td>
<td>Ileitis</td>
</tr>
<tr>
<td>4</td>
<td>Neoplasm</td>
</tr>
<tr>
<td>2</td>
<td>Polyps</td>
</tr>
<tr>
<td>8</td>
<td>Inflammatory parietal thickenings</td>
</tr>
<tr>
<td>2</td>
<td>Endometriosis</td>
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Table 3: Diseases found by CT but not by CE.
intrinsic low sensitivity and to the various causes of obscure gastrointestinal bleeding often unrelated to mucosal component, it’s necessary to proceed the instrumental diagnostic practice.

From this point of view, CE and CT enteroclysis could represent two complementary diagnostic procedures, especially by integrating the two for the diagnostic definition of obscure bleedings of the digestive tube.

Iconography

Picture 1: 63-year-old man with obscure gastrointestinal bleeding. Presence of a mucosal angiodysplasia, well documented by capsule endoscopic procedure (arrow in picture A), but not demonstrable by CT enteroclysis (picture B).

Picture 2 A: CT enteroclysis: exam performed after administration of i.v. contrast agent in portal phase, after bowel loops distension through administration of a watery solution of polyethylene glycol (asterisks): parietal thickening of the last ileum loop (white arrow) with submucosal edema and mucosal hyperemia (black arrow), irregular due to the presence of linear ulcers. Findings compatible to active IBD with ileal location.

Picture 2 B: Capsule endoscopy: clinical case compatible to IBD. Case of diagnostic concordance between the two procedures.

Picture 3: 48-year-old patient with obscure gastrointestinal bleeding. CT scan (A) found a lesion close to pancreatic head (white arrows) suspected for heteroplasia, diagnosis confirmed by pathologic procedure. Capsule endoscopy (B) “stopped” in this patient nearby duodenum, not giving any information for diagnostic purposes.

References


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