

Wireless capsule endoscopy

A Mata, J Llach, JM Bordas

A Mata, J Llach, JM Bordas, Digestive Endoscopy Unit, Gastroenterology Service, Imd, Hospital Clinic Barcelona, Barcelona 08036, Spain

Correspondence to: Dr. Josep M Bordas, Digestive Endoscopy Unit, IMD, Hospital Clinic of Barcelona, c/Villarroel 170, Barcelona 08036, Spain. jmbordas@clinic.ub.es

Telephone: +34-93-2275513 Fax: +34-93-2279859

Received: August 11, 2006 Revised: December 12, 2006

Abstract

Wireless capsule endoscopy is a new technique that allows complete exploration of the small bowel without external wires. Its role has been analyzed in many small bowel diseases such as obscure gastrointestinal bleeding, Crohn's disease and gastrointestinal polyposis syndromes with promising results. Studies on other pathologies (i.e. small bowel tumour, celiac disease) are under evaluation to define the role of this technique.

© 2008 WJG. All rights reserved.

Key words: Wireless capsule endoscopy; Small bowel; Obscure gastrointestinal bleeding; Crohn's disease; Gastrointestinal polyposis syndrome

Peer reviewer: Joerg C Hoffmann, Dr, Medizinische Klinik I, Charité-Universitätsmedizin Berlin, Campus Benjamin Franklin, Hindenburgdamm 30, Berlin D12200, Germany

Mata A, Llach J, Bordas JM. Wireless capsule endoscopy. *World J Gastroenterol* 2008; 14(13): 1969-1971 Available from: URL: <http://www.wjgnet.com/1007-9327/14/1969.asp> DOI: <http://dx.doi.org/10.3748/wjg.14.1969>

The need and wish to perform endoscopic examination of the small bowel have led to the development of an ingestible miniature camera device capable of obtaining images of the whole small intestine.

Wireless capsule endoscopy is a new type of radiotelemetry video system which is small enough to be swallowed and has no external wires, fiberoptic bundles or cables. It measures 11 mm × 26 mm and weighs 3.7 g. By using a lens of a short focal length, images are obtained as the optical window of the capsule sweeps past the gut wall, without requiring air insufflation of the gut lumen. The capsule is propelled by peristalsis through the gastrointestinal tract and does not require a pushing force to propel it

through the bowel. Up to 2002, more than 250 000 capsule explorations had been performed^[1], and nowadays this number has increased significantly.

The M2A capsule [Mouth to (2) Anus] initially, and Pillcam SB (Small Bowel) later, from GIVEN (GastroIntestinal Video Endoscopy, Given Imaging Limited, Yoqneam, Israel), and endocapsule from Olympus are the capsules that have been approved for use in the clinical setting. Each capsule contains a lens, light emitting diodes (LEDs), a color camera, 2 batteries, a radio frequency transmitter and an antenna. The camera takes 2 images per second and transmits these by means of radio frequency to a sensor array in a belt placed around the patient's abdomen and from there to a recording device in the belt. Once the study is completed (between 6 and 8 h), the recording device is removed and the images are downloaded to a computer workstation with software that displays the video images on a computer monitor.

Capsule endoscopy can be performed as an outpatient procedure. Small bowel preparation is still a controversial issue. Some groups used fasting or clear liquids for 10 to 12 h (or even for 24) before the study, although some studies suggest that bowel preparation (with 2 or 4 litres of polyethylene glycol based electrolyte solution or oral sodium phosphate preparation) improves the visualization of the small intestine^[2,3]. A recent Spanish prospective multicenter trial published in abstract form, has shown that all three strategies have similar results^[4].

The role of wireless capsule endoscopy has been analyzed in patients with obscure gastrointestinal bleeding and in comparative studies with endoscopic^[5] or radiographic methods^[6]. Capsule endoscopy has shown a diagnostic yield of 71% compared to 29% of push enteroscopy, in a recent analysis of 7 prospective studies^[7]. Another study has shown that the detection rate of capsule endoscopy is higher in patients with ongoing overt bleeding than in those with anemia or prior overt bleeding^[8]. In a comparative study with intraoperative enteroscopy, the sensitivity, specificity, positive and negative predictive value of capsule endoscopy were 95%, 75%, 95% and 86%, respectively^[9]. For obscure gastrointestinal bleeding, capsule endoscopy has shown better results than radiographic studies, which have a low diagnostic yield in detecting small bowel lesions^[6,10].

Capsule endoscopy has also shown its usefulness in the evaluation of the small intestine in patients with suspected or known Crohn's disease^[11], and is superior to small bowel follow-through^[12-14], enteroclysis^[15,16], push enteroscopy^[16] and CT enteroclysis^[17] for identifying small intestinal dis-

ease. The sensitivity and specificity of capsule endoscopy have recently been estimated to be 89.6% and 100%, respectively^[18].

However, the diagnostic criteria of capsule endoscopy for Crohn's disease have not yet been defined. Mucosal breaks and aphthous ulcers or erosions are also seen in asymptomatic healthy volunteers, and small bowel ulcers and strictures have been associated with the use of nonsteroidal anti-inflammatory agents, making it, at times, difficult to differentiate these findings with the presence of a Crohn's disease^[9].

Capsule endoscopy has been performed in patients with gastrointestinal polyposis syndrome, and several studies have suggested that it may be useful in the detection of small bowel polyps^[19,20]. A comparative prospective study showed that capsule endoscopy can detect more polypoid lesions than small-bowel follow through in these patients^[21]. Nevertheless, more prospective studies with longer follow-up are required, to define the role of capsule endoscopy findings in the outcome of patients with gastrointestinal polyposis syndrome.

Capsule endoscopy in the pediatric population and esophageal capsule endoscopy (Pillcam ESO) have shown promising results but larger prospective trials are needed to define their role in these patients.

Other possible indications for capsule endoscopy, such as celiac disease, HIV positive patients with gastrointestinal symptoms, mal-absorption or small bowel transplantation, have not been defined so far, and more prospective trials assessing the use of capsule endoscopy in these groups of patients are still needed.

The main contraindication of performing the capsule endoscopy procedure is the suspicion or knowledge of a gastrointestinal obstruction, stricture or fistula. Other former contraindications such as implanted cardiac pacemakers or other electro-medical devices and patients with swallowing disorders have been excluded since some studies showed no interference between capsule endoscopy and pacemaker or implantable defibrillators functioning^[22,23] and endoscopic placement of the capsule into the gut^[24].

The capsule retention rate varies with the indication of the examination, being reported of 1.5% in patients with obscure gastrointestinal bleeding^[25] and 5% in patients with suspected Crohn's disease^[26], who are usually asymptomatic^[10,25] and may require endoscopic removal or surgery. How to prevent capsule retention has yet to be defined since neither radiologic studies nor the "patency capsule" has shown conclusive results so far. The clinical setting of each patient, as well as some features related to intestinal strictures (previous small bowel surgery, NSAIDs, suspected small bowel Crohn's disease), have to be analyzed prior to the study. Patients should be informed about the possibility of capsule retention and further treatment.

REFERENCES

- Ginsberg GG, Barkun AN, Bosco JJ, Isenberg GA, Nguyen CC, Petersen BT, Silverman WB, Slivka A, Taitelbaum G. Wireless capsule endoscopy: August 2002. *Gastrointest Endosc* 2002; **56**: 621-624
- Dai N, Gubler C, Hengstler P, Meyenberger C, Bauerfeind P. Improved capsule endoscopy after bowel preparation. *Gastrointest Endosc* 2005; **61**: 28-31
- de Franchis R, Avgerinos A, Barkin J, Cave D, Filoche B. ICCE consensus for bowel preparation and prokinetics. *Endoscopy* 2005; **37**: 1040-1045
- Pons V, Gonzalez B, Gonzalez C, Perez-Cuadrado E, Fernandez S, Fernandez-Urien I, Mata A, Espinos J, Perez Grueso MJ, Arguello L. Evaluation of different bowel preparations for study with capsule endoscopy: a prospective randomized controlled study. Abstract presented at the ICCE Paris, France, 2006
- Mata A, Bordas JM, Feu F, Gines A, Pellise M, Fernandez-Esparrach G, Balaguer F, Pique JM, Llach J. Wireless capsule endoscopy in patients with obscure gastrointestinal bleeding: a comparative study with push enteroscopy. *Aliment Pharmacol Ther* 2004; **20**: 189-194
- Costamagna G, Shah SK, Riccioni ME, Foschia F, Mutignani M, Perri V, Vecchioli A, Brizi MG, Picciocchi A, Marano P. A prospective trial comparing small bowel radiographs and video capsule endoscopy for suspected small bowel disease. *Gastroenterology* 2002; **123**: 999-1005
- Melmed GY, Lo SK. Capsule endoscopy: practical applications. *Clin Gastroenterol Hepatol* 2005; **3**: 411-422
- Pennazio M, Santucci R, Rondonotti E, Abbiati C, Beccari G, Rossini FP, De Franchis R. Outcome of patients with obscure gastrointestinal bleeding after capsule endoscopy: report of 100 consecutive cases. *Gastroenterology* 2004; **126**: 643-653
- Hartmann D, Schmidt H, Bolz G, Schilling D, Kinzel F, Eickhoff A, Huschner W, Moller K, Jakobs R, Reitzig P, Weickert U, Gellert K, Schultz H, Guenther K, Hollerbuhl H, Schoenleben K, Schulz HJ, Riemann JF. A prospective two-center study comparing wireless capsule endoscopy with intraoperative enteroscopy in patients with obscure GI bleeding. *Gastrointest Endosc* 2005; **61**: 826-832
- Hara AK, Leighton JA, Sharma VK, Fleischer DE. Small bowel: preliminary comparison of capsule endoscopy with barium study and CT. *Radiology* 2004; **230**: 260-265
- Papadakis KA, Lo SK, Fireman Z, Hollerbach S. Wireless capsule endoscopy in the evaluation of patients with suspected or known Crohn's disease. *Endoscopy* 2005; **37**: 1018-1022
- Mow WS, Lo SK, Targan SR, Dubinsky MC, Treyzon L, Abreu-Martin MT, Papadakis KA, Vasilias EA. Initial experience with wireless capsule enteroscopy in the diagnosis and management of inflammatory bowel disease. *Clin Gastroenterol Hepatol* 2004; **2**: 31-40
- Herrerias JM, Caunedo A, Rodriguez-Tellez M, Pellicer F, Herrerias JM Jr. Capsule endoscopy in patients with suspected Crohn's disease and negative endoscopy. *Endoscopy* 2003; **35**: 564-568
- Fireman Z, Mahajna E, Broide E, Shapiro M, Fich L, Sternberg A, Kopelman Y, Scapa E. Diagnosing small bowel Crohn's disease with wireless capsule endoscopy. *Gut* 2003; **52**: 390-392
- Liangpunsakul S, Chadawalada V, Rex DK, Maglinte D, Lappas J. Wireless capsule endoscopy detects small bowel ulcers in patients with normal results from state of the art enteroclysis. *Am J Gastroenterol* 2003; **98**: 1295-1298
- Chong AK, Taylor A, Miller A, Hennessy O, Connell W, Desmond P. Capsule endoscopy vs. push enteroscopy and enteroclysis in suspected small-bowel Crohn's disease. *Gastrointest Endosc* 2005; **61**: 255-261
- Voderholzer WA, Beinhörl J, Rogalla P, Murrer S, Schachschal G, Lochs H, Ortner MA. Small bowel involvement in Crohn's disease: a prospective comparison of wireless capsule endoscopy and computed tomography enteroclysis. *Gut* 2005; **54**: 369-373
- Dubcenco E, Jeejeebhoy KN, Petroniene R, Tang SJ, Zalev AH, Gardiner GW, Baker JP. Capsule endoscopy findings in patients with established and suspected small-bowel Crohn's disease: correlation with radiologic, endoscopic, and histologic findings. *Gastrointest Endosc* 2005; **62**: 538-544
- Schulmann K, Hollerbach S, Kraus K, Willert J, Vogel T, Moslein G, Pox C, Reiser M, Reinacher-Schick A, Schmiegel W.

- Feasibility and diagnostic utility of video capsule endoscopy for the detection of small bowel polyps in patients with hereditary polyposis syndromes. *Am J Gastroenterol* 2005; **100**: 27-37
- 20 **Soares J**, Lopes L, Vilas Boas G, Pinho C. Wireless capsule endoscopy for evaluation of phenotypic expression of small-bowel polyps in patients with Peutz-Jeghers syndrome and in symptomatic first-degree relatives. *Endoscopy* 2004; **36**: 1060-1066
- 21 **Mata A**, Llach J, Castells A, Rovira JM, Pellise M, Gines A, Fernandez-Esparrach G, Andreu M, Bordas JM, Pique JM. A prospective trial comparing wireless capsule endoscopy and barium contrast series for small-bowel surveillance in hereditary GI polyposis syndromes. *Gastrointest Endosc* 2005; **61**: 721-725
- 22 **Leighton JA**, Sharma VK, Srivathsan K, Heigh RI, McWane TL, Post JK, Robinson SR, Bazzell JL, Fleischer DE. Safety of capsule endoscopy in patients with pacemakers. *Gastrointest Endosc* 2004; **59**: 567-569
- 23 **Leighton JA**, Srivathsan K, Carey EJ, Sharma VK, Heigh RI, Post JK, Erickson PJ, Robinson SR, Bazzell JL, Fleischer DE. Safety of wireless capsule endoscopy in patients with implantable cardiac defibrillators. *Am J Gastroenterol* 2005; **100**: 1728-1731
- 24 **Leung WK**, Sung JJ. Endoscopically assisted video capsule endoscopy. *Endoscopy* 2004; **36**: 562-563; author reply 563-564
- 25 **Sears DM**, Avots-Avotins A, Culp K, Gavin MW. Frequency and clinical outcome of capsule retention during capsule endoscopy for GI bleeding of obscure origin. *Gastrointest Endosc* 2004; **60**: 822-827
- 26 **Lewis B**. How to prevent endoscopic capsule retention. *Endoscopy* 2005; **37**: 852-856

S- Editor Liu Y L- Editor Wang XL E- Editor Ma WH