ORIGINAL ARTICLE

Retrospective Study

For "difficult" benign colorectal lesions referred to surgical resection a second opinion by an experienced endoscopist is mandatory: A single centre experience

Carmelo Luigiano, Giuseppe Iabichino, Nico Pagano, Leonardo Henry Eusebi, Stefania Miraglia, Antonino Judica, Angela Alibrandi, Clara Virgilio

Carmelo Luigiano, Giuseppe Iabichino, Stefania Miraglia, Antonino Judica, Clara Virgilio, Unit of Gastroenterology and Digestive Endoscopy, ARNAS Garibaldi, 95122 Catania, Italy

Nico Pagano, Leonardo Henry Eusebi, Unit of Gastroenterology, S. Orsola-Malpighi University Hospital, 40138 Bologna, Italy

Angela Alibrandi, Department of Statistics, University of Messina, 98122 Messina, Italy

Correspondence to: Carmelo Luigiano, MD, Unit of Gastroenterology and Digestive Endoscopy, ARNAS Garibaldi, Via Palermo 636, 95122 Catania, Italy. carmeluigiano@libero.it
Telephone: +39-9-57595408
Fax: +39-9-57595828

Abstract

AIM: To assess how many patients with benign "difficult" colorectal lesions (DCRLs) referred to surgical resection, may be treated with endoscopic resection (ER) rather than surgical resection.

METHODS: The prospectively collected colonoscopy database of our Endoscopic Unit was reviewed to identify all consecutive patients who, between July 2011 and August 2013, underwent an endoscopic re-evaluation before surgical resection due to the presence of DCRLs with a histological confirmation of benignancy on forceps biopsy. ER was attempted when the lesion

did not have definite features of deeply invasive cancer. The "nonlifting sign" excluded ER only in naive lesions without a prior attempted resection. Lesions were classified, using the Kyoto-Paris classification for mucosal neoplasia. For sessile and non-polypoid lesions the "inject and cut" resection technique was used. Pedunculated and semi-pedunculated lesions were transected at the stalk just below the polyps head and before or after resection, metal clips or a loop were applied on the stalk to prevent bleeding. The lesions were histologically classified according to the Vienna criteria and for the pedunculated lesions the Haggitt classification was used.

RESULTS: Eighty-two patients (42 females, mean age 62 years) with 82 lesions (mean size 37 mm) were included in the study. Sixty-nine (84%) lesions were endoscopically resected, while 13 underwent surgical resection since ER was deemed unsuitable. On histology, cancer was found in 21/69 lesions (14 intra-mucosal, 7 sub-mucosal) and was associated with the size ($P < 0.001$) and with type 0-IIa + Is ($P = 0.011$) and 0-IIa + IIc ($P < 0.001$) lesions. All patients with sub-mucosal cancer, underwent surgical resection. Complications occurred in 11/69 patients (7 bleedings, 2 transmural burn syndromes, 2 perforations), all managed endoscopically or conservatively, and were associated with presence of invasive cancer ($P = 0.021$). During follow-up recurrence/residual tissue was found in 14/51 sessile or non-polypoid lesions (13 treated endoscopically, 1 underwent surgical resection) and was associated with type 0-IIa + Is lesions ($P = 0.001$), piecemeal resections ($P = 0.01$) and with lesion size ($P = 0.004$). Overall, 74% of patients avoided surgery. Surgical resection was significantly associated with type 0-IIa + Is ($P = 0.01$) and 0-IIa + IIc ($P = 0.001$) lesions, with sub-mucosal invasion on histology ($P < 0.001$), with presence of the "nonlifting sign" ($P < 0.001$), and related to the dimension of the lesions ($P = 0.001$). In the logistic regression analysis, the only independent predictor for surgical resection was the dimension of the lesions ($P = 0.002$).

CONCLUSION: Before submitting patients to surgical resection for a benign DCRL, a second opinion by an experienced endoscopist is mandatory to avoid unnecessary surgery.

Key words: Difficult colorectal lesion; Complications; Endoscopic resection; Non-polypoid lesions; Polypoid lesions; Recurrence

Core tip: A "difficult" colorectal lesion (DCRL) is defined as any lesion that due to its size, shape and location or due to fibrosis as a consequence of previous attempts of endoscopic resection (ER), makes it difficult to remove. Patients with DCRLs are often referred to surgeons for surgical colorectal resection. In our institution, for all patients referred for colorectal surgical resection for DCRLs, the surgeons request an endoscopic re-evaluation and if possible an ER of the lesions. The purpose of this study was to review our results with this approach.

INTRODUCTION

A "difficult" colorectal lesion (DCRL) is defined as any lesion who's endoscopic resection (ER) is technically challenging due to the size, the shape or the location, or due to the presence of fibrosis as a consequence of previous attempts of ER[1].

For these reasons, patients with DCRLs are often referred to surgeons for colorectal surgical resection[2,3].

However, surgery is associated with significant morbidity and mortality, especially in older patients with comorbid illnesses, as well as higher costs of the procedures[4-6].

In our institution, patients referred for surgical colorectal resection of DCRLs, with a histological confirmation of benignancy on forceps biopsy, are advised by surgeons to undergo an endoscopic re-evaluation and, if possible, an ER of the lesions.

The aims of this study were to estimate how many patients referred to our unit with DCRLs really needed surgical resection, and to evaluate the outcomes of ER of the lesions in whom it was possible.

MATERIALS AND METHODS

Patients

The prospectively collected colonoscopy database of our Endoscopic Unit was reviewed to identify all consecutive patients who, between July 2011 and August 2013, underwent an endoscopic re-evaluation before surgical resection due to the presence of DCRLs with a histological confirmation of benignancy on forceps biopsy.

All patients underwent a colonoscopy to confirm the presence and location of the lesions, to exclude synchronous lesions, and if possible to endoscopically resect the lesion.

ER was attempted when the lesion did not have definite features of deeply invasive cancer, such as surface ulceration, converging folds, firm consistency with a surface pit pattern suggestive of invasion.

The "nonlifting sign" excluded ER only in naive lesions without a prior attempted resection, whereas it was

not considered an exclusion criteria in case of recurrent lesions or that had undergone a previous partial resection.

Lesion classification

Lesions were classified, using the Kyoto-Paris classification for mucosal neoplasia[7,8]. Polypoid types rise > 2.5 mm above the surrounding mucosa, including lesions with a clear stalk, pedunculated (0-Ip) and semi-pedunculated (0-Isp) types, and lesions without clear stalk, defined as sessile (0-Is) type. Non-polypoid types rise < 2.5 mm above the surrounding mucosa and include elevated (0-IIa), barely perceptible elevated or flat (0-IIb) and slightly depressed (0-IIc) types. Mixed types are lesions with mixed pattern of both a polypoid sessile and a non-polypoid morphology in distinct sectors and include 0-IIa + Is and 0-IIa + IIc types.

ER procedure

All endoscopic procedures were performed by one expert interventional endoscopist (Carmelo Luigiano)[9-12].

For sessile and non-polypoid lesions the "inject and cut" resection technique was used; *en bloc* resection was attempted for lesions ⩽ 30 mm, while for lesions > 30 mm piecemeal resection was performed, taking care to include 1-3 mm of normal tissue in the lateral margins of the resection[9,10].

Pedunculated and semi-pedunculated lesions were transected at the stalk just below the polyps head, complete ensnarement of the head portion with a single application of the snare was first attempted; if this failed, the lesion was trimmed with piecemeal technique until the snare could be placed around the lesion. Before or after resection, metal clips or a loop were applied on the stalk to prevent bleeding[11,12].

Patients were prepared with a fiber- and residue-free diet within 72 h and 4000 mL of a polyethylene glycol electrolytic lavage solution 18 h before colonoscopy.

The procedures were performed with a high-definition colonoscope (Pentax EC-3490L: Pentax, Hamburg, Germany), with a paediatric colonoscope or with an operative or diagnostic video gastroscope (Pentax, Hamburg, Germany), with a high-definition processor (Pentax EPK-i HD).

Submucosal injections were performed with variceal injection needles (Olympus). The injection solution contained only saline, saline with epinephrine (1:10000) or saline and epinephrine with methylene blue mixture (1:10000). The snares used were standard, jumbo or stiff (US Endoscopy, Mentor, Ohio).

Electrosurgery was performed using a combination of cutting (120 W) and coagulation current (60 W), using an ERBE-ICC 200 (Erbe Elektromedizin GmbH, Tübingen, Germany). For sessile or non-polypoid lesions argon plasma coagulation (APC) at a power of 40-60 W and gas flow of 2 L/min using an ERBE APC 300 (Erbe Elektromedizin) was used to ablate any residual tissue at the edge of the resection area.

If localization of the ER site during colonoscopic follow-up was likely to be difficult, the site was marked with a submucosal injection of sterile carbon particle suspension (Spot, GI Supply, Camp Hill, Penn) in the adjacent normal mucosa.

ER procedures were performed on outpatients in the morning. After ER, patients remained in a second-stage recovery area for 4 to 6 h until medically cleared for discharge by the endoscopist. If the case of clinical concerns, the patient was admitted for observation. On discharge, dietary instructions, written contact information and instructions regarding symptoms and potential problems were provided to patients.

Assessment of lesions size and histopathology

The size of the lesions was estimated by comparison with open biopsy forceps and, when possible, also after retrieval. All removed tissue was retrieved using a basket or through the suction channel. All specimens were stained with hematoxylin and eosin for histopathological assessment, and two experienced pathologists examined the resected material. Based on the histological configuration of the crypts, adenomas were classified into tubular, villous, and tubulo-villous. The lesions were histologically classified according to the Vienna criteria and for the pedunculated lesions the Haggitt classification was used[13,14].

Complications

ER induced bleeding was defined as procedural (occurring during resection), early (within 24 h) or delayed (after 24 h). The diagnosis of early and delayed bleeding was based on the presence of rectorrhagia or melena. Transmural burn syndrome, caused by thermal injury, with resultant serosal inflammation, was characterized by localized abdominal pain, leucocytosis and, occasionally, fever. Perforation was diagnosed either by endoscopy during the resection or by the presence of free air on plain abdominal film or abdominal computed tomography scan.

Clinical and endoscopic follow-up

Clinical follow-up was performed after 3 wk from the ER, when the histological results were communicated to the referring specialists and patients.

In patients with pedunculated and semi-pedunculated lesions, surveillance colonoscopy was performed at 12 and 24 mo for lesions with high and low-grade dysplasia, respectively, while for lesions harbouring cancer at 6 and 12 mo, and annually thereafter.

In patients with sessile, non-polypoid and mixed type lesions surveillance colonoscopy was performed after 3, 6 and 12 mo, and then annually after the initial ER.

In patients with sessile, non-polypoid and mixed types lesions, recurrence was defined as the presence of tissue on a follow-up endoscopy. If visible tissue was seen on follow-up examinations, it was snare resected when

Table 1 Characteristics of patients and colorectal lesions recruited

No. of patients	82
Age (mm ± SD) (range)	62 ± 10 (38-81)
Sex (M/F)	40/42
Associated extra-intestinal diseases (%)	
Hypertension	6 (7.5)
Cardiac diseases	3 (3.5)
Chronic renal failure	1 (1.5)
Neoplasms	1 (1.5)
Diabetes mellitus	1 (1.5)
Associated intestinal diseases (%)	
Diverticula	15 (18)
Others colorectal lesions	10 (12)
Left hemicolectomy	3 (3.5)
Number of lesions	82
Size (mm ± SD) (range)	37 ± 18 (20-100)
Indication for surgical resection (%)	
Location	36 (44)
Size	32 (39)
Shape	10 (12)
Recurrence	4 (5)
Shape (%)	
0-Ip	11 (13)
0-Isp	1 (1.5)
0-Is	17 (21)
0–IIa	19 (23)
0–IIa + Is	18 (22)
0–IIa + IIc	12 (14.5)
0–IIb	4 (5)
Location (%)	
Anorectal junction	4 (5)
Rectal	7 (8.5)
Rectosigmoid junction	14 (17)
Sigmoid	16 (19)
Descending colon	3 (4)
Splenic flexure	4 (5)
Transverse	3 (3.5)
Hepatic flexure	10 (12)
Ascending colon	8 (10)
Caecum only	9 (11)
Cecum with ileocecal valve involvement	3 (3.5)
Cecum with appendix orifice involved	1 (1.5)
Biopsy results at the first colonoscopy (%)	
Low-grade dysplasia	18 (22)
High-grade dysplasia	64 (78)
Successful endoscopic resection (%)	69 (84)
Aborted endoscopic resection (%)	13 (16)
Non-lifting sign	6
Frankly malignant lesions	3
Difficult position	2
Very large lesions with difficult position	2

mm: Millimeters; M: Male; F: Female; 0-Ip: Pedunculated lesions; 0-Isp: Semi-pedunculated lesions; 0-Is: Sessile lesions; 0-IIa: Elevated non-polypoid lesions; 0-IIb: Barely perceptible elevated non-polypoid lesions; 0–IIc: Slightly depressed non-polypoid lesions.

feasible and submitted for histopathological examination. The edges of the resection site were typically cauterized with the argon plasma coagulator. Lesions that were too small for snare resection were removed with forceps and then fulgurated with an argon plasma coagulator. During the endoscopic follow-up, any alterations of the mucosa in the area of the previous resection (ulceration, scarring, retraction of mucosa, *etc.*) underwent biopsies.

Outcomes of the study

The parameters evaluated in the study were: age, sex, associated intestinal or extra-intestinal diseases, lesions size, shape and location, reason for surgical resection, successful of ER, reason of aborted ER, technique of ER, complications, technique of treatment of complications, histology, grade of dysplasia and cancer, and recurrence.

Statistical analysis

Continuous data are described by mean, standard deviation and range, according to distribution. Categorical data are presented as numbers and percentages. Relationships between numerical variables were examined by the Spearman correlation coefficient, between categorical and numerical variables by the Biserial correlation, and between categorical variables by the Log-likelihood Ratio test. Results were analyzed in relation to lesion size (divided in two groups: group A lesions < 35 mm and group B lesions ≥ 35 mm) and were also compared for the technique of resection used (*en bloc vs* piecemeal; APC *vs* no APC). Logistic regression was used to assess the independent predictors of outcomes. A *P*-value of less than 0.05 was considered statistically significant. The software packages applied were SPSS for Windows 11.0. Data analysis of the study was performed by a biomedical statistician (Angela Alibrandi).

RESULTS

During the study period, 82 patients (42 female; mean age 62 years) underwent an endoscopic re-evaluation before surgical resection of a DCRLs with a histological confirmation of benignancy on forceps biopsy. Demographic and clinical data of the included patients are summarised in Table 1.

The reason for referral was the location of the lesion in 36 cases, the size in 32 cases, the type in 10 and recurrence in 4 cases.

The mean (± SD) lesion size was 37 ± 18 mm (range 20-100 mm). The most frequent type was the mixed types in 30 cases (18 type IIa + Is and 12 type IIa + IIc) and the most frequent location was the sigmoid colon in 16 cases.

Among the included lesions, 44 (54%) were < 35 mm, while 38 (46%) were ≥ 35 mm in diameter.

Of the 82 lesions, 69 (84%) were successfully resected endoscopically, while 13 cases were referred for surgical resection since ER was considered unsuitable due to the following reasons: presence of the "nonlifting sign" in 6 patients, endoscopic appearance of invasive cancer in 3 cases, very large size with difficult location in 2 cases (one patient with a sessile lesion occupying more than 60% of the lumen in the rectosigmoid junction and one patient with a type IIa lesion involving more than half of the cecum and more than half of the circumference of the proximal ascending colon) and in 2 cases due to difficult location (1 with ileocecal valve and 1 with appendiceal orifice involvement).

Table 2 Characteristics of colorectal lesions resected	
No. of lesions	69
Size (mm ± SD) (range)	33 ± 12 (20-80)
Shape (%)	
0-Ip	11 (16)
0-Isp	1 (1.5)
0-Is	15 (22)
0–IIa	16 (23)
0–IIa + Is	15 (22)
0–IIa + IIc	8 (11.5)
0–IIb	3 (4)
Location (%)	
Anorectal junction	4 (6)
Rectal	6 (8.5)
Rectosigmoid junction	13 (19)
Sigmoid	15 (22)
Descending colon	2 (3)
Splenic flexure	3 (4)
Transverse	1 (1.5)
Hepatic flexure	9 (13)
Ascending colon	6 (8.5)
Caecum only	8 (11.5)
Cecum with ileocecal valve involvement	2 (3)
Technique of endoscopic resection for the 57 sessile and non-polypoid lesions	
En-bloc endoscopic mucosal resection	23
Piecemeal endoscopic mucosal resection	34
Resection with argon plasma coagulation	15
Technique of endoscopic resection for the 12 pedunculated and semipedunculated lesions	
Clips	9
Endoloop	3
Complications (%)	11 (16)
Bleeding	7
Perforation	2
Transmural burn syndrome	2
Histology (%)	
Tubular adenoma	13 (19)
Villous adenoma	22 (32)
Tubulovillous adenoma	33 (47.5)
Serrated adenoma	1 (1.5)
Low-grade dysplasia	3 (4)
High-grade dysplasia	45 (65.5)
Intramucosal cancer	14 (20.5)
Invasive cancer	7 (10)

mm: Millimeters; 0-Ip: Pedunculated lesions; 0-Isp: Semi-pedunculated lesions; 0-Is: Sessile lesions; 0–IIa: Elevated non-polypoid lesions; 0-IIb: Barely perceptible elevated non-polypoid lesions; 0–IIc: Slightly depressed non-polypoid lesions.

The characteristics of the 69 resected lesions are presented in Table 2. All lesions were resected in a single session and the resection was evaluated as endoscopically complete in all procedures.

Of the resected lesions, 42 (61%) were < 35 mm, while 27 (39%) were ≥ 35 mm in diameter. In 12 pedunculated and semi-pedunculated lesions, bleeding prophylaxis was performed with the application of clips to the stalk in 9 cases and with endoloop in the 3 remaining cases.

In the 57 sessile and non-polypoid lesions, *en-bloc* resection was performed in 23 cases while piecemeal resection was used in the other 34 cases. Argon plasma coagulation was applied to the margins of the lesions in 15 of the 57 lesions (all piecemeal resections).

Histological diagnosis of the resected lesions showed 47.5% tubulo-villous, 32% villous, 19% tubular and 1.5% serrated adenomas. Carcinoma was found in 30% of patients (21 cases), out of which 14 showed intra-mucosal and 7 sub-mucosal invasion. All patients with lesions showing sub-mucosal invasion on histology underwent surgery.

Of the 7 invasive lesions, one was located at the rectum, one at the rectosigmoid junction and the remaining 5 lesions in the colon.

The presence of cancer on histology was significantly associated with type 0-IIa + Is (P = 0.011) and 0-IIa + IIc (P < 0.001), and was also related to the size (P < 0.001) of the lesions.

Procedural bleeding occurred in 5/69 (7%) resected lesions; one early (within 10 h) and one delayed (after 72 h) bleeding occurred, both requiring blood units transfusion. The procedural bleeding was always managed endoscopically by applying clips.

Transmural burn syndrome occurred in 2 patients (3%) and was successfully managed conservatively.

Two patients had a perforation that occurred during the final resection of a 40 mm 0-IIa lesion of the ascending colon and during a resection of a 30 mm 0-Is recurred lesion of the rectum. In both patients, successful closure of the perforation with clips was achieved and no further intervention was required.

Endoscopic complications were significantly associated with the presence of invasive cancer on histology (P = 0.021), and in the logistic regression analysis, the only independent predictor of a complication was the dimension of the lesions (P = 0.002).

Among the 69 cases of successful ER, 62 (90%) patients have undergone colonoscopy follow-up for a mean (± SD) time of 16 ± 6 mo (range 6-24).

Among the sessile and non-polypoid lesions (51 cases), during the endoscopic follow-up residual/recurrence tissue was found in 14 (27%) cases; 13 were successfully treated endoscopically, while one patient underwent surgical resection due to 2 recurrence during the endoscopic follow-ups.

Recurrence of the lesion after ER was significantly associated to type 0-IIa + Is (P = 0.001) lesions, to piecemeal resection (P = 0.01) and to the dimension (P = 0.004) of the lesions.

Overall, 74% of patients avoided surgery. Surgical resection was significantly associated with type 0-IIa + Is (P = 0.01) and 0-IIa + IIc (P = 0.001) lesions, with sub-mucosal invasion on histology (P < 0.001), with presence of the "nonlifting sign" (P < 0.001), and related to the dimension (P = 0.001) of the lesions.

In the logistic regression analysis, the only independent predictor for surgical resection was the dimension of the lesions (P = 0.002).

DISCUSSION

This report describes a single-center experience in the endoscopic treatment of a cohort of patients with

DCRLs, showing that three quarters of the patients referred for surgical resection were successfully treated endoscopically.

Data of an European regional FOBT-based colorectal cancer screening program, suggest that up to 10% of patients with benign adenomas detected by screening colonoscopy after a positive fecal occult blood test will be treated surgically[15].

Indeed, a proportion of colorectal lesions, due to their location, size, or shape are considered technically more challenging to be removed endoscopically or are associated with an increased risk of complications (such as bleeding or perforation). Thus, these lesions are not routinely endoscopically resected and are often referred to surgeons for surgical resection[1-3].

Our study confirms these findings since, in our series, failure of ER was associated with the large size and the type of the lesions, as well as the lack of the lifting sign.

However, considering all the patients evaluated, 69 (84%) of them were successfully treated endoscopically, and 61 (74%) have so far avoided an unnecessary surgical procedure.

Our results are in agreement with other studies in whom, in referral centers surgical resection was avoided in the majority of patients with DCRLs (range 58%-90%)[2,16-18].

Therefore, it is possible that endoscopists who are inexperienced or are not used to treat technically challenging lesions, choose to refer patients for surgical resection.

Compared to the 20.1% morbidity and 1.3% mortality rates for surgery of colorectal tumors, general data on ER show much lower morbidity rates (0.7% to 3.7% for perforation and 0.4% to 3.8% for bleeding) and no mortality[19].

The Munich Polypectomy Study showed a correlation between large size, non-pedunculated shape and right-sided location of colorectal lesions and the occurrence of post-procedural complications[20].

Considering only the studies on DCRLs resection, these findings were evident, indeed the mean morbidity rate was 18% (the majority treated endoscopically), however without mortality[2,16-18,21,22].

In accordance with previous studies[2,16-18,21,22], also in our series, ER for DCRLs was performed without mortality and with an acceptable rate of morbidity (16%); moreover, all the complications that occurred were successfully managed endoscopically or conservatively. Procedural bleedings were controlled endoscopically in all cases and all the perforations were detected during the procedure and closed endoscopically with good clinical outcomes.

Furthermore, the complications of ER seem to depend on the lesions characteristics as well as on the experience and skills of the endoscopist.

The present study confirms that ER of DCRLs can be performed with satisfactory safety and that high-risk ERs should be performed by experts at a high-volume center.

Residual/recurrent disease can occur after ER of non-pedunculated colorectal lesions, with a mean rate of 15%[23].

For DCRLs, the mean rate of residual/recurrence is doubled, approximately 30%[2,16-18,21,22]. In our study the local residual/recurrence was detected in 27% of cases in accordance with the results of previous studies on the ER of DCRLs. Moreover, our results confirmed that the piecemeal technique is associated with a higher rate of residual/recurrent neoplasia, as stated by the Italian Colorectal ER Study Group in a recent published paper[24], and was similar despite the use or not of APC after resection.

Our results show also a correlation with the size of the lesions, in accordance with a recent systematic review[23]. The review also confirmed that the pooled estimate risk of recurrence was significantly higher for piecemeal (20%; 95%CI: 16%-25%) than for en bloc resections (3%; 95%CI: 2%-5%; Cochran's Q test $P < 0.0001$)[23].

To reduce residual/recurrence rates, endoscopic submucosal dissection (ESD) has been proposed as a superior technique compared to the "inject and cut" piecemeal ER, since it allows an *en bloc* excision of large colorectal neoplastic tissue, thus allowing a more accurate pathological diagnosis[19].

However, ESD in the colon is technically demanding, with a long learning curve and increased procedures duration; moreover, it requires the use of specialized accessories, increasing the costs of the procedures and has a high perforation rate, making it unlikely to be adopted into therapeutic colonoscopy practice in western countries[19].

Hypothetically, applying ESD to our series, at the best of the performance of the technique, we would have achieved an *en-bloc* resection rate of 80% (45 out of 57 patients). This could have allowed a better evaluation of the submucosal invasion in the 7 patients in which it was found to be present, virtually avoiding surgery to 2 or 3 more patients. The lower recurrence rate (about 1%-2%) could allow a reduction of the number of treatments needed to achieve complete clearance of the lesion, but the higher costs of the procedures counterbalance the reduction of the number of sessions. Moreover, ESD has higher complication rates, requiring the mandatory admission of the patient to be treated. About 1% to 2% of these complications need surgical intervention, reducing the beneficial effect of the better *en-bloc* resection rate.

Furthermore, if the piecemeal ER is performed acquiring as bigger and fewer pieces as possible, including at least 1-3 mm of normal tissue surrounding the lesions, and all fragments of the lesion are retrieved, the risk of missing neoplastic invasion seems negligible, and the recurrence rate is acceptable.

Our results also show that the endoscopic treatment of residual/recurrent tissue was easy and effective (successful in 93%), in accordance with the systematic review by Belderbos *et al*[23], in which after a mean of 1.2 endoscopic re-treatments, successful eradication was

achieved in 91.4% of recurrences.

The main limitations of our study are the relatively small number of reported lesions and the non-prospective, randomized design of the study. Thus, the superiority of ER over surgical treatment cannot be proven, however, such a trial would probably be unethical to perform.

In conclusion, before submitting patients to surgical resection of a benign colorectal lesion, a second opinion by an examiner who is experienced in ER of such lesions is worthwhile and mandatory to avoid unnecessary surgery.

COMMENTS

Background
A "difficult" colorectal lesion (DCRL) is defined as any lesion who's endoscopic resection (ER) is technically challenging. In less experienced endoscopic centres, benign DCRLs are often referred to surgical resection.

Research frontiers
This study aimed to assess how many patients with benign DCRLs referred to surgical resection, may be treated with ER rather than surgical resection.

Innovations and breakthroughs
In these research results, 74% of patients with DCRLs referred to surgeons for colorectal resection, after an endoscopic re-evaluation were successfully treated with ER and avoided surgery.

Applications
Before submitting patients to surgical resection for a benign DCRL, a second opinion by an experienced endoscopist is mandatory to avoid unnecessary surgery.

Terminology
A DCRL is defined as any lesion who's ER is technically challenging due to the size, the shape or the location, or due to the presence of fibrosis as a consequence of previous attempts of ER.

Peer-review
It is an good article.

REFERENCES

1   **Jung M**. The 'difficult' polyp: pitfalls for endoscopic removal. *Dig Dis* 2012; **30** Suppl 2: 74-80 [PMID: 23207936 DOI: 10.1159/000341898]
2   **Voloyiannis T**, Snyder MJ, Bailey RR, Pidala M. Management of the difficult colon polyp referred for resection: resect or rescope? *Dis Colon Rectum* 2008; **51**: 292-295 [PMID: 18202891 DOI: 10.1007/s10350-007-9175-2]
3   **Onken JE**, Friedman JY, Subramanian S, Weinfurt KP, Reed SD, Malenbaum JH, Schmidt T, Schulman KA. Treatment patterns and costs associated with sessile colorectal polyps. *Am J Gastroenterol* 2002; **97**: 2896-2901 [PMID: 12425565 DOI: 10.1111/j.1572-0241.2002.07058.x]
4   **McNicol L**, Story DA, Leslie K, Myles PS, Fink M, Shelton AC, Clavisi O, Poustie SJ. Postoperative complications and mortality in older patients having non-cardiac surgery at three Melbourne teaching hospitals. *Med J Aust* 2007; **186**: 447-452 [PMID: 17484705]
5   **Birkmeyer JD**, Siewers AE, Finlayson EV, Stukel TA, Lucas FL, Batista I, Welch HG, Wennberg DE. Hospital volume and surgical mortality in the United States. *N Engl J Med* 2002; **346**: 1128-1137 [PMID: 11948273 DOI: 10.1056/NEJMsa012337]
6   **Birkmeyer JD**, Stukel TA, Siewers AE, Goodney PP, Wennberg DE, Lucas FL. Surgeon volume and operative mortality in the United States. *N Engl J Med* 2003; **349**: 2117-2127 [PMID: 14645640 DOI: 10.1056/NEJMsa035205]
7   **Kudo Se**, Lambert R, Allen JI, Fujii H, Fujii T, Kashida H, Matsuda T, Mori M, Saito H, Shimoda T, Tanaka S, Watanabe H, Sung JJ, Feld AD, Inadomi JM, O'Brien MJ, Lieberman DA, Ransohoff DF, Soetikno RM, Triadafilopoulos G, Zauber A, Teixeira CR, Rey JF, Jaramillo E, Rubio CA, Van Gossum A, Jung M, Vieth M, Jass JR, Hurlstone PD. Nonpolypoid neoplastic lesions of the colorectal mucosa. *Gastrointest Endosc* 2008; **68**: S3-47 [PMID: 18805238 DOI: 10.1016/j.gie.2008.07.052]
8   **Endoscopic Classification Review Group**. Update on the paris classification of superficial neoplastic lesions in the digestive tract. *Endoscopy* 2005; **37**: 570-578 [PMID: 15933932 DOI: 10.1055/s-2005-861352]
9   **Ferrara F**, Luigiano C, Ghersi S, Fabbri C, Bassi M, Landi P, Polifemo AM, Billi P, Cennamo V, Consolo P, Alibrandi A, D'Imperio N. Efficacy, safety and outcomes of 'inject and cut' endoscopic mucosal resection for large sessile and flat colorectal polyps. *Digestion* 2010; **82**: 213-220 [PMID: 20588036 DOI: 10.1159/000284397]
10   **Luigiano C**, Consolo P, Scaffidi MG, Strangio G, Giacobbe G, Alibrandi A, Pallio S, Tortora A, Melita G, Familiari L. Endoscopic mucosal resection for large and giant sessile and flat colorectal polyps: a single-center experience with long-term follow-up. *Endoscopy* 2009; **41**: 829-835 [PMID: 19750448 DOI: 10.1055/s-0029-1215091]
11   **Consolo P**, Luigiano C, Pellicano R, Ferrara F, Giacobbe G, Morace C, Pallio S, Tortora A, Melita G, Bassi M, D'Imperio N, Alibrandi A, Familiari L. Endoscopic resection as a safe and effective technique for treatment of pedunculated and non-pedunculated benign-appearing colorectal neoplasms measuring 40 mm or more in size. *Minerva Med* 2010; **101**: 311-318 [PMID: 21048553]
12   **Luigiano C**, Ferrara F, Ghersi S, Fabbri C, Cennamo V, Landi P, Polifemo AM, Billi P, Bassi M, Consolo P, Alibrandi A, D'Imperio N. Endoclip-assisted resection of large pedunculated colorectal polyps: technical aspects and outcome. *Dig Dis Sci* 2010; **55**: 1726-1731 [PMID: 19657735 DOI: 10.1007/s10620-009-0905-2]
13   **Schlemper RJ**, Riddell RH, Kato Y, Borchard F, Cooper HS, Dawsey SM, Dixon MF, Fenoglio-Preiser CM, Fléjou JF, Geboes K, Hattori T, Hirota T, Itabashi M, Iwafuchi M, Iwashita A, Kim YI, Kirchner T, Klimpfinger M, Koike M, Lauwers GY, Lewin KJ, Oberhuber G, Offner F, Price AB, Rubio CA, Shimizu M, Shimoda T, Sipponen P, Solcia E, Stolte M, Watanabe H, Yamabe H. The Vienna classification of gastrointestinal epithelial neoplasia. *Gut* 2000; **47**: 251-255 [PMID: 10896917 DOI: 10.1136/gut.47.2.251]
14   **Haggitt RC**, Glotzbach RE, Soffer EE, Wruble LD. Prognostic factors in colorectal carcinomas arising in adenomas: implications for lesions removed by endoscopic polypectomy. *Gastroenterology* 1985; **89**: 328-336 [PMID: 4007423]
15   **Manfredi S**, Piette C, Durand G, Plihon G, Mallard G, Bretagne JF. Colonoscopy results of a French regional FOBT-based colorectal cancer screening program with high compliance. *Endoscopy* 2008; **40**: 422-427 [PMID: 18231963 DOI: 10.1055/s-2007-995430]
16   **Church JM**. Avoiding surgery in patients with colorectal polyps. *Dis Colon Rectum* 2003; **46**: 1513-1516 [PMID: 14605571 DOI: 10.1007/s10350-004-6805-9]
17   **Swan MP**, Bourke MJ, Alexander S, Moss A, Williams SJ. Large refractory colonic polyps: is it time to change our practice? A prospective study of the clinical and economic impact of a tertiary referral colonic mucosal resection and polypectomy service (with videos). *Gastrointest Endosc* 2009; **70**: 1128-1136 [PMID: 19748615 DOI: 10.1016/j.gie.2009.05.039]
18   **Friedland S**, Banerjee S, Kochar R, Chen A, Shelton A. Outcomes of repeat colonoscopy in patients with polyps referred for surgery without biopsy-proven cancer. *Gastrointest Endosc* 2014; **79**: 101-107 [PMID: 23916398 DOI: 10.1016/j.gie.2013.06.034]
19   **Kaltenbach T**, Soetikno R. Endoscopic resection of large colon

polyps. *Gastrointest Endosc Clin N Am* 2013; **23**: 137-152 [PMID: 23168124 DOI: 10.1016/j.giec.2012.10.005]

20   **Heldwein W**, Dollhopf M, Rösch T, Meining A, Schmidtsdorff G, Hasford J, Hermanek P, Burlefinger R, Birkner B, Schmitt W. The Munich Polypectomy Study (MUPS): prospective analysis of complications and risk factors in 4000 colonic snare polypectomies. *Endoscopy* 2005; **37**: 1116-1122 [PMID: 16281142 DOI: 10.1055/s-2005-870512]

21   **Moss A**, Bourke MJ, Williams SJ, Hourigan LF, Brown G, Tam W, Singh R, Zanati S, Chen RY, Byth K. Endoscopic mucosal resection outcomes and prediction of submucosal cancer from advanced colonic mucosal neoplasia. *Gastroenterology* 2011; **140**: 1909-1918 [PMID: 21392504 DOI: 10.1053/j.gastro.2011.02.062]

22   **Buchner AM**, Guarner-Argente C, Ginsberg GG. Outcomes of EMR of defiant colorectal lesions directed to an endoscopy referral center. *Gastrointest Endosc* 2012; **76**: 255-263 [PMID: 22657404 DOI: 10.1016/j.gie.2012.02.060]

23   **Belderbos TD**, Leenders M, Moons LM, Siersema PD. Local recurrence after endoscopic mucosal resection of nonpedunculated colorectal lesions: systematic review and meta-analysis. *Endoscopy* 2014; **46**: 388-402 [PMID: 24671869 DOI: 10.1055/s-0034-1364970]

24   **Cipolletta L**, Rotondano G, Bianco MA, Buffoli F, Gizzi G, Tessari F. Endoscopic resection for superficial colorectal neoplasia in Italy: a prospective multicentre study. *Dig Liver Dis* 2014; **46**: 146-151 [PMID: 24183949 DOI: 10.1016/j.dld.2013.09.019]

Baishideng®

Published by **Baishideng Publishing Group Inc**
8226 Regency Drive, Pleasanton, CA 94588, USA
Telephone: +1-925-223-8242
Fax: +1-925-223-8243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.wjgnet.com/esps/helpdesk.aspx
http://www.wjgnet.com