

# Rectal Dieulafoy's lesion: a comprehensive review of patient characteristics, presentation patterns, diagnosis, management, and clinical outcomes

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**Abstract:** Dieulafoy's lesion is an abnormally large, tortuous, submucosal vessel that erodes the overlying mucosa, without primary ulceration or erosion. Although these lesions predominantly involve the stomach and upper small intestine, they are being detected with increasing frequency in the rectum. We conducted a systematic literature search of MEDLINE, Cochrane, Embase, and Scopus databases for adult rectal Dieulafoy's lesion. After careful review of the search results, a total of 101 cases were identified. The data on patient characteristics, clinical features, colonoscopy findings, diagnosis, treatment, and clinical outcomes were collected and analyzed. The mean age of presentation was 66±17 years (range, 18–94 years), with 54% of cases reported in males. Clinical presentation was dominated by acute lower gastrointestinal bleeding in the form of bright-red blood per rectum 47% and hematochezia 36%, whereas 16% of patients were admitted with symptoms related to other medical conditions. Major underlying disorders were hypertension 29%, diabetes mellitus 21%, and chronic kidney disease 16%. The average number of colonoscopies required for the diagnosis of rectal Dieulafoy's lesion was 1.5±0.7. In regard to treatment, endoscopic therapy was applied in 80%, direct surgical suturing in 12%, angiographic embolization in 4%, and endoscopic therapy followed by surgical ligation was performed in 4% of patients. The endoscopic treatment was a feasible choice for rectal disease, with a primary hemostasis rate of 88%. Although the overall mortality rate was 6%, the causes of death were unrelated to this entity. This review illustrates that patients with rectal Dieulafoy's lesion can have a favorable clinical outcome. Prompt diagnosis and appropriate management are of paramount importance to prevent serious hemodynamic complications. The best therapeutic modality remains to be determined but the data presented here support the use of mechanical endoscopic methods as safe and effective.

**Keywords:** Rectal Dieulafoy's lesion; gastrointestinal bleeding; patient characteristics; clinical presentation; colonoscopy; diagnosis; management; mechanical endoscopic therapy; clinical outcomes

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## Introduction

Dr. M.T. Gallard first described Dieulafoy's lesion as "miliary aneurysms of the stomach" in 1884 (1). Later on, these lesions were named after a French surgeon, Paul Georges Dieulafoy (1839–1911) who attributed them as "Exulceratio simplex" in 1898 (2). The overall incidence of Dieulafoy's lesion in the adult population presenting with acute gastrointestinal hemorrhage is approximately 5% (3). Over 70% of all lesions occur in the proximal stomach and 80–95% of gastric lesions are located close to the gastroesophageal junction (3). Moreover, less than 35% of all the cases involve extragastric sites, with duodenum (15%), esophagus (8%), colon (2%), and jejunoileal lesions making up less than 1% (4–6). This disease has a predilection for males in their fifth and sixth decades of life, with the overall male-to-female ratio of 2:1 (6). Although conventional endoscopy remains initial investigation of choice, variable combinations of push enteroscopy and wireless capsule endoscopy can be employed. Angiography, red-cell scan, and intraoperative endoscopy via exploratory laparotomy can be useful in difficult-to-diagnose cases (6). Endoscopic procedures like sclerotherapy, thermal probes, band ligation, and hemocclipping are the cornerstone of management and portend favorable short- and long-term prognoses in most cases (7). In patients with massive life-threatening hemorrhage and hemodynamic instability, angiographic embolization or an open surgical approach can be life-saving (7). With the advancements in endoscopy, the mortality rate has significantly decreased mainly due to early diagnosis and circumventing the complications caused by open surgery (7).

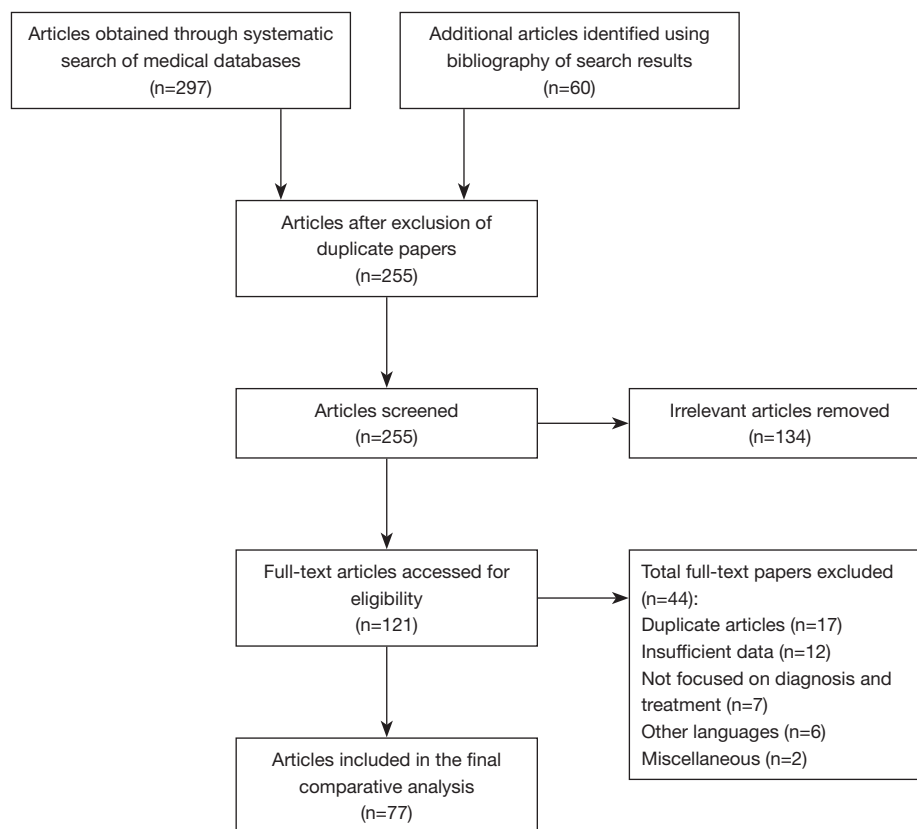
Rectal Dieulafoy's lesion was first reported by Franko *et al.* in 1991 (8). Since then, it remained an unusual entity with only 25 cases described till 2007 (9). Currently, rectal lesions account for less than 2% of all Dieulafoy's lesions, still making it an extremely rare cause of gastrointestinal bleeding (10). Therefore, published medical literature lacks extensive and organized data regarding this disease. The purpose of this comparative review is to summarize the patient demographics, presentation patterns, diagnostic investigations, therapeutic modalities, and clinical outcomes of rectal Dieulafoy's lesion. This article prompts gastroenterologists to remain vigilant in identifying and reporting this disease, especially in patients presenting with hemodynamic instability secondary to gastrointestinal hemorrhage.

## Materials and methods

We conducted a systematic literature search to retrieve available data on rectal Dieulafoy's lesion using the MEDLINE (PubMed, Ovid), Cochrane, Embase, and Scopus databases. Several controlled vocabulary search terminologies (Medical Subject Headings [MeSH] and Embase Subject Headings [Emtree]) such as "Dieulafoy's lesion", "rectum", "Dieulafoy-like", "anorectum", and "rectal Dieulafoy lesion" were combined using the Boolean operators "AND" and "OR" with the terms "diagnosis", "treatment", and "outcomes". The search was performed without a defined time filter, with language limitation to English-only articles. Furthermore, a manual search was also performed using the reference list of all accessed publications through the above-mentioned strategy. We initially screened titles and abstracts of all retrieved papers to determine their relevance to our topic. The same protocol was used to screen the selected articles for full texts to assess the availability of data. The inclusion criteria for the final comparative analysis consisted of articles describing relevant cases of rectal Dieulafoy's lesion in the English language that were also available in the full-text form. We presented descriptive data as mean  $\pm$  standard deviation, median (range), or percentage, as applicable.

## Results

A total of 357 articles consisting of but not limited to original articles, case series, and case reports were initially obtained using the aforementioned search methodology. After reviewing the titles and abstracts, a total of 236 papers were excluded as they were not related to our topic, were in a language other than the English, and/or full-text versions were not available, whereas 121 articles were first enlisted for re-review. After further exclusion of duplicate and redundant articles, 77 papers were included in the present study for the final comparative review (*Figure 1*). A thorough reading of these articles yielded a total of 101 cases of rectal Dieulafoy's lesion. The data on individual cases regarding patient demographics, diagnosis, management, and clinical outcomes are summarized. We divided the data into three categories according to the year of publication. First group consisted of patients from 1991 till 2003 (*Table S1*). The second group included cases from the 2004 till 2012 (*Table S2*). Similarly, third group contained cases of rectal Dieulafoy's lesion from 2014 till 2019 (*Table S3*).



**Figure 1** Flow diagram representing the search methodology for data synthesis regarding rectal Dieulafoy's lesion.

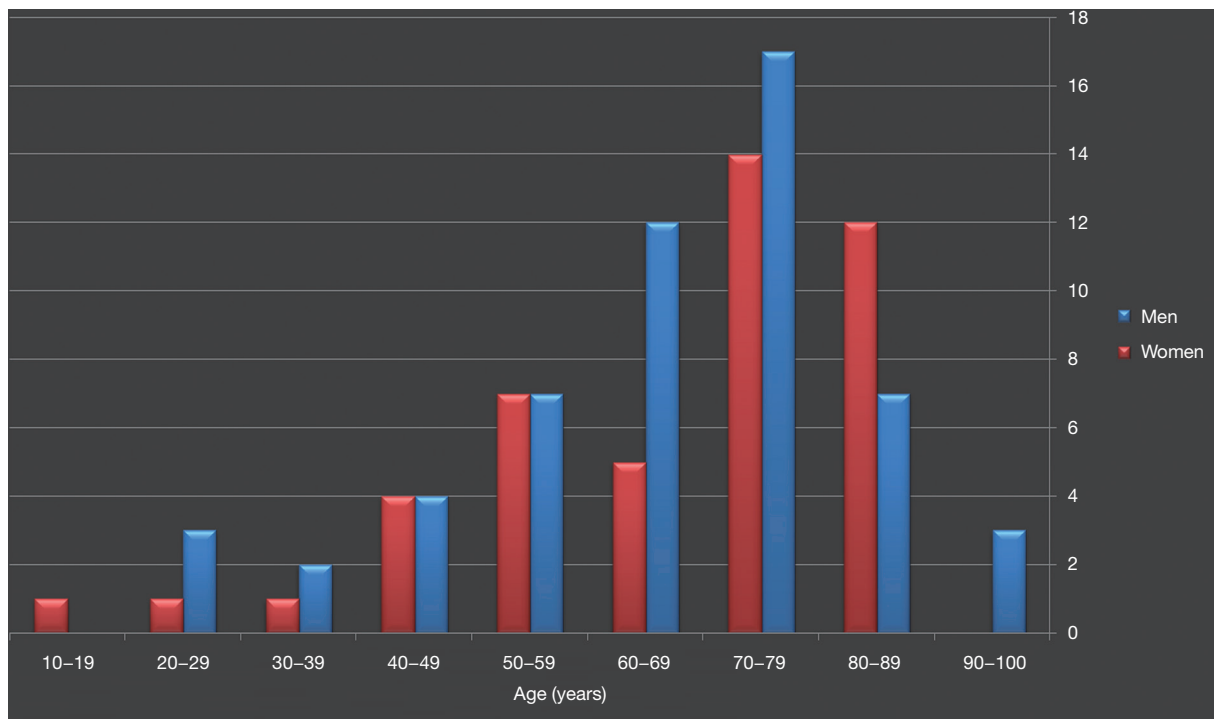
## Discussion

### *Patient characteristics*

In patients with Dieulafoy's lesion of the rectum, demographic features correlated with Dieulafoy's lesions from the other parts of gastrointestinal tract. A comprehensive review of the cases of rectal disease indicated a slight male predominance (males,  $n=55$ ; females,  $n=46$ ), with the male-to-female ratio of 1.2:1. The age of the patients ranged from 18 to 94 years (mean  $\pm$  standard deviation,  $66 \pm 17$  years; median, 71 years). Rectal disease frequently involved patients in their seventh ( $n=31$ ) and eighth ( $n=19$ ) decades of life (Figure 2). Although a fixed geographical distribution was not evident, a vast majority of cases included in this review were reported in the developed world (Figure 3). Generally, higher detection rates in these countries can be attributed to the technical advancements in diagnostic modalities.

### *Pathogenesis*

Dr. Dieulafoy initially believed that the lesion was an early stage of a gastric ulcer, with its growth interrupted by the hemorrhagic event (2). In prior studies, it was speculated that gastric arterial aneurysm leads to the development of this lesion, which was occasionally associated with arteriosclerosis. Congenital and acquired vascular malformations have also been considered as plausible etiological factors (3). In current times, it is a general consensus that a Dieulafoy's lesion is an unusually large, caliber-persistent artery (4,5). The vessel has a diameter of 1.0–3.0 mm and assumes a submucosal tortuous course (6). This artery approaches the mucous membrane and hemorrhage occurs due to erosion of the exposed vascular wall. One theory of spontaneous bleeding highlights the possibility of shear stress caused by compressive arterial pulsations, culminating in mucosal ischemia and subsequent erosion (6,11). Another theory suggests arterial thrombosis as the



**Figure 2** Age and gender distribution of patients with Dieulafoy's lesion of the rectum.

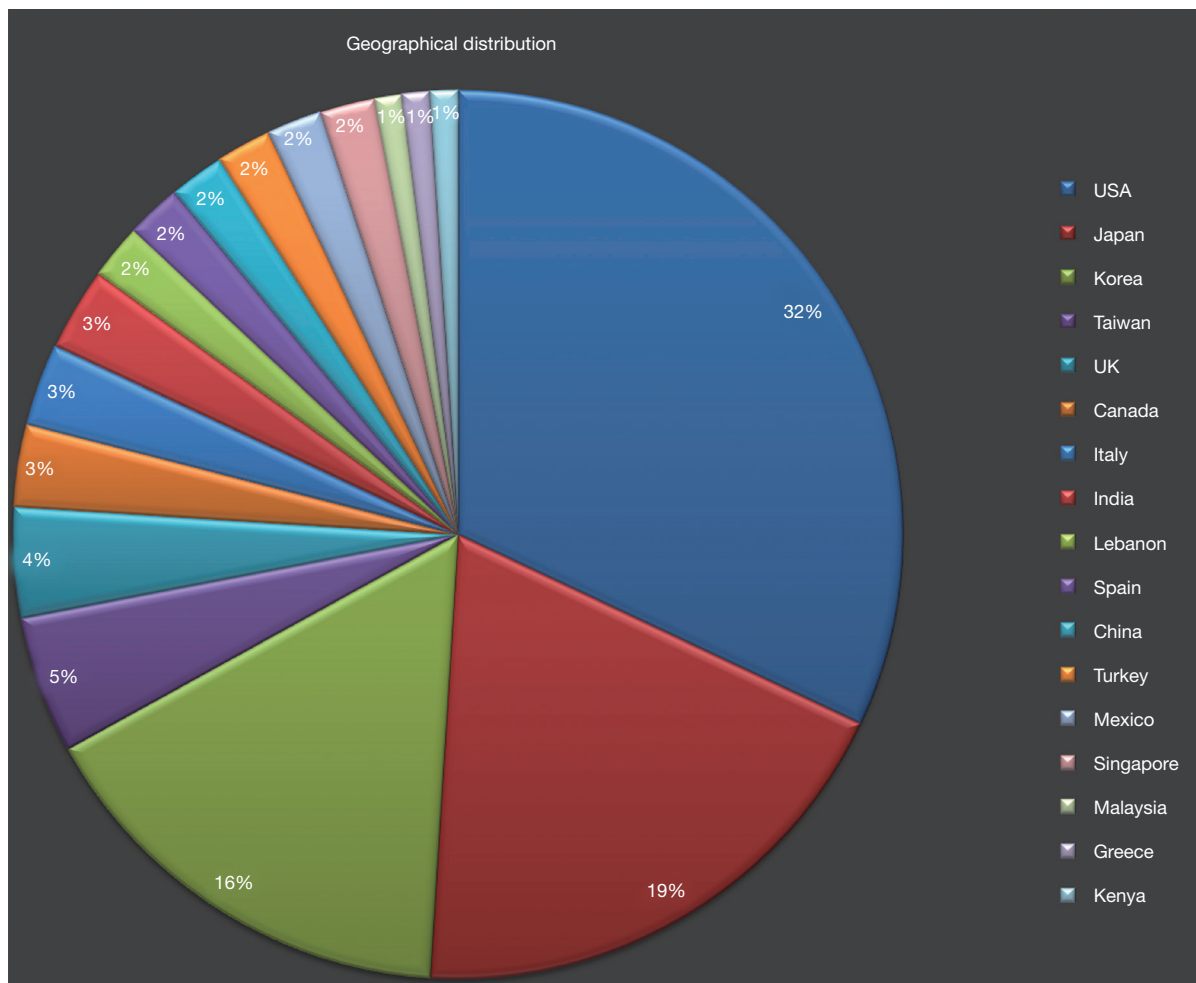
cause of ischemia and bleeding (12).

Rectal Dieulafoy's lesion shares gross pathological and histological peculiarities with lesions located in other segments of the gastrointestinal tract (13). However, regional, anatomical, and functional differences between lower and upper gastrointestinal segments can play a role either in the genesis or exacerbation of an existing congenital lesion (14). Stercoral damage due to constipation, inspissated fecal matter, chronic immobilization, cancer, and senile degenerative changes in the vascular and submucosal beds can be mechanical inciting factors for the erosional mechanisms behind bleeding rectal lesions (15-19). Furthermore, mucosal atrophy attributed to senile changes can also be contributory to this process (20). In Dieulafoy's lesion of the rectum, anal receptive intercourse may also be considered as a potential pathogenetic factor, especially in relatively younger patients with no significant medical conditions (21).

### **Clinical presentation**

Patients with Dieulafoy's lesion are typically asymptomatic before presenting with acute, profuse gastrointestinal

hemorrhage (22). The clinical presentation of rectal Dieulafoy's lesion is frequently varied as it encompasses a spectrum ranging from episodic self-limited bleeding to massive life-threatening hemorrhage (23). In this review, patients commonly presented with sudden, massive bright-red blood per rectum (47%), hematochezia (36%), painless rectal bleeding (11%), melena (4%), or with variable combinations of above-mentioned forms of lower gastrointestinal bleeding (24-28) (*Table 1*). Sudden hemodynamic compromise, lower abdominal pain, loss of consciousness, acute stroke, and iron-deficiency anemia were among the other notable presenting clinical features (9,29-34). Several patients were admitted to the hospital for causes other than the gastrointestinal hemorrhage. They either experienced bleeding from rectal Dieulafoy's lesion during their hospital stay or were diagnosed on incidental colonoscopy performed as a part of the diagnostic workup of other medical conditions (35-40). The bleeding episodes in a number of cases were mild and self-limiting. However, a few patients were identified with an intermittent and massive gastrointestinal hemorrhage leading to severe hemodynamic compromise, necessitating urgent management (41-44). Moreover, hemodynamic status is important as it not only requires urgent detection of the culprit bleeder but



**Figure 3** Pie-chart showing the geographical distribution of the reported cases of rectal Dieulafoy's lesion.

also guides appropriate therapeutic approach. Therefore, presentation patterns in patients with rectal Dieulafoy's lesion are a harbinger for the duration of gastrointestinal hemorrhage, overall condition of the patients, and diameter of bleeding artery (45).

**Comorbid conditions**

Dieulafoy's lesion has typically been associated with several chronic medical conditions. It is an interesting observation that a history for gastrointestinal disorders is frequently negative in these patients. However, at presentation, either recurrent gastrointestinal bleeding or a dramatic episode of massive gastrointestinal hemorrhage is the clinical phenomenon. A correlation between non-steroidal anti-

inflammatory drugs (NSAIDs), aspirin, and warfarin use has been identified in the past (6,22,46). Published medical literature shows that such patients commonly require NSAIDs and/or anticoagulants for various medical conditions. As expected, the administration of these medications potentially increases the risk for prolonged and severe gastrointestinal hemorrhage. In patients with rectal Dieulafoy's lesion, hypertension (29%), diabetes mellitus (21%), chronic renal disease (16%), cancer (14%), ischemic heart disease (11%), and prior cerebrovascular accident (11%) were among the common comorbid conditions (47-50).

Mechanical pathologies like constipation and fecalith have also been implicated as a risk factor for gastrointestinal bleeding in these patients (51-53). Mechanical pressures coupled with direct erosive mechanisms are considered

**Table 1** Clinical presentations of patients with rectal Dieulafoy's lesion

Clinical presentations	N (%)
Lower gastrointestinal bleeding	
Bright-red blood per rectum	47 (47%)
Hematochezia	36 (36%)
Painless rectal bleeding	11 (11%)
Melena	4 (4%)
Admitted with other medical conditions	16 (16%)
Hemodynamic compromise	5 (5%)
Sudden change in conscious status	4 (4%)
Blood loss anemia	4 (4%)
Shortness of breath	3 (3%)
Abdominal pain	3 (3%)

**Table 2** Major comorbid conditions associated with rectal Dieulafoy's lesion

Comorbid conditions	N (%)
Hypertension	29 (29%)
Diabetes mellitus	21 (21%)
Chronic kidney disease	16 (16%)
Cancer	14 (14%)
Prior cerebral vascular accident	11 (11%)
Ischemic heart disease	10 (10%)
Constipation	9 (9%)
Gastroenterological surgery	6 (6%)
Alcohol use disorder	6 (6%)
Hemorrhoids	5 (5%)
Liver cirrhosis	3 (3%)
Chronic obstructive pulmonary disease	3 (3%)
Dementia	3 (3%)
Sigmoid diverticula	2 (2%)
Diverticulosis	2 (2%)

in this regard. In concordance with the gastric and duodenal Dieulafoy's lesion, gastroenterological surgery also precipitated bleeding in a number of patients with rectal disease, indicating the stress injury as a probable

inciting factor (6). Alcohol use disorder was another frequently found underlying entity in patients with rectal lesions. However, it is notable that the exact effects of alcohol and tobacco on Dieulafoy's lesion remain to be determined. Hemorrhoids, hepatic cirrhosis, chronic obstructive pulmonary disease, dementia, sigmoid diverticula, and diverticulosis were among the less commonly associated medical conditions (54-56) (Table 2). Rare associations of rectal disease included burns, rectal mucous fistula, and deep venous thrombosis (57-60). Anal receptive intercourse may also be considered as a factor that can increase the propensity of bleeding from rectal lesions (21). Furthermore, there may be increased risk of gastrointestinal bleeding due to rectal Dieulafoy's lesion in patients undergoing therapy with cyclophosphamide, possibly following impaired tissue repair (61,62). However, direct association between immunosuppression and Dieulafoy's lesion requires further research.

### Diagnosis

Rectal Dieulafoy's lesion may pose a significant diagnostic challenge in certain cases. This is mainly due to their small size, relatively inconspicuous nature, and ability to cause intermittent hemorrhage. It may also masquerade as other common vascular abnormalities, such as arteriovenous malformations or vascular aneurysms (6,63,64). In cases with no active bleeding, endoscopic evaluation may reveal the lesion as a nipple-like protrusion, polyp or an exposed vessel, without overlying ulceration or erosion (65-68). However, aberrant culprit arteries are predominantly visualized only during active bleeding (69,70). It is observed that the lesion can also be covered with a blood clot following a prior bleeding episode. Therefore, careful suctioning and proper irrigation may help in such cases (71,72). These factors constitute a significant diagnostic dilemma that may culminate in increased complications in patients with Dieulafoy's lesion compared to other etiologies of gastrointestinal bleeding. Endoscopy is the initial modality of choice due to its widespread availability and easy use. The endoscopic criteria have been formulated to diagnose patients with Dieulafoy's lesion: (I) active arterial oozing or micropulsatile, intermittent bleeding from small (<3 mm) mucosal defects, with no ulceration or erosion of surrounding mucosa; (II) visual evidence of raised nipple-like artery; (III) blood clots with a visible tiny point of mucosal attachment (73). In this review, all patients fulfilled

**Table 3** Efficacy of different therapeutic approaches for rectal Dieulafoy's lesion

Therapeutic modality	Primary hemostasis rate, n (%)	Rebleeding rate, n (%)
Electrocoagulation	1/1 (100%)	0/1 (0%)
Heater probe	2/2 (100%)	0/2 (0%)
Gauze tamponade	2/2 (100%)	0/2 (0%)
Sclerotherapy (epinephrine, ethanol, tetradecyl sulfate)	4/6 (67%)	2/6 (33%)
Band ligation	9/11 (82%)	2/11 (18%)
Hemoclipping	18/20 (90%)	2/20 (10%)
Combination endoscopic therapy	35/39 (90%)	4/39 (10%)
Angiographic embolization	2/4 (50%)	2/4 (50%)
Endoscopic therapy followed by surgical ligation	4/4 (100%)	0/4 (0%)
Direct surgical ligation	11/12 (92%)	1/12 (8%)

the above-mentioned endoscopic diagnostic criteria.

The final diagnostic yield of endoscopy is 70%; however, initial examination with this modality may not be remarkable in all cases. In a study by Reilly and al-Kawas, only 49% of bleeders were detected on initial endoscopy, 33% of patients required a second endoscopic examination, and 18% necessitated exploratory laparotomy to identify the Dieulafoy's lesion (74). In our analysis of rectal Dieulafoy's lesion, colonoscopy failed to diagnose 9% of patients and surgical exploration was required for etiology establishment. Yoshikumi *et al.* demonstrated that the average number of colonoscopies needed for the detection of rectal Dieulafoy's lesion was  $1.7 \pm 0.9$  (75). In our data, the average number of colonoscopies required was  $1.5 \pm 0.7$ , indicating improvements in endoscopic diagnosis of rectal disease. Although poor bowel preparation and stagnant blood contribute to potential dilemma encountered in patients with lower gastrointestinal Dieulafoy's lesion, an initial thorough endoscopic examination is imperative in patients with rectal lesions.

Radiological investigations, such as computed tomography angiography (CTA), contrast-enhanced magnetic resonance imaging (CEMRI), and multidetector-row computed tomography (MDCT) were rarely used to pinpoint the rectal lesions (76-79). The findings of these

investigations were subsequently validated by colonoscopy. Therefore, these modalities can be helpful when an initial colonoscopy is nondiagnostic for colorectal Dieulafoy's lesion. Furthermore, endoscopic ultrasonography may also be performed to establish the diagnosis in selected cases (80).

### Management

Until 1990, surgical intervention was the mainstay of treatment for Dieulafoy's lesion and was associated with a mortality rate up to 80%. In 1990, Goldenberg *et al.* proposed endoscopic therapy for primary hemostasis in these patients, which has gradually decreased mortality rate to 8% (81,82). The therapeutic endoscopy has evolved into a feasible, safe and effective modality with a hemostatic success rate reported between 75% and 100% (82). For rectal Dieulafoy's lesion, Abdulian *et al.* first described endoscopic management (13). In our review, of the 101 reported cases of rectal Dieulafoy's lesion, patients were initially treated with endoscopic therapy in 81 cases, surgical suturing alone in 12, angiographic embolization in 4, and a combination of endoscopic modalities and surgical ligation in 4 patients. The overall primary hemostasis rate was 87% (88 of 101), with a rebleeding rate of 13% (13 of 101) (Table 3).

Based on analysis of this data, endoscopic mechanical therapy, which was used in 49 of 101 patients, showed relatively better therapeutic outcomes. It was either applied as endoscopic monotherapy using hemoclipping or banding alone, or in combination with epinephrine (83-87). Recent literature demonstrates that hemoclipping and band ligation both were equally effective ways of achieving hemostasis in Dieulafoy's lesions (88). In patients with rectal lesions, Park *et al.* considered endoscopic band ligation as the preferred therapy (53). On the contrary, Kim *et al.* suggested that band ligation carried a number of risks and disadvantages, associated with rebleeding in patients with rectal disease (86). In this review, endoscopic hemoclipping with or without epinephrine in comparison to band ligation with or without epinephrine, achieved a higher primary hemostasis rate (91% *vs.* 79%) and a lower rebleeding rate (9% *vs.* 21%), respectively. Therefore, endoscopic hemoclipping may have a slight therapeutic superiority over banding for rectal Dieulafoy's lesion. However, it is notable that patients who received hemoclipping (n=35) as therapy were more than the ones who were treated with band ligation (n=14). Thus, mechanical therapy is feasible, safe, quick and has

**Table 4** Efficacy of various combinations employed as endoscopic combination therapy in reported cases (n=39) of rectal Dieulafoy's lesion

Combination of endoscopic modalities	Primary hemostasis rate, n (%)	Rebleeding rate, n (%)
Epinephrine + endoscopic hemoclipping	14/15 (93%)	1/15 (7%)
Epinephrine + electrocoagulation	6/7 (86%)	1/7 (14%)
Epinephrine + heater probe	3/4 (75%)	1/4 (25%)
Epinephrine + endoscopic band ligation	2/3 (67%)	1/3 (33%)
Endoscopic hemoclipping + site tattooing	2/2 (100%)	0/2 (0%)
Epinephrine + endoscopic hemoclipping + site tattooing	2/2 (100%)	0/2 (0%)
Epinephrine + ethanol	2/2 (100%)	0/2 (0%)
Ethanol + electrocoagulation	1/1 (100%)	0/1 (0%)
Epinephrine + polidocanol	1/1 (100%)	0/1 (0%)
Epinephrine + 50% glucose water	1/1 (100%)	0/1 (0%)
Heater probe + endoscopic band ligation	1/1 (100%)	0/1 (0%)

good long-term results. Future research should compare the efficacies of hemoclipping and band ligation for rectal disease in large patient cohorts to designate either one as the best endoscopic choice.

Meister *et al.* reported 3 adult patients with rectal Dieulafoy's lesions who were successfully treated with endoscopic combination therapy using epinephrine and heater-probe coagulation methods (17). In our review, epinephrine plus electrocoagulation in 7, and epinephrine plus heater probe were employed in 4 cases (Table 4). The outcomes of these methods were comparable to endoscopic mechanical therapy. However, mechanical endoscopic techniques appeared to be more feasible and were used in the majority of patients with rectal disease. In this data, repeat therapeutic endoscopy was applied in 10 of 13 patients with rectal disease who experienced rebleeding, which eventually resulted in 100% hemostasis rate. Repeat endoscopic approaches that were used included epinephrine plus heater probe (n=2), endoscopic hemoclipping (n=2), ethanol plus tetradecyl sulphate (n=1), electrocoagulation (n=1), epinephrine plus endoscopic band ligation (n=1),

endoscopic hemoclipping plus endoscopic band ligation (n=1), endoscopic band ligation (n=1), and polidocanol (n=1).

Radioscintigraphy and angiography are inferior to colonoscopy in localization and treatment of a lower gastrointestinal bleed. However, they can be of use in hemodynamically unstable patients with brisk bleeding, precluding adequate preparation or failed colonoscopy. Angiography can localize the source of bleeding in 25–70% of cases and is therapeutically effective in 40–89% cases of non-diverticular bleeding (89). In our review, angiographic embolization was performed in four cases. Two patients were successfully treated with this modality while the other two required surgery for definitive hemostasis (57,90-92).

Surgical intervention is the ultimate method for achieving hemostasis in patients with rectal Dieulafoy's lesion. The common surgical techniques are wide-wedge resection or wide oversewing of culprit artery. Atallah *et al.* also used transanal minimally invasive surgery (TAMIS) to perform suture ligation of the rectal Dieulafoy's lesion (93). In our review, 4 patients required surgery after failed initial therapeutic attempts, whereas 12 patients underwent direct surgical ligation or resection of the bleeding rectal Dieulafoy's lesion. Of 16 patients, 15 achieved adequate hemostasis with surgery.

### Clinical outcomes

In this review of rectal cases (n=101), clinical outcomes were comparable. A total of 6 patients died due to varied causes such as pneumonia (n=2), multiorgan failure (n=2), tumor progression (n=1), and withdrawal of care (n=1). Out of the 101 patients studied, 13 experienced recurrent bleeding. Notably, all of these patients achieved hemostasis with repeat treatment. Thus, it may be speculated that rectal Dieulafoy's lesion bear a relatively better prognosis and lower recurrence rate, assuming appropriate management is undertaken early in the course of the hemorrhage. However, we acknowledge the limitation of this review as the data were gained mainly from case reports and small case series.

### Follow-up

Despite the undeniable benefits of endoscopic therapy, the data on long-term follow-up of rectal Dieulafoy's lesion is sparse. Therefore, the follow-up duration and methodology generally vary from case to case. In few patients, surveillance



colonoscopy was performed in first 24 hours to assess the efficacy of treatment applied and to decipher recurrence of bleeding. After initial intervention to secure hemostasis, the time period to encounter recurrent hemorrhage was varied. Although rebleed occurred in only a few hours of first treatment attempt in a few patients (n=3), it was mostly after 3–7 days (n=8). Out of the total 101 patients, long-term follow-up was documented in 46 patients, with a mean duration of 12 months (range, 1–72 months).

## Conclusions

While rectal Dieulafoy's lesion remains uncommon, it is none-the-less an important cause of gastrointestinal hemorrhage. Due to the intermittent nature of bleeding, diagnostic investigations may have their limitations. Gastroenterologists should maintain a high index of clinical suspicion for this etiology. An updated knowledge of the lesion and its presentation patterns can help early detection, which can then lead to timely improvisation of endoscopic or surgical management, ultimately improving clinical outcomes. Standard therapeutic guidelines for rectal Dieulafoy's lesion are not available. The data presented here favor the use of endoscopic mechanical therapy as relatively effective in such patients. Future research should aim to stratify the efficacy of commonly used endoscopic methods to devise an optimal approach to achieve primary hemostasis. Furthermore, population-based registries should be created in order to systematically organize the patient data regarding Dieulafoy's lesion of the rectum.

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## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Supplementary

Table S1 Demographic, clinical presentation, comorbid conditions, lesion site, treatment, and outcome data of patients with rectal Dieulafoy's lesion (1991–2003)

Author	Region	Year	Age/gender	Clinical presentation	Comorbid conditions	Endoscopic findings	Diagnostic attempts	Treatment	Rebled	Treatment of recurrence	Outcome/follow-up duration
Franko <i>et al.</i> (8)	USA	1991	20/M	BRBPR	No known conditions	Pulsatile bleeding, 11 cm from the anal verge	1	Electrocoagulation + rectal packing, surgical ligation	No	–	Recovered, 9 months
Abdulian <i>et al.</i> (13)	USA	1993	43/M	Rectal bleeding	Not reported	Protuberant vessel in the rectum	1	Ethanol injection	Yes (4 days)	Ethanol + tetradecyl sulphate	Recovered
Yeoh <i>et al.</i> (14)	Singapore	1996	66/M	Sudden acute stroke	HTN, RAS, IHD, AAA, COPD	Protuberant vessel, 6 cm from the anal verge	1	Epinephrine injection	No	–	Died of pneumonia 4 days later
Harrison <i>et al.</i> (15)	UK	1997	68/M	Melena	Tongue CA, radiotherapy, hemorrhoids	Failed to diagnose, surgery showed a spurting rectal artery	1	Surgical ligation	No	–	Recovered
Kalman <i>et al.</i> (63)	USA	1997	33/M	Hematochezia	Subtle coagulation defect	Protruding adherent blood clot, 10 cm from the anal verge	1	Epinephrine + electrocoagulation	Yes (7 days)	Electrocoagulation	Recovered
Abdelmalek <i>et al.</i> (58)	USA	1997	76/M	Rectal bleeding	Rectal mucous fistula	Pulsatile bleeding	2	Epinephrine + heater probe + surgical ligation	No	–	Recovered
Eguchi <i>et al.</i> (18)	Japan	1997	78/M	Ureterolithiasis, hematochezia	Anemia	Failed to diagnose. Surgery showed small exposed vessel, 13 cm from the anal verge	1	Surgical ligation	No	–	Recovered, 12 months
Meister <i>et al.</i> (17)	USA	1998	74/M	Rectal bleeding	Constipation, DM, dementia, hypothyroidism	Protuberant blood vessel near dentate line	2	Epinephrine + heater probe	No	–	Recovered, 17 months
Meister <i>et al.</i> (17)	USA	1998	77/M	BRBPR	Parkinson's disease, dementia, C. difficile colitis	Small adherent clot in distal rectum	1	Heater probe	No	–	Recovered, 17 months
Meister <i>et al.</i> (17)	USA	1998	67/M	Hematochezia	Bilroth I procedure for PUD	Pulsatile bleeding, 10 cm from anal verge	1	Epinephrine + heater probe	No	–	Recovered, 13 months
Dobson <i>et al.</i> (91)	UK	1999	75/F	Leg weakness, rectal bleeding	Cord compression, renal papillary CA	Failed to diagnose	1	Angiographic embolization	No	–	Recovered, 9 months
Amaro <i>et al.</i> (45)	USA	1999	73/M	BRBPR	DM, HTN, COPD, CKD, PVD with gangrenous left toe	Protuberant vessel oozing blood, 7 cm from the anal verge	1	Epinephrine + heater probe	Yes (3 days)	Epinephrine + heater probe	Recovered, 8 months
Nozoe <i>et al.</i> (47)	Japan	1999	65/M	Anal bleeding	CKD	Protuberant vessel, 5 cm from the anal verge	1	Endoscopic hemoclippping	No	–	Recovered
Vandervoort <i>et al.</i> (69)	USA	1999	50/M	Hematochezia	Lung cancer	4 rectal ulcers, 2 had a visible vessel with otherwise normal-appearing mucosa	1	Endoscopic band ligation	No	–	Recovered
Rajendra <i>et al.</i> (24)	China	2000	78/M	Hematochezia	HTN, renal impairment	Protuberant vessel, 6 cm from the anal verge	2	Epinephrine + electrocoagulation failed, followed by surgical ligation	No	–	Recovered, 2 months
Matsuoka <i>et al.</i> (31)	Japan	2000	54/F	Lower abdominal pain, hematochezia	CKD, sigmoid diverticulum (partial resection)	Protuberant vessel bleeding, 1 cm above the pectinate line	3	Ethanol + electrocoagulation	No	–	Recovered, 72 months
Kayali <i>et al.</i> (23)	USA	2000	77/F	Mental status change, dehydration, rectal bleeding	No known conditions	Protuberant vessel	2	Epinephrine + ethanol	No	–	Recovered
Kayali <i>et al.</i> (23)	USA	2000	73/F	LGIB	Diverticulosis	Protuberant vessel	2	Epinephrine + ethanol	No	–	Recovered, 9 months
Enns <i>et al.</i> (10)	Canada	2001	72/M	SOB, BRBPR	Extensive cardiac history	Spurting site of bleeding in the rectum	2	Epinephrine + electrocoagulation	No	–	Recovered, 8 months
Jani <i>et al.</i> (59)	Kenya	2001	60/M	BRBPR	HC, DVT	Pulsating red adherent clot, 13 cm from the anal verge	1	Epinephrine	No	–	Recovered
Guy <i>et al.</i> (57)	Singapore	2001	18/F	Rectal bleeding	45% body surface area burns	Dieulafoy-type lesion at the anorectal junction	4	Gauze pack soaked in epinephrine + angiographic embolization	Yes (3 hours)	Surgical ligation	Recovered, 7 weeks
Katsinelos <i>et al.</i> (34)	Greece	2001	40/F	Sudden disturbance of consciousness	Not reported	Small mucosal defect in the superior valve of Houston	1	Epinephrine + 50% glucose water	No	–	Recovered, 1 month
Yadav <i>et al.</i> (83)	USA	2001	59/F	Rectal bleeding, dizziness	DM, HTN, CVA	An ulcerated rectal lesion	1	Surgical resection	No	–	Recovered, 2 months
Gul <i>et al.</i> (51)	Malaysia	2002	76/F	BRBPR	HTN, CRF, constipation	Failed to diagnose (scope and angiography)	2	Surgical ligation + bupivacaine + epinephrine	Yes (5 days)	FCT + epinephrine + heater probe	Recovered, 12 months
Nomura <i>et al.</i> (56)	Japan	2002	82/M	Hematochezia with BRBPR	Internal hemorrhoids	Active punched-out lesion, 7 cm from the anal verge	1	Endoscopic hemoclippping	No	–	Recovered
Mizukami <i>et al.</i> (67)	Japan	2002	85/F	BRBPR	Not available	Exposed vessel in the anterior rectal wall	1	Epinephrine + endoscopic band ligation	No	–	Recovered, 6 months
Lee <i>et al.</i> (84)	Korea	2002	81/M	Hematochezia	Not reported	Small rectal mucosal defect with a visible vessels	2	Epinephrine + endoscopic hemoclippping	No	–	Recovered
Lee <i>et al.</i> (84)	Korea	2002	86/F	Hematochezia	Not reported	Small rectal mucosal defect with a visible vessels	2	Epinephrine + endoscopic hemoclippping	No	–	Recovered
Abe <i>et al.</i> (20)	Japan	2003	55/M	Hematochezia	SAH	Protuberant bleeding vessel, 5 cm from the anal verge	1	Endoscopic hemoclippping	No	–	Recovered, 36 months
Fujimaru <i>et al.</i> (27)	Japan	2003	83/F	Hematochezia	Not reported	Small arterial bleeding point, 4 cm from the anal verge	1	Epinephrine + endoscopic band ligation	No	–	Recovered, 6 months

BRBPR, bright-red blood per rectum; HTN, hypertension; RAS, renal artery stenosis; IHD, ischemic heart disease; AAA, abdominal aortic aneurysm; COPD, chronic obstructive pulmonary disease; CA, carcinoma; DM, diabetes mellitus; PUD, peptic ulcer disease; CKD, chronic kidney disease; PVD, peripheral venous disease; LGIB, lower gastrointestinal bleeding; SOB, shortness of breath; CRF, chronic renal failure; SAH, subarachnoid hemorrhage; CVA, cerebrovascular accident; NIDDM, non-insulin-dependent diabetes mellitus; CA, carcinoma; SOB, shortness of breath; HC, hemorrhoidectomy; DVT, deep venous thrombosis; FCT, Foley's catheter tamponade.

**Table S2** Demographic, clinical presentation, comorbid conditions, lesion site, treatment, and outcome data of patients with rectal Dieulafoy's lesion (2004–2012)

Author	Region	Year	Age/gender	Clinical presentation	Comorbid conditions	Endoscopic findings	Diagnostic attempts	Treatment	Rebled	Treatment of recurrence	Outcome/follow-up duration
Tseng <i>et al.</i> (19)	Taiwan	2004	74/F	Rectal bleeding	Cerebral hemorrhage	Submucosal bleeding arteriole, 2 cm from dentate line	1	Gauze tamponade	No	–	Recovered
Tseng <i>et al.</i> (19)	Taiwan	2004	78/F	Rectal bleeding	Colon cancer, sepsis, E. coli infection	Submucosal bleeding arteriole, 4 cm from dentate line	1	Gauze tamponade	No	–	Died due to multiorgan failure
Chiu <i>et al.</i> (35)	Taiwan	2004	81/M	Pneumonia	CRF, HTN	A 2-mm adherent clot, 5 cm from the anal verge	2	Heater probe + endoscopic band ligation	No	–	Died of pneumonia 18 days later
Lee <i>et al.</i> (90)	USA	2004	73/M	Hematochezia	Not reported	Protuberant bleeding vessel, 10 cm from the anal verge	1	Angiographic embolization	Yes (5 hours)	Epinephrine + endoscopic band ligation	Recovered, 12 months
Fukumori <i>et al.</i> (68)	Japan	2004	76/M	LGIB	CRF	Active bleeding focus in the rectum	1	Endoscopic hemocclipping	No	–	Recovered
Hokama <i>et al.</i> (65)	Japan	2005	76/M	Rectal bleeding	Bladder + cecal CA, CVA	Exposed vessel in the distal rectum	2	Endoscopic band ligation	No	–	Recovered
Casella <i>et al.</i> (29)	Italy	2005	81/F	Anemia, hematochezia	PUD, CKD, NIDM, HTN, nephrectomy	A visible arterial bleeding spot in the rectum	2	Epinephrine + electrocoagulation	No	–	Recovered, 36 months
Gupta <i>et al.</i> (11)	India	2006	45/F	Hematochezia	Fecal impaction	Pulsatile vessel, 5 cm from the anal verge	2	Epinephrine + endoscopic band ligation + surgical ligation	No	–	Recovered, 2 months
Berretti <i>et al.</i> (52)	Italy	2006	80/F	Rectal bleeding	Constipation, DM, IHD, CVA, CCY, AH, GIB	Active punched-out lesion, 4 cm from the anal verge	1	Epinephrine + endoscopic hemocclipping + tattooing with India ink	No	1	Recovered, 12 months
Yoshikumi <i>et al.</i> (75)	Canada	2006	44/M	Sudden disturbance of consciousness	HTN, DM, HLD, fatty liver	Protuberant vessel, 5 cm from the anal verge	1	Endoscopic hemocclipping	Yes (4 days)	Endoscopic hemocclipping + band ligation	Recovered, 12 months
Apiratpracha <i>et al.</i> (43)	Canada	2006	67/F	LGIB, hemodynamic compromise	Cadaveric OLT, on IMS	Pulsatile bleeding site, 0.5 cm from the anorectal junction	1	Epinephrine + electrocoagulation	No	–	Recovered, 4 months
Slim <i>et al.</i> (85)	Lebanon	2006	58/F	Massive BRBPR	DM, HTN, left hemiplegia	Protruding vessel, 3 cm above the anal margin	2	Epinephrine + polidocanol	No	–	Recovered, 23 months
Slim <i>et al.</i> (85)	Lebanon	2006	72/F	Rectal bleeding	CABG	Visible vessel, 5 cm from anal verge	1	Epinephrine + heater probe	No	–	Recovered, 18 months
Kim <i>et al.</i> (86)	Korea	2007	77/F	Acute LGIB	HTN	Protruding vessel	Not reported	Endoscopic band ligation	No	–	Recovered, 18 months
Kim <i>et al.</i> (86)	Korea	2007	78/F	Acute LGIB	CRF	Protruding vessel with active bleeding	Not reported	Epinephrine + endoscopic band ligation	Yes	Surgical ligation	Recovered, 10 months
Kim <i>et al.</i> (86)	Korea	2007	85/F	Acute LGIB	HTN	Protruding vessel	Not reported	Endoscopic band ligation	Yes	Surgical ligation	Recovered, 6 months
Kim <i>et al.</i> (86)	Korea	2007	61/M	Acute LGIB	CRF	Protruding vessel with active bleeding	Not reported	Endoscopic band ligation	No	–	Recovered, 7 months
Kim <i>et al.</i> (86)	Korea	2007	42/F	Acute LGIB	None	Protruding vessel	Not reported	Epinephrine + endoscopic hemocclipping	No	–	Recovered, 20 months
Kim <i>et al.</i> (86)	Korea	2007	61/M	Acute LGIB	None	Protruding vessel	Not reported	Epinephrine + electrocoagulation	No	–	Recovered, 16 months
Fuchizaki <i>et al.</i> (87)	Japan	2007	54/M	Hematochezia	Sigmoid cancer, sigmoidectomy	A spurting exposed vessel in the rectum	1	Endoscopic hemocclipping	No	–	Recovered
Fuchizaki <i>et al.</i> (87)	Japan	2007	50/F	Rectal bleeding	CVA, brain surgery	Two exposed rectal spurting vessels	1	Endoscopic hemocclipping	No	–	Recovered
Fuchizaki <i>et al.</i> (87)	Japan	2007	86/F	IE, rectal bleeding	NM	Spurting exposed vessel in the rectum	1	Endoscopic band ligation	No	–	Recovered
Fuchizaki <i>et al.</i> (87)	Japan	2007	76/M	Acute MI, rectal bleeding	CABG	Pulsatile bleeding from a rectal vessel	1	Endoscopic band ligation	No	–	Recovered
Aghenta <i>et al.</i> (32)	USA	2008	45/M	Upper abdominal pain, nausea, emesis, melena	Alcohol abuse, HCV infection, cirrhosis	Active spurting of blood, 4 cm from the anal verge	1	Epinephrine + endoscopic hemocclipping	No	–	Died, family withdrew care
Nunoo-Mensah <i>et al.</i> (42)	UK	2008	76/M	BRBPR, hypovolemic shock	Not reported	Pulsatile bleeding lesion just over the anorectal junction	1	Epinephrine + electrocoagulation	No	–	Recovered
Chen <i>et al.</i> (78)	Taiwan	2008	77/F	Hematochezia	HTN, DM, SCF, DH, CES	MDCT detected and colonoscopy confirmed the lesion	2	Endoscopic band ligation	No	–	Recovered, 1 month
Ruiz-Tovar <i>et al.</i> (49)	Spain	2008	64/M	Rectal bleeding, hemodynamic instability	Lung mass	Failed to diagnose, anoscopy revealed rectal arterial bleeding point	1	Surgical ligation	No	–	Recovered
Hotta <i>et al.</i> (46)	Japan	2009	70/F	Rectal bleeding	CVD, DM, HTN	Multiple Dieulafoy-like lesions	1	Surgical ligation	No	–	Recovered
Hotta <i>et al.</i> (46)	Japan	2009	88/M	Rectal bleeding	Renal, orthopedic	Solitary Dieulafoy-like lesion	1	Surgical ligation	No	–	Recovered
Hotta <i>et al.</i> (46)	Japan	2009	85/F	Rectal bleeding	CAD, lung disease, cancer	Solitary Dieulafoy-like lesion	1	Endoscopic hemocclipping	No	–	Recovered
Hotta <i>et al.</i> (46)	Japan	2009	71/M	Rectal bleeding	CAD, CVD, HTN, DM	Solitary Dieulafoy-like lesion	1	Surgical ligation	No	–	Recovered
Atallah <i>et al.</i> (93)	USA	2013	38/M	BRBPR	None	A rectal Dieulafoy's lesion	1	TAMIS	No	–	Recovered, 6 months
Baccaro <i>et al.</i> (9)	USA	2012	71/M	Routine visit, history of BRBPR	AF, CAD, CABG, ZD, BE, SD, SH	Failed to diagnose. Surgery showed exposed rectal vessel	3	Surgical ligation	No	–	Recovered, 36 months
Kim <i>et al.</i> (44)	Korea	2012	89/M	BRBPR, hematochezia	HTN, DM	Pulsatile bleeding from an exposed vessel, 10 cm from anal verge	1	Epinephrine + endoscopic hemocclipping	No	–	Recovered, 6 months
Nishimuta <i>et al.</i> (92)	Japan	2012	50/M	Hematochezia	Alcoholic cirrhosis, laryngeal CA, prior CVA	Protruding vessel in the lower rectum but no active bleeding	2	Angiographic embolization	No	–	Recovered

BRBPR, bright-red blood per rectum; HTN, hypertension; CRF, chronic renal failure; NA, not available; LGIB, lower gastrointestinal bleeding; CA, carcinoma; CVA, cerebrovascular accident; PUD, peptic ulcer disease; CKD, chronic kidney disease; NIDM, non-insulin-dependent diabetes mellitus; DM, diabetes mellitus; IHD, ischemic heart disease; CCY, cholecystectomy; AH, abdominal hysterectomy; GIB, gastrointestinal bleeding; HLD, hyperlipidemia; OLT, orthotopic liver transplant; IMS, immunosuppressive therapy; CABG, coronary artery bypass grafting; NR, not reported; IE, infective endocarditis; NM, not mentioned; HCV, hepatitis C virus; SCF, spinal compression fracture; DH, disc herniation; CES, cauda equina syndrome; MDCT, multidetector-row computed tomography; CVD, cardiovascular disease; CAD, coronary artery disease; TAMIS, transanal minimally invasive surgery; AF, atrial fibrillation; CAD, coronary artery disease; CABG, coronary artery bypass grafting; ZD, Zenker's diverticulum; BE, Barrett's esophagus; SD, sigmoid diverticulum; SH, stapled hemorrhoidectomy; CA, carcinoma.

**Table S3** Demographic, clinical presentation, comorbid conditions, lesion site, treatment, and outcome data of patients with rectal Dieulafoy's lesion (2014–2019)

Author	Region	Year	Age/gender	Clinical presentation	Comorbid conditions	Endoscopic findings	Diagnostic attempts	Treatment	Rebleed	Treatment of recurrence	Outcome/follow-up duration
Park <i>et al.</i> (53)	Korea	2014	65/F	Hematochezia	DM, constipation, femoral neck surgery	A 3-mm protuberance and an adherent clot	3	Endoscopic band ligation	No	–	Recovered, 2 months
Park <i>et al.</i> (53)	Korea	2014	68/M	Hematochezia	HTN, metastatic SCLC, constipation	A 2-mm protuberance with an adherent clot in the rectum	1	Endoscopic band ligation	Yes	Endoscopic hemoclipping	Recovered, 6 months
Park <i>et al.</i> (53)	Korea	2014	75/M	Hematochezia	HTN, DM, CKD, constipation	Protruding vessel and adherent clot	2	Epinephrine	Yes (few hours)	Endoscopic hemoclipping	Recovered
Park <i>et al.</i> (53)	Korea	2014	71/M	Hematochezia	HTN, DM, CVA, CHF, CKD, constipation	Exposed vessel in the distal rectum	1	Endoscopic hemoclipping	Yes (4 days)	Endoscopic band ligation	Recovered
Park <i>et al.</i> (53)	Korea	2014	65/F	BRPRB	Tongue cancer	Protruding vessel, 8 cm above the anal verge	1	Endoscopic band ligation	No	–	Recovered, 22 months
Park <i>et al.</i> (53)	Korea	2014	68/F	Hematochezia	HTN, constipation	Small adherent clot in the distal rectum	2	Heater probe	No	–	Recovered, 1 month
Vila <i>et al.</i> (80)	Spain	2014	68/M	Severe LGIB, hemodynamic instability	RCC (stage IV)	Pulsatile bleeding vessel, 3 cm above the anal verge	2	Epinephrine + endoscopic hemoclipping	Yes (5 days)	Polidocanol	Died 2 months later, tumor progression
Dogan <i>et al.</i> (50)	Turkey	2014	75/F	Rectal bleeding	HTN, DM, CKD	Failed to diagnose	1	Epinephrine + surgical ligation	No	–	Recovered
Wells <i>et al.</i> (72)	USA	2014	44/M	Hematochezia	Alcoholism, HTN, PUD	A protruding visible rectal vessel with a blood clot	1	Endoscopic hemoclipping + India ink tattooing	No	–	Recovered
Goldkamp <i>et al.</i> (71)	USA	2014	60/M	Hematochezia	CAD, GERD	Upon suctioning, active arterial squirting	1	Epinephrine + endoscopic hemoclipping	No	–	Recovered
Lee <i>et al.</i> (76)	Taiwan	2015	84/F	Hematochezia	CHF, HTN, AF, VHD	CTA detected, colonoscopy confirmed active protruding vessel, 5 cm from the anal verge	2	Epinephrine + endoscopic hemoclipping	No	–	Recovered
Kiran <i>et al.</i> (77)	India	2016	34/M	Hematochezia	Blood loss anemia	CEMRI detected, colonoscopy confirmed a spurting site, 8 cm from the anal verge	3	Sodium tetradecyl sulfate	No	–	Recovered, 12 months
Arya <i>et al.</i> (33)	UK	2016	82/F	Lower abdominal pain, diarrhea, BRBPR	HTN, recurrent UTI	Failed to diagnose. Active rectal lesion just above the dentate line at 5 o'clock	1	Surgical ligation	No	–	Recovered
Battista <i>et al.</i> (26)	USA	2016	F	Hematochezia	Not reported	Voluminous, arterial, pulsatile, rectal spurting	1	Epinephrine + endoscopic hemoclipping	No	–	Recovered
Malik <i>et al.</i> (48)	USA	2017	91/M	BRBPR	Hemorrhoids, PUD, HTN, CKD, AF, CHF and SSS sp. pacemaker	A bleeding rectal submucosal artery	1	Endoscopic hemoclipping	No	–	Recovered
Inayat <i>et al.</i> (25)	USA	2017	79/F	Melena, BRBPR	No known comorbidities	Pulsatile bleeding vessel in the rectum	1	Endoscopic hemoclipping	No	–	Recovered, 1 month
Tursi <i>et al.</i> (64)	Italy	2017	28/M	Rectal bleeding	No comorbidities	Pulsatile bleeding from exposed nipple-like vessel	1	Endoscopic hemoclipping	No	–	Recovered
Nadhem <i>et al.</i> (28)	USA	2017	53/F	BRBPR, hematochezia	DM, HTN	Single spurting lesion in the rectum	1	Endoscopic hemoclipping	No	–	Recovered, 1 month
Choi <i>et al.</i> (55)	Korea	2017	57/M	SOB	Alcoholic cirrhosis	Blood gushing from exposed vessel in the distal rectum	2	Endoscopic hemoclipping	No	–	Recovered
Wang <i>et al.</i> (21)	China	2017	21/M	Hematochezia	Anal receptive intercourse	Nipple-like protuberance, 5 cm from the anal verge	1	Endoscopic hemoclipping	No	–	Recovered, 6 months
Yagnik <i>et al.</i> (16)	India	2017	60/M	BRBPR	DM, IHD	Protuberant rectal lesion	1	Epinephrine	No	–	Recovered, 12 months
Natarajan <i>et al.</i> (54)	USA	2018	84/F	BRBPR	Anemia, hemorrhoids, rectal prolapse	An area of active bleeding in the distal rectum	2	Endoscopic hemoclipping	No	–	Recovered
Natarajan <i>et al.</i> (54)	USA	2018	54/M	BRBPR	Alcoholism, PUD	A Dieulafoy's lesion of the rectum	2	Epinephrine + endoscopic hemoclipping	No	–	Recovered
Esmadi <i>et al.</i> (66)	USA	2018	22/F	BRBPR	No comorbidities	Pedunculated "polyp" with superficial erosion in the rectum	1	Epinephrine + endoscopic hemoclipping	No	–	Recovered
Kaneko <i>et al.</i> (79)	Japan	2018	82/M	Hematochezia	AF, CHF, DM, hyperuricemia	MDCT detected and colonoscopy confirmed bleeding nipple-like vessel	1	Electrocoagulation	No	–	Recovered, 6 months
Jaber <i>et al.</i> (37)	KSA	2018	63/F	Admitted for TSSH, BRBPR	DM, HTN, pituitary adenoma	Failed to localize. CTA pinpointed but intraoperative anoscope confirmed the culprit arteriole at the anorectal junction	3	Surgical ligation	No	–	Died due to prior comorbidities
Hudspath <i>et al.</i> (61)	USA	2019	59/F	Hematochezia, shock	IST for GPS DM, HTN, anemia, stercoral ulcer	A single, pulsatile, visible rectal artery	4	Epinephrine + endoscopic hemoclipping + site tattooing	No	–	Recovered, 2 months
Philipose <i>et al.</i> (60)	USA	2019	59/M	Rectal bleeding	DVT	An actively bleeding protruding vessel	1	Endoscopic hemoclipping	No	–	Recovered
Zamora-Nava <i>et al.</i> (30)	Mexico	2018	38/F	Rectal bleeding	Subtotal colectomy	A visible rectal vessel	2	Endoscopic hemoclipping	No	–	Recovered
Then <i>et al.</i> (38)	USA	2019	84/F	SOB, fatigue	HTN, CVA, ESRD	Actively spurting lesion just proximal to the pectinate line	1	Epinephrine + endoscopic hemoclipping	No	–	Recovered
Onem <i>et al.</i> (70)	Turkey	2019	80/M	Hematochezia	DM, HTN, atrial fibrillation	A protruding and oozing rectal vessel	2	Adrenaline + endoscopic hemoclipping	No	–	Recovered
Pineda-De Paz <i>et al.</i> (39)	Mexico	2019	44/F	Vascular access infection	CKD, HTN, 2 C-sections, appendectomy, renal transplant	Active bleeding from small bulgy rectal vessel	1	Endoscopic hemoclipping	No	–	Recovered
Mehta <i>et al.</i> (41)	USA	2019	58/F	DKA	Necrotizing pneumonia requiring VATS, trach/PEG insertion	Continued irrigation and careful endoscopic inspection showed an actively spurting small vessel	5	Endoscopic hemoclipping + site tattooing	No	–	Recovered
Khan <i>et al.</i> (40)	USA	2019	79/M	Bilateral leg weakness, melena	Prostate cancer, HTN gout, degenerative joint disease, alcoholism	CTA pinpointed rectal-wall vascular malformation. Colonoscopy showed a stream of pulsatile rectal bleeding	2	Epinephrine + endoscopic hemoclipping	No	–	Recovered
Singh <i>et al.</i> (36)	USA	2019	94/M	Sepsis (osteomyelitis), hematochezia	Multiple CV and pulmonary conditions	A visible rectal Dieulafoy's lesion	1	Epinephrine + endoscopic hemoclipping	No	–	Recovered
Singh <i>et al.</i> (36)	USA	2019	91/M	Hematochezia	Dementia, COPD	A visible Dieulafoy's lesion in the rectum	1	Endoscopic hemoclipping	No	–	Recovered

BRBPR, bright-red blood per rectum; HTN, hypertension; DM, diabetes mellitus; SCLC, small-cell lung cancer; CKD, chronic kidney disease; CHF, congestive heart failure, RCC, renal cell carcinoma; PUD, peptic ulcer disease; GERD, gastroesophageal reflux disease; VHD, valvular heart disease; CTA, computed tomography angiography; CEMRI, contrast-enhanced magnetic resonance imaging; UTI, urinary tract infection; NM, not mentioned; MDCT, multi-detector computed tomography; SSS, sick sinus syndrome; IHD, ischemic heart disease; TSSH, trans-sphenoidal hypophysectomy; IST, immunosuppressive therapy; GPS, Goodpasture syndrome; DVT, deep vein thrombosis; SOB, shortness of breath; ESRD, end-stage renal disease; VATS, video-assisted thoracoscopic surgery; PEG, percutaneous endoscopic gastrostomy; CV, cardiovascular; COPD, chronic pulmonary obstructive disease.