

Double balloon enteroscopy: Initial experience in a university hospital

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Abstract

Introduction: The study of the small bowel is a challenging task that has sparked interest and progress in medicine. In this context, double balloon enteroscopy (DBE) has allowed the direct visualization of the small intestine. **Objective:** To describe indications, procedure characteristics, findings, complications, and follow-up of patients taken to DBE at the Hospital de San José, Bogotá, between November 2011 and April 2019. **Methodology:** Case series study. Patients with a clinical indication or diagnostic images suggestive of small bowel lesion were included. Descriptive statistics were used. **Results:** 45 enteroscopies were performed in 44 patients, with a median age of 58 years. The main indication was potential small bowel bleeding (53.3%) and chronic diarrhea (11.1%). Anterograde procedures were more frequent. Most of the results were normal (46.7%); tumors (11.1%), Crohn's disease (8.9%), and ulcers/erosions (6.7%) were among the most frequent findings. The diagnostic yield was 53.3% and the correlation with capsule endoscopy (CE) was 37.5%, and with imaging studies 42.9%. There were no complications. 91.1 % of patients were followed up on after a median of 56 months, with 78.1 % reporting symptom remission. The aim of enteroscopy was diagnostic in 84.4%. **Conclusions:** DBE is useful in the evaluation of the small intestine with a therapeutic possibility. The results are similar to those reported in the world literature. Follow-up can define the need for repeating the procedure, performing further studies, or symptom resolution.

Keywords

Double Balloon Enteroscopy; Gastrointestinal Bleeding; Capsule Endoscopy.

INTRODUCTION

For a long time, the small intestine was considered the “black box” by gastroenterologists because of the impossibility of an endoscopic visualization by a non-surgical method; this was due to its length, anatomical position, and size⁽¹⁾. However, in the 21st century, endoscopic tech-

niques were developed in order to study the small intestine without the need for surgery^(2,3). Study methods include endoscopic video capsule (VCE), enteroscopy with different techniques, and imaging studies.

VCE is considered a first-line study with a high negative predictive value, but with the limitation of not performing therapeutic interventions⁽⁴⁾. An additional technique is an

enteroscopy, which should be performed if the findings of the VCE or other imaging studies are positive since it has a therapeutic possibility (biopsy, coagulation, polypectomy, among others)⁽⁵⁾. However, enteroscopy is invasive, requires sedation, and is difficult in patients with adhesions⁽⁶⁾. Some studies show that VCE and double-balloon-enteroscopy (DBE) have comparable diagnostic yields of up to 60 %⁽⁴⁾.

Among the methods that have been developed, there is the assisted DBE introduced in 2001, single-balloon DBE in 2007, spiral DBE in 2008, and through-the-scope balloon-assisted enteroscopy (TTS-BAE[®]) in 2013, which uses a standard endoscope without the need for an overtube. In general, these techniques have comparable diagnostic yields^(7,8), and their choice depends on local experience and availability. There have been no reported differences in the diagnostic yield, therapeutic performance, or complication rate between spiral enteroscopy and DBE^(9,10) and between single-balloon enteroscopy and DBE⁽¹¹⁻¹³⁾.

There are two possibilities to perform it. The access route is chosen depending on the clinical presentation and review of previous studies. In up to 85 % of cases, a complete examination of the small intestine is achieved when both pathways are used^(14,15). Its complications are low and are more related to the performance of therapeutic procedures, including pancreatitis (2 %) and perforation (1 %)⁽⁴⁾. Intraoperative enteroscopy is a useful but invasive diagnostic and eventually a therapeutic procedure; in general, its use should be limited to settings with difficulty performing enteroscopy, either by availability, previous surgery, or severe adhesions⁽¹⁴⁾.

The main indication is potential bleeding from the small intestine, which accounts for 5 % of the causes of gastrointestinal bleeding⁽⁴⁾; it is called this way because by using all diagnostic tools, it is possible to establish the cause of the bleeding 75 % of the time, while obscure gastrointestinal bleeding is diagnosed in the patient with negative endoscopic and small intestine studies⁽¹⁶⁻¹⁸⁾.

The study of small bowel bleeding is difficult, can be recurrent, and is related to neoplasms, especially in patients younger than 40 years who are more likely to have small bowel tumors (lymphoma, carcinoid tumors, adenocarcinoma, and hereditary polyposis)⁽¹⁴⁾. Therefore, a diagnostic algorithm that rationally uses the locally available tools is required. Considering the above, it is essential to carry out studies in patients brought to DBE that allow us to know the indications, findings, complications, and relationship with other diagnostic methods and their impact on the outcomes.

METHODS

Descriptive observational study type case series. The information was collected prospectively. Patients over 18 years

old were included, whose clinical indication or diagnostic imaging suggesting small bowel injury, and thus, DBE was performed. It excluded intraoperative enteroscopies. DBE was performed with a Fujinon EN-450T5[®] enteroscope according to the usual technique and without fluoroscopy (which is not used in most studies).

Information about sociodemographic variables was obtained—sex and age. In regard to the procedure, the following data were collected: indication, duration, access route defined according to the patient's clinical picture, imaging studies or VCE, distance explored—it was calculated both in centimeters via antegrade starting from the pylorus and retrograde, from the ileocecal valve, adding the advances and subtracting the setbacks approximately—findings, results of biopsies, correlation with other studies, and patient's clinical status in routine follow-up. Qualitative variables were described by absolute and relative frequencies. The quantitative variables were described using central tendency and dispersion measures: medians and interquartile ranges IQR if the distribution was not normal suggested or means and standard deviations (SD) if otherwise. *Diagnostic yield* was considered the relative frequency of abnormal findings and the correlation of similar findings between DBE and VCE or imaging studies.

ETHICAL CONSIDERATIONS

The Ethics Committee approved the protocol of the Hospital de San José in Bogotá and the Research Committee of the Fundación Universitaria de Ciencias de la Salud.

This work does not involve additional procedures, but it does use the information from them. Nor is any additional benefit expected since its scope is descriptive. In addition, it is classified as risk-free research according to resolution 8430 of 1993 of the Colombian Ministry of Health.

RESULTS

In total, 49 procedures were performed, four were excluded—three intraoperative enteroscopies and one performed on a child under 18 years; therefore, 45 enteroscopies were included out of 44 patients. The median age was 58 years (IQR: 48.5 to 70.5 years), with a minimum of 18 years and a maximum of 83 years. The majority were women ($n = 29$, 65.9 %).

The main indication was potential gastrointestinal bleeding from the small intestine ($n = 24$, 53.3 %) followed by chronic diarrhea ($n = 5$, 11.1 %) and chronic abdominal pain ($n = 4$, 8.9 %) (**Table 1**). The average procedure time was 90.2 minutes (SD: 23.6 minutes), with a minimum of 30 minutes and a maximum of 150 minutes.

Table 1. Indications and time of the DBE procedure

Variable	n (%)
Indication	
- Potential gastrointestinal bleeding from the small intestine	24 (53.3)
- Chronic diarrhea	5 (11.1)
- Chronic abdominal pain	4 (8.9)
- Crohn's disease	3 (6.7)
- Ileum thickening	2 (4.4)
- Intestinal polyposis (PAF and Peutz-Jeghers syndrome)	2 (4.4)
- Stenosis (jejunum and ileocecal valve)	2 (4.4)
- Tumor in the small intestine	2 (4.4)
- Jejunitis under investigation	1 (2.2)
Procedure time in minutes-average (SD)	90.2 (23.6)

FAP: Familial adenomatous polyposis.

28 procedures via antegrade and 17 via retrograde were performed. The median length achieved via antegrade was 310 cm (IQR: 222-400 cm), and via retrograde was 195 cm (IQR: 176-475 cm).

Most of the procedures were normal (n = 21, 46.7 %). Among the most frequent findings were tumors (n = 5, 11.1 %), Crohn's disease (n = 4, 8.9 %), and ulcers or erosions (n = 3, 6.7 %) (Table 2). In five cases (11.1 %), enteroscopy diagnosed lesions within the scope of conventional endoscopic studies, either from intermittent bleeding or undiagnosed lesions. One patient had a giant hiatal hernia with Cameron ulcers that was taken to surgery 11 months after diagnosis. Two patients presented hemorrhage secondary to colon diverticulum managed endoscopically with follow-ups at 14 and 71 months without new bleeding episodes. One presented cecum angiectasis, which was managed with electrocoagulation and a follow-up at 56 months without new bleeding episodes. The fifth case was an immunosuppressed patient with lymphoproliferative syndrome who presented an inflammatory ulcer due to histology in the rectum; anemia was corrected by controlling the underlying pathology with a follow-up at 69 months.

Overall diagnostic yield of BDE was 53.3 % (n = 24 abnormal findings). For the most frequent case, potential gastrointestinal bleeding of the small intestine, this yield was 54.2 %. The correlation of the results with the CVE was 37.5 %, and imaging studies were 42.9 %, whereas either of the two was 40 % (Table 3). There were no complications.

Table 2. Diagnosis according to DBE

Diagnostics	n (%)
Normal	21 (46.7)
Tumor	5 (11.1)
Crohn's disease	4 (8.9)
Ulcer/Erosion	3 (6.7)
Ulcerated diverticulum	2 (4.4)
Polyps	2 (4.4)
Intestinal polyposis	2 (4.4)
Angiectasis in the cecum	1 (2.2)
Ischemic enteritis	1 (2.2)
Stenosis of the jejunum secondary to bridges	1 (2.2)
Postsurgical inflammatory granuloma in the mid-jejunum	1 (2.2)
Giant hiatal hernia with Cameron ulcers	1 (2.2)
Lipoma in the second duodenal portion	1 (2.2)

Table 3. Correlation of DBE with other studies

Study	VCE (n = 16)	Imaging studies* (n = 14)	All studies (n = 30)
Double-balloon enteroscopy	6 (37.5 %)	6 (42.9 %)	12 (40 %)

CAT, CAT Enterography, MRI Enterography, intestinal transit. CAT: computerized axial tomography.

Follow-up was achieved in 91.1 % (n = 41), in a median time of 56 months, with a minimum of 4 and a maximum of 87 months. The majority of these patients were asymptomatic and did not require further studies (n = 32, 78.1 %); four of the patients died from causes unrelated to the procedure (Table 4). Of the 24 patients with potential gastrointestinal bleeding from the small intestine, abnormal findings were reported in 13, of whom 2 (15.4 %) had a new episode of bleeding, while of the 11 patients with normal results, only 1 (9 %) presented a new bleeding episode that was considered secondary to an anal fissure in the coloproctology assessment.

For patients who underwent pathology studies (n = 21), the main result was cancer (n = 5) and chronic non-specific inflammation (n = 5), followed by infectious enteritis (n = 3) (Table 5), only 15.6 % (n = 7) of the DBE were therapeutic. 84.4 % (n = 38) had a diagnostic indication.

Table 4. Follow-up of patients undergoing double-balloon enteroscopy

Follow-up	n (%)
Follow-up patients	41 (91.1)
Follow-up time in months	Median: 56 IQR: 15-65 Minimum: 4 Maximum: 87
Findings	
Resolution of the clinical picture	32 (78.1)
Persistence of the clinical picture	5 (12.2)
Death	4 (9.8)

Table 5. Pathology results

Results	n = 21 (%)
Cancer	5 (23.8)
Chronic non-specific inflammation	5 (23.8)
Infectious enteritis	3 (14.3)
Hyperplastic polyps	2 (9.5)
Villous adenoma with low-grade dysplasia	1 (4.8)
Crohn's disease	1 (4.8)
Hyperplasia of Brunner's glands	1 (4.8)
Hamartomatous polyps	1 (4.8)
Celiac disease	1 (4.8)
Normal	1 (4.8)

DISCUSSION

This study describes the indications, findings, complications, and relationship with other DBE diagnostic methods. It also describes patient follow-up and compares the results with those reported nationally and internationally. At the local level, a series of cases of patients undergoing single-balloon enteroscopy⁽¹⁾ and DBE enteroscopy⁽¹⁹⁾ have been published to date; the specific experience in bleeding was also recently published⁽²⁰⁾. The median age in this study was similar to the DBE reported series^(5,21-24).

Potential gastrointestinal bleeding of the small intestine was also the most frequent indication of DBE in other case series, including those published in Latin America^(3,5,19,21,22,24,25) and in a review that included 66 studies with 12,823 procedures published between 2001 and 2010⁽²⁶⁾. This provides ground to define the procedure as a method for diagnosing and treating this condition.

The route of insertion varies according to the most likely location of the lesion, determined mainly by the medical history associated with image studies such as VCE. The antegrade pathway was the most frequent, which is also the most used in the reported case series^(5,21,23,24). If the location of a lesion is unknown, the antegrade pathway is generally used since the retrograde technique is more complex, requires preparation, less intestine can be explored, and sometimes the ileocecal valve cannot be cannulated⁽²²⁾.

The median distance reached via antegrade was similar to that reported worldwide^(13,23). The median distance reached via retrograde apparently was greater than reported in the literature^(10,24); it is important to note that these measurements in all series are subjective, non-homogeneous, and therefore, inaccurate, so comparisons are difficult. The rate and clinical impact of the complete visualization of the small intestine are controversial⁽²⁷⁻²⁹⁾. There seems to be a consensus that this does not guarantee a greater diagnostic or therapeutic yield⁽³⁰⁾.

The average time of the procedure was 90.2 minutes, and these are very variable (40-180 minutes)^(3,24,31) due to different factors, such as training and experience of the gastroenterologist, history of previous surgery, intestinal adhesions, and obesity⁽³⁰⁾.

Despite the frequency of normal findings⁽²⁶⁾, the benefit of DBE should not be ruled out since the possibility of treatment offered reduces the need for more invasive interventions and surgical risks; moreover, it is a safe method with low complication rates⁽²²⁾. The detection rate of abnormal findings can be increased with a rigorous patient selection and early procedure⁽³²⁾.

The VCE has a variable diagnostic yield (between 45 % and 81 %), with an accuracy rate of up to 30 %; it is accepted that the DBE is a complement to its limitations⁽³⁾. In this study, overall diagnostic yield, defined as the percentage of abnormal findings, was 53.3 %, lower than in other studies^(3,21). This result can be explained in the late performance of the DBE due to administrative issues related to our healthcare system or overdiagnosis of previous studies that increased the amount of DBE that would not have to be performed.

The diagnostic yield for potential gastrointestinal bleeding of the small intestine was 54.2 %, similar to other studies⁽⁴⁾; however, it was low compared with series with results of close to 80 %^(3,31). This difference can be explained due to the long time taken from the onset of symptoms to the completion of complementary studies for administrative reasons already noted^(4,16,33,34).

The most frequent diagnoses in patients with potential gastrointestinal bleeding of the small intestine were tumors (12.5 %: two gastrointestinal stromal tumors (GIST), and one small intestine adenocarcinoma), followed by ulcera-

ted colon diverticula (8.3 %); these results are similar to those reported in the world literature⁽⁴⁾.

Among the study's strengths is the follow-up of 91 % of patients for an extended period (median 56 months). 78 % of the patients were asymptomatic and did not require further studies. Among the explanations for this finding, it may be suggested that the pathologies were intermittent alterations, for which the enteroscopy may not have been necessary, or the patients may have received some medical intervention, such as acetylsalicylic acid (ASA) suspension, non-steroidal anti-inflammatory drugs (NSAIDs), antibiotics, anticoagulants, among others, which led to a resolution of the symptoms. Follow-up was investigated for symptom resolution and additional studies. The study was raised as a series of cases with reduced sample size, so cohort studies are required to evaluate hypotheses related to symptom resolution. When the DBE has an abnormal result, it allows targeted management to the pathology; if the result is normal, this allows to indicate a follow-up, considering that it is the most advanced small intestine study.

The new bleeding episodes occurred in 15.4 % (n = 2), one secondary to colonic diverticulum and the other due to anemia secondary to giant hiatal hernia. In 9 % (n = 1) with normal findings that persisted with hematochezia, its cause was reported as an anal fissure. If the DBE reports abnormal findings, there is a possibility of up to 50 % rebleeding; on the other hand, if normal findings are reported, it is only 5 %⁽¹⁴⁾. Some authors suggest that there are predictors of recurrent bleeding, such as frequent bleeding episodes and transfusional requirement⁽¹⁴⁾.

During the study of potential gastrointestinal bleeding of the small intestine, conventional endoscopic procedures

were not useful in 14 % of cases due to either intermittent bleeding or undiagnosed lesions (giant hiatal hernia with Cameron ulcers, ulcerated diverticulum, angiectasis, and rectal ulcer); up to 25 % of hemorrhagic lesions not diagnosed by conventional high or low endoscopy are reported in the literature and can be explained in inappropriate or null intestinal preparations; however, it is also important to insist on the academic education of gastroenterologists that guarantees conventional quality procedures by avoiding the practice of advanced and unnecessarily expensive ones⁽¹⁴⁾.

There were no complications in the present study, compared with other publications that mention a low frequency of pancreatitis and perforation^(3,26,35).

DBE is a useful tool in evaluating the small intestine with therapeutic possibility, low complication rates, and a diagnostic yield that can reach up to 85 %, depending on a rigorous selection of patients^(36,37) and a decrease in overdiagnosis in previous studies. We suggest performing it in university hospitals that guarantee an objective training and learning curve^(15,38,39). The diagnostic yield for bleeding depends on the time interval between the indication of the procedure and its performance; this is only achieved by the patient's proper understanding of their problem, academic knowledge of medical staff, and administrative entities that contribute to improving this window of opportunity.

The clinical follow-up to patients taken to DBE may define the need for a second procedure, an indication of additional studies, or the resolution of the problem.

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REFERENCES

1. Ospina Nieto J, Villamizar Suárez J. Enteroscopia de un balón: Una nueva herramienta para la evaluación gastrointestinal. *Rev Col Gastroenterol*. 2009;24(3):241-7.
2. Reyes Medina GA. El intestino delgado: ya no es más la "caja negra" del tubo digestivo. *Rev Col Gastroenterol*. 2009;24(3):238-40.
3. Tang L, Huang LY, Cui J, Wu CR. Effect of Double-Balloon Enteroscopy on Diagnosis and Treatment of Small-Bowel Diseases. *Chin Med J (Engl)*. 2018;131(11):1321-1326. <https://doi.org/10.4103/0366-6999.232802>
4. Westerhof J, Weersma RK, Koornstra JJ. Investigating obscure gastrointestinal bleeding: capsule endoscopy or double balloon enteroscopy? *Neth J Med*. 2009;67(7):260-5.
5. De Simone F, Machado P, Guzmán Calderon E. Abordaje diagnóstico y terapéutico de las patologías del intestino delgado mediante cápsula endoscópica y enteroscopia de doble balón. *Rev Gastroenterol Perú*. 2017;37(1):58-64.
6. Otani K, Watanabe T, Shimada S, Hosomi S, Nagami Y, Tanaka F, Kamata N, Taira K, Yamagami H, Tanigawa T, Shiba M, Fujiwara Y. Clinical Utility of Capsule Endoscopy and Double-Balloon Enteroscopy in the Management of Obscure Gastrointestinal Bleeding. *Digestion*. 2018;97(1):52-58. <https://doi.org/10.1159/000484218>
7. Muniraj T, Lee LS. Enteroscopy for GI Fellows. En: Adler D (editor). *Upper Endoscopy for GI Fellows*. Springer; 2017. p. 151-62. https://doi.org/10.1007/978-3-319-49041-0_13
8. Leighton JA. The role of endoscopic imaging of the small bowel in clinical practice. *Am J Gastroenterol*.

- 2011;106(1):27-36; quiz 37.
<https://doi.org/10.1038/ajg.2010.410>
9. Baniya R, Upadhaya S, Subedi SC, Khan J, Sharma P, Mohammed TS, Bachuwa G, Jamil LH. Balloon enteroscopy versus spiral enteroscopy for small-bowel disorders: a systematic review and meta-analysis. *Gastrointest Endosc.* 2017;86(6):997-1005.
<https://doi.org/10.1016/j.gie.2017.06.015>
 10. Rahmi G, Samaha E, Vahedi K, Ponchon T, Fumex F, Filoche B, Gay G, Delvaux M, Lorenceau-Savale C, Malamut G, Canard JM, Chatellier G, Cellier C. Multicenter comparison of double-balloon enteroscopy and spiral enteroscopy. *J Gastroenterol Hepatol.* 2013;28(6):992-8.
<https://doi.org/10.1111/jgh.12188>
 11. Kim TJ, Kim ER, Chang DK, Kim YH, Hong SN. Comparison of the Efficacy and Safety of Single- versus Double-Balloon Enteroscopy Performed by Endoscopist Experts in Single-Balloon Enteroscopy: A Single-Center Experience and Meta-Analysis. *Gut Liver.* 2017;11(4):520-527.
<https://doi.org/10.5009/gnl16330>
 12. Wadhwa V, Sethi S, Tewani S, Garg SK, Pleskow DK, Chuttani R, Berzin TM, Sethi N, Sawhney MS. A meta-analysis on efficacy and safety: single-balloon vs. double-balloon enteroscopy. *Gastroenterol Rep (Oxf).* 2015;3(2):148-55.
<https://doi.org/10.1093/gastro/gov003>
 13. Lipka S, Rabbanifard R, Kumar A, Brady P. Single versus double balloon enteroscopy for small bowel diagnostics: a systematic review and meta-analysis. *J Clin Gastroenterol.* 2015;49(3):177-84.
<https://doi.org/10.1097/MCG.0000000000000274>
 14. Raju GS, Gerson L, Das A, Lewis B; American Gastroenterological Association. American Gastroenterological Association (AGA) Institute technical review on obscure gastrointestinal bleeding. *Gastroenterology.* 2007;133(5):1697-717.
<https://doi.org/10.1053/j.gastro.2007.06.007>
 15. ASGE Technology Committee, Chauhan SS, Manfredi MA, Abu Dayyeh BK, Enestvedt BK, Fujii-Lau LL, Komanduri S, Konda V, Maple JT, Murad FM, Pannala R, Thosani NC, Banerjee S. Enteroscopy. *Gastrointest Endosc.* 2015;82(6):975-90.
<https://doi.org/10.1016/j.gie.2015.06.012>
 16. Gerson LB, Fidler JL, Cave DR, Leighton JA. ACG Clinical Guideline: Diagnosis and Management of Small Bowel Bleeding. *Am J Gastroenterol.* 2015;110(9):1265-87; quiz 1288.
<https://doi.org/10.1038/ajg.2015.246>
 17. Pennazio M, Spada C, Eliakim R, Keuchel M, May A, Mulder CJ, Rondonotti E, Adler SN, Albert J, Baltes P, Barbaro F, Cellier C, Charton JP, Delvaux M, Despott EJ, Domagk D, Klein A, McAlindon M, Rosa B, Rowse G, Sanders DS, Saurin JC, Sidhu R, Dumonceau JM, Hassan C, Gralnek IM. Small-bowel capsule endoscopy and device-assisted enteroscopy for diagnosis and treatment of small-bowel disorders: European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline. *Endoscopy.* 2015;47(4):352-76.
<https://doi.org/10.1055/s-0034-1391855>
 18. Enns RA, Hookey L, Armstrong D, Bernstein CN, Heitman SJ, Teshima C, Leontiadis GI, Tse F, Sadowski D. Clinical Practice Guidelines for the Use of Video Capsule Endoscopy. *Gastroenterology.* 2017;152(3):497-514.
<https://doi.org/10.1053/j.gastro.2016.12.032>
 19. Rey A, Reyes G, Sierra F, Patarroyo O, Ardila A, Prada L. Enteroscopia de doble balón: experiencia de una técnica endoscópica innovadora en el Hospital Universitario de la Fundación Santa Fe de Bogotá. *Rev Gastroenterol Mex.* 2020;85(1):25-31.
<https://doi.org/10.1016/j.rgm.2019.01.001>
 20. Cañadas Garrido R, Costa Barney VA, Roa Ballester PA, Espinosa Martínez CA, Pinzón Arenas DF, Ramírez Barranco R. Concordancia diagnóstica entre la videocápsula endoscópica y enteroscopia mono y de doble balón en la hemorragia de intestino delgado en un hospital de alta complejidad en Bogotá, Colombia. *Rev Gastroenterol Mex.* 2021;86(1):51-8.
<https://doi.org/10.1016/j.rgm.2020.03.004>
 21. Garcia-Correa JJE, Ramirez-Garcia JJ, Garcia-Contreras LF, Fuentes-Orozco C, Irusteta-Jimenez L, Michel-Espinoza LR, Carballo Uribe AS, Torres Chávez JA, González-Ojeda A. Double-balloon enteroscopy: Indications, approaches, diagnostic and therapeutic yield, and safety. Early experience at a single center. *Rev Gastroenterol Mex.* 2018;83(1):31-40.
<https://doi.org/10.1016/j.rgm.2017.08.001>
 22. Ivano FH, Villela IR, Miranda LF, Nakadomari TS. Analysis of double balloon enteroscopy: Indications, findings, therapeutic and complications. *Arq Bras Cir Dig.* 2017;30(2):83-7.
<https://doi.org/10.1590/0102-6720201700020002>
 23. Dişibeyaz S, Suna N, Kuzu UB, Saygılı F, Öztaş E, Ödemiş B, Önal İK, Kılıç ZM, Akdoğan M, Kayaçetin E. Double balloon enteroscopy: A 7-year experience at a tertiary care Centre. *Eur J Intern Med.* 2016;33:108-11.
<https://doi.org/10.1016/j.ejim.2016.06.011>
 24. Paredes Mendez J, Lazo Molina L, Molina Martos B. Rol de la enteroscopia con doble balón en el manejo de la patología del intestino delgado: experiencia en el Hospital Nacional Guillermo Almenara Irigoyen, Lima, Perú. *Rev Gastroenterol Perú.* 2016;36(2):107-14.
 25. Áñez M, Hernández I, Fuenmayor M, Mengual E, Rangel R, Romero G, Silva N, Namías N, Lizarábal M. Enteroscopia doble balón y videocápsula endoscópica en el diagnóstico de patologías del intestino delgado: Hospital Universitario de Maracaibo. 2007-2010. *Gen.* 2011;65(2):117-22.
 26. Xin L, Liao Z, Jiang YP, Li ZS. Indications, detectability, positive findings, total enteroscopy, and complications of diagnostic double-balloon endoscopy: a systematic review of data over the first decade of use. *Gastrointest Endosc.*

- 2011;74(3):563-70.
<https://doi.org/10.1016/j.gie.2011.03.1239>
27. Lenz P, Domagk D. Double- vs. single-balloon vs. spiral enteroscopy. *Best Pract Res Clin Gastroenterol.* 2012;26(3):303-13.
<https://doi.org/10.1016/j.bpg.2012.01.021>
 28. May A. How much importance do we have to place on complete enteroscopy? *Gastrointest Endosc.* 2011;73(4):740-2.
<https://doi.org/10.1016/j.gie.2010.11.030>
 29. Xin L, Gao Y, Liao Z, Li ZS. The reasonable calculation of complete enteroscopy rate for balloon-assisted enteroscopy. *Endoscopy.* 2011;43(9):832.
<https://doi.org/10.1055/s-0030-1256569>
 30. Jeon SR, Kim JO. Deep enteroscopy: which technique will survive? *Clin Endosc.* 2013;46(5):480-5.
<https://doi.org/10.5946/ce.2013.46.5.480>
 31. Su MY, Lin WP, Chiu CT. Experience of double balloon enteroscopy. *J Chin Med Assoc.* 2018;81(3):225-9.
<https://doi.org/10.1016/j.jcma.2017.06.020>
 32. Tu CH, Kao JY, Tseng PH, Lee YC, Chiang TH, Chen CC, Wang HP, Chiu HM, Wu MS. Early timing of single balloon enteroscopy is associated with increased diagnostic yield in patients with overt small bowel bleeding. *J Formos Med Assoc.* 2019;118(12):1644-1651.
<https://doi.org/10.1016/j.jfma.2019.01.003>
 33. Bresci G, Parisi G, Bertoni M, Tumino E, Capria A. The role of video capsule endoscopy for evaluating obscure gastrointestinal bleeding: usefulness of early use. *J Gastroenterol.* 2005;40(3):256-9.
<https://doi.org/10.1007/s00535-004-1532-5>
 34. Hartmann D, Schmidt H, Bolz G, Schilling D, Kinzel F, Eickhoff A, Huschner W, Möller 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(7):826-32.
[https://doi.org/10.1016/s0016-5107\(05\)00372-x](https://doi.org/10.1016/s0016-5107(05)00372-x)
 35. Landaeta J, Dias C, Rodriguez M, Urdaneta C. Enteroscopia de doble balón Vs. Enteroscopia de un solo balón en hemorragia digestiva de origen oscuro. *Gen.* 2010;64(1):26-8.
 36. May A. Double-Balloon Enteroscopy. *Gastrointest Endosc Clin N Am.* 2017;27(1):113-22.
<https://doi.org/10.1016/j.giec.2016.08.006>
 37. Moeschler O, Mueller MK. Deep enteroscopy - indications, diagnostic yield and complications. *World J Gastroenterol.* 2015;21(5):1385-93.
<https://doi.org/10.3748/wjgv21.i5.1385>
 38. Reyes G, Rey M. Entrenamiento en enteroscopia profunda. En: Emura F (editor). *¿Cómo y dónde formarse en los nuevos procedimientos endoscópicos digestivos avanzados, ahora y en el futuro?* Cartagena: SIED; 2016. p. 83-5.
 39. Gross SA, Stark ME. Initial experience with double-balloon enteroscopy at a U.S. center. *Gastrointest Endosc.* 2008;67(6):890-7.
<https://doi.org/10.1016/j.gie.2007.07.047>