Chron Precis Med Res 2023; 4(3): 399-405
DOI: 10.5281/zenodo.10020937

ORIGINAL ARTICLE
ORİJİNAL ARAŞTIRMA

Twelve Years of Experience Using Double-Balloon Enteroscopy for Diagnosing and Treating Patients with Obscure Gastrointestinal Bleeding

Nedeni Bilinmeyen Gastrointestinal Kanamalı Hastaların Tanı ve Tedavisinde Çift Balonlu Enteroskopi Kullanımında On İki Yıllık Deneyim

Bayram Yeşil[1], Vedat Kılıç[2], Mahmut Yüksel[2], Meral Akdoğan Kayhan[2]

[1]Department of Gastroenterology, Kırıkkale University Faculty of Medicine, Kırıkkale, Turkey
[2]Ankara City Hospital, Gastroenterology, Ankara, Turkey

ABSTRACT

Aim: Double-balloon enteroscopy (DBE) is a medical procedure employed for the assessment of small intestines that are inaccessible by standard endoscopes and colonoscopes. This study aimed to assess the data obtained from DBE procedures conducted to investigate the underlying causes of iron deficiency anemia and gastrointestinal bleeding when traditional diagnostic approaches were inconclusive.

Material and Method: The present investigation is a retrospective study conducted at a single center. The medical data pertaining to DBE procedures conducted at the Gastroenterology Clinic of Ankara Türkiye Yüksek Ihtisas Training and Research Hospital was collected by the researchers for the period spanning from January 2007 to December 2018. The present investigation employed exclusion criteria to eliminate individuals with inadequate medical records and those who were transferred to another institution without a confirmed diagnosis.

Results: The study comprised a sample size of 118 individuals, with 45 (38.1%) being female and 73 (61.9%) being male. The average age of the participants was found to be 54.98 ± 16.1 years. A total of 88 patients received the procedure utilizing an anterograde (oral) method, while in 13 patients it was performed retrograde (anal). Additionally, 17 patients got the procedure utilizing both approaches. The observed lesions consisted of 18 (31.5%) inflammatory, 26 (45.6%) vascular, 9 (15.7%) neoplastic, and 4 (7%) diverticular kinds. Using double-balloon enteroscopy (DBE), it was found that 49.1% of the patients with obscure gastrointestinal bleeding (OGIB) had a positive result. A total of 22 instances (18.6%) necessitated the use of interventional techniques.

Conclusion: Consequently, the diagnostic efficacy of double-balloon enteroscopy in obscure gastrointestinal bleeding was very limited. The frequent location of the lesion varied depending on its nature; however, this variation did not yield a statistically significant difference when considering the presence of overt or occult bleeding.

Keywords: Enteroscopy, double-balloon, anemia, iron deficiency

ÖZ

Amaç: Çift balonlu enteroskopi (DBE), standart endoskoplar ve kolonoskoplar tarafından erişilemeyen ince bağırsakların değerlendirilmesi için kullanılan tıbbi bir prosedürdür. Bu çalışmanın amacı, geleneksel tanı yaklaşımlarının yetersiz kaldığı durumlarda demir eksikliği anemisi ve gastrointestinal kanamanın altında yatan nedenleri araştırmak için yapılan DBE işlemlerinden elde edilen verileri değerlendirmektir.

Gereç ve Yöntem: Bu araştırma tek bir merkezde yürütülen retrospektif bir çalışmadır. Ankara Türkiye Yüksek İhtisas Eğitim ve Araştırma Hastanesi Gastroenteroloji Kliniği'nde gerçekleştirilen DBE prosedürlerine ilişkin tıbbi veriler, Ocak 2007 ile Aralık 2018 arasındaki dönem için araştırmacılar tarafından toplanmıştır. Bu araştırmada, tıbbi kayıtları yetersiz olan ve tanısı doğrulanmadan başka bir kuruma nakledilen hastalar çalışma dışında tutulmuştur.

Bulgular: Çalışmada 45'i (%38,1) kadın ve 73'ü (%61,9) erkek olmak üzere 118 kişilik bir örneklem grubu yer almıştır. Katılımcıların yaş ortalaması 54.98 ± 16.1 yıl olarak bulunmuştur. Toplam 88 hastaya anterograd (oral) yöntemle işlem uygulanırken, 13 hastaya retrograd (anal) yöntemle işlem uygulanmıştır. Ayrıca, 17 hastaya her iki yaklaşım da uygulanmıştır. Gözlenen lezyonların 18'i (%31,5) enflamatuar, 26'sı (%45,6) vasküler, 9'u (%15,7) neoplastik ve 4'ü (%7) divertiküler türdeydi. Çift balon enteroskopi (DBE) kullanılarak, belirsiz gastrointestinal kanaması (OGIB) olan hastaların %49,1'inde pozitif sonuç elde edilmiştir. Toplam 22 vakada (%18,6) girişimsel tekniklerin kullanılması gerekmiştir.

Sonuç: Sonuç olarak, belirsiz gastrointestinal kanamalarda çift balon enteroskopinin tanısal etkinliği çok sınırlıdır. Lezyonun sık yerleşim yeri, doğasına bağlı olarak değişmekteydi; ancak bu varyasyon, açık veya gizli kanama varlığı göz önüne alındığında istatistiksel olarak anlamlı bir fark yaratmadı.

Anahtar Kelimeler: Enteroskopi, çift balon, anemi, demir eksikliği

Corresponding Author: Bayram Yeşil
Address: Department of Gastroenterology, Kırıkkale University Faculty of Medicine, Kırıkkale, Turkey
E-mail: drbyesil@gmail.com

Başvuru Tarihi/Received: 24.09.2023
Kabul Tarihi/Accepted: 14.10.2023

INTRODUCTION

Obscure gastrointestinal bleeding (OGIB) is when a procedure like an esophagogastroduodenoscopy (EGD) or a colonoscopy can't figure out where the bleeding is coming from. Overt and occult bleeding are two distinct clinical presentations of OGIB (1). Visible bleeding manifestations such as hematemesis, melena, or hematochezia are observed in cases of overt gastrointestinal (GI) bleeding, although the specific source of the bleeding remains unidentified. The condition known as occult gastrointestinal bleeding does not exhibit any external indications of bleeding but manifests as anemia resulting from iron deficiency or a positive occult fecal blood test.

Following the procedures of endoscopy and colonoscopy, the subsequent course of action in the examination of OGIB is the examination of the small intestine in order to ascertain the source of the bleeding. The exponential advancement of technology has resulted in a significant proliferation of diagnostic modalities used to evaluate the small bowel. Video capsule endoscopy, CT enterography, spiral enteroscopy, and deep enteroscopy have been recognized as valuable methodologies, offering improved visualization capabilities and heightened therapeutic effectiveness (2).

Hironori Yamamoto created the double-balloon enteroscopy (DBE) technique in 2001 with the primary goal of thoroughly evaluating the entire small intestine. The primary indication for DBE is the evaluation of patients presenting with obscure gastrointestinal bleeding (3). This method facilitates the examination of the mucosa of the small bowel while also enabling the execution of several treatments, including biopsy, polypectomy, and hemostasis (4). A comprehensive review has demonstrated that the utilization of the experimental anterograde technique proves to be a cost-effective strategy for managing individuals afflicted with OGIB.Diagnostic DBE is renowned for its minimal incidence of complications and high level of safety (6). Research utilizing DBE has shown perforation rates ranging from 0.3% to 3.4%, which is considered the most noteworthy problem (7).

The objective of this study is to present our center's retrospective findings on the performance, effectiveness, and safety of DBE in patients with suspected small bowel disease caused by OGIB.

MATERIAL AND METHOD

The study was conducted after obtaining approval from the Scientific Research Assessment and Ethics Committee of Ankara Bilkent City Hospital (Approval No. E. Kurul-E1-20-1211) on November 11, 2020. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The present investigation is a retrospective study conducted at a single center. The researchers gathered medical records pertaining to DBE procedures conducted at the Gastroenterology Clinic of Ankara Türkiye Yüksek Ihtisas Training and Research Hospital over a period spanning from January 2007 to December 2018. The study excluded patients who had insufficient medical records and were moved to another institution without a confirmed diagnosis. The study examined variables such as age, gender, prior gastrointestinal surgery, and the presence of complications. Patients who were unable to achieve sufficient intestinal cleansing, had looping during the operation, or were unable to proceed with the procedure owing to technical issues (such as device malfunction) were excluded from the study. The confirmation of the method utilized during DBE, the identification of lesion types and sites, the assessment of complications, and the establishment of a definitive diagnosis were achieved by a comprehensive evaluation of medical records and endoscopic examinations.

The double-balloon enteroscopy was performed by endoscopists who have considerable experience. The DBE operations were performed with conscious sedation, specifically employing midazolam, propofol, and fentanyl, under the supervision of an anesthesiologist. Before implementing the device for oral administration, there was a lack of bowel preparation. The patient had the standard colonoscopy preparatory procedure before the anal approach was performed. The choice of the access technique was based on the assessment of clinical observations and diagnostic imaging tests. If no lesion was identified during the initial method of entry, an anal technique was later utilized. If the patient received a DBE for evaluation on the subsequent day, these two procedures were regarded as a unified intervention. The technique commonly referred to as "push and pull" was utilized to achieve overtubular folding of the intestine.

The primary indication for DBE was established as an obscure gastrointestinal hemorrhage. Exclusion criteria encompassed patients presenting with alternative indications for DBE, such as unexplained chronic abdominal pain or diarrhea, the presence of abnormal findings in the small bowel as observed through diagnostic imaging techniques (including capsule endoscopy, computed tomography, and magnetic resonance imaging), histological verification of a suspected disease, assessment of an underlying condition, or retrieval of a foreign object.

Patients exhibiting apparent indications of bleeding, although without an identifiable cause of bleeding as determined by endoscopy or colonoscopy, were classified as having overt gastrointestinal bleeding. The study population consisted of individuals diagnosed

with occult gastrointestinal bleeding, characterized by the presence of iron deficiency and/or occult blood positive within the past six months. These patients did not exhibit any apparent indications of bleeding and were subjected to both upper and lower gastrointestinal endoscopic procedures, performed by a skilled endoscopist.

The correlation between positive DBE findings and the patient's clinical presentation was established. The lesions identified in the endoscopic pictures were categorized into four groups: vascular lesions (such as angiodysplasia, arteriovenous malformations, and Dieulafoy lesions), inflammatory lesions (including erosions, ulcers, and erythema), neoplastic lesions (comprising both malignant and benign tumors as well as polyposis), and diverticula. The lesions were classified according to their localization as being in the duodenum, jejunum, and ileum. The investigation of treatment methods was conducted when endoscopic intervention was performed using DBE. The treatment modalities employed in this study encompassed polypectomy, a surgical procedure for removing polyps, and argon plasma coagulation (APC), a technique that utilizes argon gas to achieve coagulation. The absence of bleeding or anemia brought on by illness was characterized as a negative DBE finding.

Complications were operationally defined as adverse events, both small and substantial in nature, that manifest during and subsequent to the procedure. Minor problems were described as transient symptoms, including stomach pain, asymptomatic hyperamylasemia, hypoxia, and arrhythmia. Major complications were characterized as pancreatitis, perforation, bleeding, and death.

The analysis of variables was conducted using the SPSS 25.0 software (IBM Corporation, Armonk, New York, United States). The normality of univariate data was assessed using the Shapiro-Wilk test, while the multivariate normality was tested using the Mardia (Dornik and Hansen Omnibus) test. Additionally, the homogeneity of variance was examined using Levene's test. The parametric method known as the one-way analysis of variance (ANOVA) was employed to compare multiple independent groups based on quantitative data. Subsequently, the Tukey test was utilized for post hoc analysis. Parametric and nonparametric analyses were conducted in accordance with the assumptions of normal distribution and homogeneity of variance for the data. The presentation of quantitative variables included the mean ± SD (standard deviation) and the median range (maximum-minimum), whereas categorical variables were represented as n (%). The variables were subjected to analysis at a confidence level of 95%, with significance determined by a p-value below 0.05.

RESULTS

The study consisted of a sample size of 118 individuals, with 45 (38.1%) being female and 73 (61.9%) being male. The average age of the participants was 54.98 ± 16.1 years, with a range of 15 to 92. The total count of individuals who had previously had gastrointestinal surgery amounted to 8. **Table 1** displays further attributes of the study population. The anterograde (oral) technique was utilized in 88 patients, while the retrograde (anal) approach was employed in 13 individuals. Additionally, a combination of both procedures was utilized in 17 patients.

Table 1. Characteristics of the study population

	Mean ± SD.
Age	54.98 ± 16.1
Number of operations	1.19 ± 0.43
	n (%)
Gender	
Female	45 (38.1)
Male	73 (61.9)
Indication	
Overt	77 (65.3)
Occult	41 (34.7)
Approach	
Anterograde	88 (74.6)
Retrograde	13 (11)
Both	17 (14.4)
Localization	
No lesion	58 (49.2)
Duodenum	5 (4.2)
Jejunum	34 (28.8)
Ileum	21 (17.8)
Therapeutic Process	
APC	22 (18.6)
No	96 (81.4)
Complication	
Yes	22 (18.6)
No	96 (81.4)

The observed lesions can be categorized as follows: 18 (31.5%) were identified as inflammatory, 26 (45.6%) as vascular, 9 (15.7%) as neoplastic, and 4 (7%) as diverticular. Based on the process of localization, it was observed that lesions were detected in the duodenum of 5 patients, the jejunum of 34 patients, and the ileum of 21 patients. A total of 43 patients (55.9%) exhibiting overt bleeding were found to have lesions, whereas 17 patients (41.5%) who underwent DBE for occult GI bleeding had their etiology identified. Nineteen individuals had the development of acute pancreatitis, asymptomatic hyperamylasemia, and non-specific stomach pain during and after the treatment. Additionally, one patients experienced serious consequences, including mucosal dehiscence. No deaths and perforation occurred as a result of the procedures performed.

Out of the total number of patients diagnosed with OGIB, it was found that 58 individuals, accounting for 49.1% of the sample, exhibited a positive finding during DBE examination. Interventional procedures were deemed necessary for certain patients. The interventional techniques were categorized into three groups: argon plasma coagulation (APC), polyp excision, and biopsy of benign or malignant lesions. A total of 21 patients (18.2%) underwent biopsies, whereas 22 patients (18.6%) received APC during DBE, as indicated in **Table 2**.

Table 2. Comparison of overt and occult bleeding

	Overt Mean ± SD.	Occult Mean± SD.	Total Mean ± SD.	p value
Age	54.9±17.3	55.2±13.8	55±16.1	0,927
	n (%)	n (%)	n (%)	
Gender				
Female	29 (37.6)	16 (39)	45 (38.1)	
Male	48 (62.3)	25 (60.9)	73 (61.8)	
Approach				0,052
Anterograde	53 (68.8)	35 (85.3)	88 (74.5)	
Retrograde	10 (12.9)	3 (7.3)	13 (11)	
Both	14 (18.1)	3 (7.3)	17 (14.4)	
Result				0,125
No	34 (44.1)	24 (58.5)	58 (49.1)	
Yes	43(%55.9)	17(%41.5)	60 (50.8)	
Localization				0,108
No lesions	34 (44.1)	24 (58.5)	58 (49.1)	
Duodenum	3 (3.8)	2 (4.8)	5 (4.2)	
Jejunum	24 (31.1)	10 (24.3)	34 (28.8)	
Ileum	16 (20.7)	5 (12.1)	21 (17.7)	
Biopsy				0,567
No	61 (80.2)	33 (84.6)	94 (81.7)	
Yes	15 (19.7)	6 (15.3)	21 (18.2)	
Therapies				0,467
APC	16 (20.8)	6 (14.6)	22 (18.6)	
No	61 (79.2)	35 (85.4)	96 (81.3)	
Complication				0,012
No	68 (88.3)	28 (68.2)	96 (81.3)	
Yes	9 (11.6)	13 (31.7)	22 (18.6)	

The majority of inflammatory lesions observed in this study were attributed to non-specific ulcers and erosions located in the jejunum. Bleeding attributed to vasculitis was observed in a smaller proportion of cases, affecting a total of three patients, whereas NSAID enteropathy was reported in a single patient. Lesions associated with vasculitis were seen in the jejunum and ileum. Within the category of neoplastic lesions, gastrointestinal stromal tumors (GIST) and neuroendocrine tumors (NET) were observed to be the most prevalent. Subsequent to this, the occurrence of malignant lymphoma and adenomatous polyps was seen. The incidence of neoplastic lesions was found to be higher in the jejunum. The presence of diverticular lesions was observed in both the ileum and jejunum, with two of these lesions identified as Meckel's diverticulum.

DISCUSSION

Clinicians in the field of gastroenterology face a significant problem when dealing with pathologies that originate from the small intestine due to their limited accessibility. The advancement of video capsule endoscopy (VCE) and several enteroscopy techniques, including single balloon, double balloon, and spiral enteroscopy, has greatly improved the assessment of the small intestine. These gadgets are utilized for the assessment of small bowel lesions that are inaccessible during endoscopy and colonoscopy procedures.

Video capsule endoscopy (VCE) is frequently utilized as the initial modality for examining occult gastrointestinal bleeding. However, double balloon enteroscopy is employed as an adjunctive method subsequent to identifying the bleeding location or assessing the necessity for further intervention (8). The diagnostic rates of DBE exhibit variability across different reasons for the test. According to existing data, the diagnostic yield of DBE for suspected small bowel disease, particularly in instances of OGIB, ranges from 72% to 80% (9-12). In 2016, a multicenter retrospective study was undertaken in Korea to investigate the use of balloon-assisted enteroscopy, namely single and double balloon techniques. The study reported an approximate success rate of 74.6%. The most prevalent indication for double-balloon enteroscopy was shown to be obscure gastrointestinal bleeding, accounting for a majority of the cases (58.3%) (9). Based on a comprehensive meta-analysis, the collective diagnostic yield was determined to be 68.1%. The primary indication for undergoing the diagnostic procedure was suspected mid-gastrointestinal (GI) bleeding, accounting for 62.5% of cases (13). The present investigation observed a diagnostic yield of 58 patients (49.1%) for DBE, with the primary indication for DBE being OGIB. The limited diagnostic efficacy of OGIB seen in our investigation may be attributed to the following factors: Initially, it is important to note that while performing DBE for OGIB, it is possible that no actual lesion exists in the small bowel (SB), or alternatively, the lesion may have already undergone healing prior to the time of inspection. Hence, it is possible for a negative outcome to be observed, despite the successful execution of the DBE. Furthermore, our findings demonstrate that lesions characterized by erosions or ulcers have the potential to manifest in many locations within the small bowel, posing challenges in their identification and detection.

Based on existing literature, it has been established that OGIB accounts for roughly 5% of the total cases of GI bleeding (13). In more than 80% of these cases, OGIB has its source in the small intestine (14). Angioectasia is the predominant etiology of small intestinal hemorrhage in Western nations, exhibiting a prevalence ranging from 20% to 55% (13). However,

the etiology of minor intestinal hemorrhage varies with geographical location. According to a comprehensive analysis conducted on patients experiencing small bowel bleeding in South Korea, it was found that the predominant etiology was active ulcers, which were identified in approximately 26% of the patient population, constituting the highest proportion among the identified causes (15). In the conducted investigation, it was observed that vascular etiologies accounted for the highest prevalence of OGIB. The jejunum exhibited the highest prevalence of vascular lesions. Angiodysplasia emerged as the prevailing vascular lesion in the study.

The DBE procedure has been found to be a safe diagnostic technique, exhibiting minimal rates of complications. Based on the findings of a meta-analysis, the incidence of minor complications was documented at 9.1%, whereas serious complications were reported at a rate of 0.72% (16). The incidence of complications exhibit variability contingent upon whether the procedure in question is of a diagnostic or therapeutic nature.6 In a comprehensive analysis of 2478 DBE procedures conducted across nine medical facilities in the United States, the prevailing complication seen was the occurrence of perforation, which was found to have a frequency of 0.4% (17). Additionally, there have been studies that have reported acute pancreatitis as the prevailing complication of oral DBE (18). Complications were identified in 18.6% of the individuals in our study. The primary factor contributing to the elevated incidence of complications was the presence of asymptomatic hyperamylasemias. Based on our observations, it has been noted that asymptomatic hyperamylasemia and acute pancreatitis are frequently seen problems subsequent to the procedure; however, it is worth noting that these issues tend to heal spontaneously in the majority of patients. **Table 4** shows that the lesions arising during the procedure in which it is defined complications according to lesion localization shows a categorized comparison.

The utilization of argon plasma coagulation emerged as the most favored therapeutic approach in our study. The APC treatment procedure was shown to be often utilized in prior research investigations (11,12,19). The presence of the lesion was noted in the jejunum of the majority of patients who underwent APC treatment. The majority of the treatments yielded positive outcomes, therefore establishing DBE as a viable approach for both diagnostic and therapeutic purposes.

Given the variability in the typical sites of lesions for each disease, it is imperative to ascertain the appropriate route of entry for DBE based on the suspected condition. Moreover, the identification of many potential diagnoses can be inferred by the careful examination of the site where the dubious lesion is located. According to the study conducted by Chen et al., it was observed that Crohn's disease had a higher prevalence in the ileum, whereas tumors and angioectasia were more frequently observed in the jejunum (20). In our investigation, an examination of the correlation between the ultimate diagnosis and the lesion's site revealed that Crohn's disease and diverticular lesions predominantly manifested in the ileum, while vascular lesions, nonspecific inflammation, and neoplastic lesions were primarily observed in the jejunum. **Table 3** depicts the localization of lesions and consequences.

Table 3. Localization of lesions

	LOCALIZATION					p value
	No lesions	**Duodenum**	**Jejunum**	**Ileum**	**Total**	
	Mean ± SD.	Mean ± SD.	Mean ± SD.	Mean ± SD.	Mean ± SD.	
Age	54.7±17.2	57±13.3	56.7±15.1	52.4±15.6	54.9±16.1	0,806
	n (%)	n (%)	n (%)	n (%)	n (%)	
Gender						0,786
Female	23 (39.6)	1 (20)	14 (41.1)	7 (33.3)	45 (38.1)	
Male	35 (60.3)	4 (80)	20 (58.8)	14 (66.6)	73 (61.8)	
Application						0,445
Overt	34 (58.6)	3 (60)	24 (70.5)	16 (76.1)	77 (65.2)	
Occult	24 (41.3)	2 (40)	10 (29.4)	5 (23.8)	41 (34.7)	
Results						0,060
Inflammatory	0 (0)	0 (0)	8 (23.5)	10 (52.6)	18 (31.5)	
Vascular	0 (0)	2 (50)	18 (52.9)	6 (31.5)	26 (45.6)	
Neoplastic	0 (0)	1 (25)	6 (17.6)	2 (10.5)	9 (15.7)	
Diverticulum	0 (0)	1 (25)	2 (5.8)	1 (5.2)	4 (7)	
Empty	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
Therapies						<0.001
No	58 (100)	3 (60)	21 (61.7)	14 (66.6)	96 (81.3)	
APC	0 (0)	2 (40)	13 (38.2)	7 (33.3)	22 (18.6)	

Table 4. Complications of the procedure according to the localization of the lesion

	LOCALIZATION					p value
	No lesions Mean ± SD.	Duodenum Mean ± SD.	Jejunum Mean ± SD.	Ileum Mean ± SD.	Total Mean ± SD.	
Complication						0,220
No	43 (74.1)	5 (100)	30 (88.2)	18 (85.7)	96 (81.3)	
Yes	15 (25.8)	0 (0)	4 (11.7)	3 (14.2)	22 (18.6)	
Complication						0,142
Acute pancreatitis	2 (3.4)	0 (0)	1 (2.9)	1 (4.7)	4 (3.3)	
Hyperamylasemia	11 (18.9)	0 (0)	3 (8.8)	0 (0)	14 (11.8)	
Bleeding	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
Stomach ache	1 (1.7)	0 (0)	0 (0)	0 (0)	1 (0.8)	
Hypoxia	1 (1.7)	0 (0)	0 (0)	1 (4.7)	2 (1.6)	
Mucosal opening	0 (0)	0 (0)	0 (0)	1 (4.7)	1 (0.8)	
None	43 (74.1)	5 (100)	30 (88.2)	18 (85.7)	96 (81.3)	

The present study exhibits certain limitations. Initially, it is important to note that the sample size utilized in our investigation may be deemed somewhat small in comparison to a multicenter study. Nevertheless, we have gathered data over an extended duration. This study is retrospective in nature, hence limiting the ability to ascertain comprehensive patient information and procedural details. Ultimately, the ability to identify lesions is not influenced by their inherent prevalence. The most prevalent neoplastic lesions were Gastrointestinal Stromal Tumors (GIST) and Neuroendocrine Tumors (NET). Nevertheless, it is important to note that this outcome remains unaffected by the disease's prevalence, as the occurrence of GIST and NET is rather seldom.

CONCLUSION

Consequently, the diagnostic efficacy of double-balloon enteroscopy in obscure gastrointestinal bleeding shown a comparatively limited level of effectiveness. The position of the lesion varied depending on its nature, however this variation did not yield a statistically significant difference when considering the presence of overt or occult bleeding. The endoscopic interventions conducted during DBE had a predominantly favorable outcome, with infrequent occurrences of severe sequelae. Hence, the utilization of DBE is acknowledged as a proficient and secure approach in the identification and management of lesions in the small intestine.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was conducted after obtaining approval from the Scientific Research Assessment and Ethics Committee of Ankara Bilkent City Hospital (Approval No. E. Kurul-E1-20-1211) on November 11, 2020.

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Patel A, Vedantam D, Poman DS, Motwani L, Asif N. Obscure Gastrointestinal Bleeding and Capsule Endoscopy: A Win-Win Situation or Not?. Cureus. 2022;14(7):e27137.
2. Morgan D, Upchurch B, Draganov P, et al. Spiral enteroscopy: prospective U.S. multicenter study in patients with small-bowel disorders. Gastrointest Endosc. 2010;72(5):992-8.
3. Yamamoto H, Sekine Y, Sato Y, et al. Total enteroscopy with a nonsurgical steerable double-balloon method. Gastrointest Endosc. 2001;53(2):216-20.
4. Lee SP, Jang HJ, Kae SH, Lee JG, Kwon JH. Indication, Location of the Lesion, Diagnostic Yield, and Therapeutic Yield of Double-Balloon Enteroscopy: Seventeen Years of Experience. Diagnostics (Basel). 2022;12(9):2224.
5. Alexander JA, Leighton JA. Capsule endoscopy and balloon-assisted endoscopy: competing or complementary technologies in the evaluation of small bowel disease?. Curr Opin Gastroenterol. 2009;25(5):433-7.
6. Mensink PB, Haringsma J, Kucharzik T, et al. Complications of double balloon enteroscopy: a multicenter survey. Endoscopy. 2007;39(7):613-15.
7. Pohl J, Delvaux M, Ell C, et al. European Society of Gastrointestinal Endoscopy (ESGE) Guidelines: flexible enteroscopy for diagnosis and treatment of small-bowel diseases. Endoscopy. 2008;40(7):609-18.
8. May A, Nachbar L, Pohl J, Ell C. Endoscopic interventions in the small bowel using double balloon enteroscopy: feasibility and limitations. Am J Gastroenterol. 2007;102(3):527-35.
9. Hong SN, Kim ER, Ye BD, et al. Indications, diagnostic yield, and complication rate of balloon-assisted enteroscopy (BAE) during the first decade of its use in Korea. Dig Endosc. 2016;28(4):443-9.
10. Choi H, Choi KY, Eun CS, et al. Korean experience with double balloon endoscopy: Korean Association for the Study of Intestinal Diseases multi-center study. Gastrointest Endosc. 2007;66(3 Suppl):S22-S25.
11. Jeon SR, Kim JO, Kim HG, et al. Changes over time in indications, diagnostic yield, and clinical effects of double-balloon enteroscopy. Clin Gastroenterol Hepatol. 2012;10(10):1152-6.

12. García-Correa JJE, Ramírez-García JJ, García-Contreras LF, et al. Double-balloon enteroscopy: Indications, approaches, diagnostic and therapeutic yield, and safety. Early experience at a single center. Enteroscopia de doble balón: indicaciones, abordajes, eficacia diagnóstica y terapéutica y seguridad. Experiencia temprana de un solo centro. Rev Gastroenterol Mex (Engl Ed). 2018;83(1):31-40.
13. Liu K, Kaffes AJ. Review article: the diagnosis and investigation of obscure gastrointestinal bleeding. Aliment Pharmacol Ther. 2011;34(4):416-23.
14. Keum B, Chun HJ. Capsule endoscopy and double balloon enteroscopy for obscure gastrointestinal bleeding: which is better?. J Gastroenterol Hepatol. 2011;26(5):794-5.
15. Min YW, Kim JS, Jeon SW, et al. Long-term outcome of capsule endoscopy in obscure gastrointestinal bleeding: a nationwide analysis. Endoscopy. 2014;46(1):59-65.
16. 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.
17. Gerson LB, Tokar J, Chiorean M, et al. Complications associated with double balloon enteroscopy at nine US centers. Clin Gastroenterol Hepatol. 2009;7(11):1177-82.
18. Möschler O, May AD, Müller MK, Ell C; DBE-Studiengruppe Deutschland. Ergebnisse des deutschen Registers für die Doppelballonenteroskopie [Complications in double-balloon-enteroscopy: results of the German DBE register]. Z Gastroenterol. 2008;46(3):266-70.
19. Baars JE, Theyventhiran R, Aepli P, Saxena P, Kaffes AJ. Double-balloon enteroscopy-assisted dilatation avoids surgery for small bowel strictures: A systematic review. World J Gastroenterol. 2017;23(45):8073-81.
20. Chen WG, Shan GD, Zhang H, et al. Double-balloon enteroscopy in small bowel diseases: Eight years single-center experience in China. Medicine (Baltimore). 2016;95(42):e5104.