Techniques in Gastrointestinal Endoscopy 17 (2015) 122–128

Contents lists available at ScienceDirect

Techniques in Gastrointestinal Endoscopy

journal homepage: www.techgiendoscopy.com/locate/tgie

Endoscopic full-thickness resection of colonic lesions

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ARTICLE INFO

Article history:
Received 16 March 2015
Accepted 20 June 2015

Keywords:
Endoscopy
Colonic polyp
Minimally invasive surgery
Preclinical model
Laparoscopic surgery

ABSTRACT

The introduction of colon cancer screening programs has led to detection of an increasing incidence of complex colonic polyps and early colon cancer requiring colectomy. Traditional radical colonic resection risks substantial morbidity and there is a need for alternative approaches. This review summarizes the published methods of colonic endoscopic full-thickness resection (EFTR), examining data on feasibility and safety. Preclinical research reported on 3 EFTR techniques using endoscopic stapling devices, T-tags, or compression device closure for defect closure before or after specimen resection. A total of 103 procedures were performed in 99 porcine models, with an overall success rate of 87% (90 of 103 procedures). The intraoperative complication rate was 19% (19 of 90 procedures). When bowel closure was performed after resection, rather than before it, there were higher rates of failure to close the defect and a high incidence of abnormal findings at postmortem examination. Clinical experience involved 5 studies reporting EFTR in 38 patients; of these, 3 used compression device preresection closure and 1 used postresection closure. EFTR was completed in 33 individuals without assistance. Only 3 patients had complications. Lateral margin clearance was variably reported and complete full-thickness resection was achieved in only 12 of 17 patients. The technique of EFTR is evolving, with only limited clinical evidence to date, but currently preresection closure methods seem advisable. Significant technological challenges remain, including reproducible lateral margin clearance before colonic EFTR can be recommended.

1. Introduction

The advent of colon cancer screening programs internationally has resulted in more early-stage colon cancers being identified, along with an increase in the volume of complex colonic polyps [1,2]. To tackle this challenge, advanced polypectomy techniques such as endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD) have been developed to effect complete lesion excision without compromising on the integrity of the bowel wall. However, for larger colonic lesions, EMR is usually performed piecemeal. This means that accurate histologic assessment of the lesion is compromised; there is a substantial risk of recurrence, which requires intensive surveillance and, often, further intervention [3,4]. In contrast, ESD provides an en bloc resection of the specimen but complications (mainly perforation and bleeding) are considerably more frequent [3,5]. With these challenges in mind, a significant proportion of patients with large colonic polyps, and most patients with early malignancy, are referred for surgery [6]. However, even when performed laparoscopically and within an optimized enhanced recovery plan after surgery, colectomy has significant risks of patient morbidity and mortality [7,8].

In the rectum, this challenge has been addressed by full-thickness resection techniques. Transanal endoscopic micro-surgery (TEMS) has evolved as an organ-preserving approach for patients with low-risk early stage rectal cancer and those with significant comorbidity. Systematic reviews have confirmed comparable survival between TEMS and radical resection for T1 and T2 category rectal cancer [9]. Although there is a substantial risk of local recurrence, the procedure is associated with rapid patient recovery and excellent postoperative functional results [10]. In the colon most polyps and early malignancy that occur are out of the reach of TEMS or other transanal techniques. As described in a systematic review by Brigic et al [11], recent improvements in endoscopic technology have allowed exploration of the possibility of endoscopic full-thickness resection (EFTR) in the colon.

This article summarizes the current evidence base for colonic EFTR and assesses the available data regarding feasibility and

R.H.K. has received research grants from Ethicon Endo-Surgery and Olympus. A.C. is in receipts of research fellowships from the Royal College of Surgeons and the Dunhill Foundation and the Pelican Cancer Foundation. A.C. has also received research funding from the Barcapel Foundation, the Wates Foundation, the Sylvia Waddilove Foundation and the Savvas Regas Foundation. Other authors report no funding or conflicts of interest.
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http://dx.doi.org/10.1016/j.tgie.2015.06.003
0049-0172/

Table 1
Summary of preclinical EFTR procedural methods and outcome measures

Study	Procedure	Approach	Number of animals	Procedure completed	Intraoperative complications
Schurr et al [12]	EFTR achieved by endoscopic FTRD	Preresection closure method	5	5/5 (100%)	0/5 (0%)
	EFTR achieved by endoscopic FTRD	Preresection closure method	20	20/20 (100%)	(S) 3/10 (30%) (A) 0/10 (0%)
Rajan et al [13]	EFTR achieved by endoscopic FTRD	Preresection closure method	8	8/8 (100%)	4/8 (50%)
Raju et al [14]	EFTR performed using endoscopic knife and snare, and interrupted TAS were used for defect closure	Postresection closure method	20	19/20 (95%)	0/19 (0%)
Von Renteln et al [16]	Snare resection of the lesion followed by OTSC application with the aid of twin grasper for defect closure	Postresection closure method	10	9/20 (45%)	6/9 (67%)
	Endoloop applied to the base of the pseudopolyp before snare resection; closure subsequently reinforced with OTSC application over endoloop	Preresection closure method	4	8/8 (100%)	2/8 (25%)
Rieder et al [18]	Tissue manipulated into an OTSC using TAS with the clip applied before snare resection	Preresection closure method	2	2/2 (100%)	0/2 (0%)
Von Renteln et al [15]	Tissue manipulated into an OTSC closure system using a grasper with the OTSC clip applied before snare resection	Preresection closure method	8	8/8 (88%)	2/8 (25%)
Schurr et al [17]	Tissue manipulated into an OTSC closure system using a grasper with the OTSC clip applied before snare resection	Preresection closure method	12	11/12 (92%)	0/11 (0%)
Total			89	90/103 (87%)	17/90 (19%)

Abbreviations: A = acute study, S = survival study.

safety in experimental models. The available data on the evolution of colonic EFTR into clinical practice are then examined. We also evaluate the potential of EFTR and explore the challenges that need to be overcome to allow further development.

2. Preclinical studies

The preclinical colonic EFTR work to date has described full-thickness wall resection and closure of the subsequent defect using porcine models. The reported approaches used either a "preresection" closure method, in which the bowel wall was plicated and anastomosed before resection, or a "postresection" closure, where colotomy and specimen resection preceded defect closure.

2.1. Procedural methods

The methods employed for colonic EFTR varied significantly among the preclinical studies and a brief summary is presented in Table 1. Schurr et al [12] and Rajan et al [13] reported using a full-thickness resection device (FTRD), which included a hollow flexible shaft with a resection head, and an endoscope within the central channel of the device (outer diameter = 9.8 mm) alongside graspers for manipulating tissue under endoscopic vision (Figure 1). Procedurally, the resection target was maneuvered into the FTRD resection chamber using either traction or suction and the device fired to create a stapled full-thickness resection.

Raju et al [14] described a postresection closure method involving colonic opening (mesenteric or antimesenteric side) using a combination of an insulated needle knife and snare, followed by closure of the resulting defect with multiple deployments of tissue apposition system (TAS) sutures (Ethicon, Endo-Surgery Inc, Cincinnati, OH) (Figure 2).

A number of studies described variations of a grasp-and-snare technique [15–18]. In the first study from von Renteln et al [16], both preresection and postresection closure methods using an over-the-scope clip (OTSC; Ovesco Endoscopy, Tubingen, Germany) were described (Figure 3). A therapeutic double-channel gastroscope (2T160, Olympus, Hamburg, Germany) was used to introduce a tissue closure clip, which deployed 3 needles at its tip to grasp the bowel wall. Traction was used to create a pseudopolyp. In all, 8 procedures were performed in 4 animals in which the base of the pseudopolyp underwent preresection closure with endoloop ligation (HX-400U-30, Olympus, Hamburg, Germany) before snare resection (2.5-cm snare, SD-990, Olympus, Hamburg, Germany). An OTSC was then loaded onto a transparent 14-mm cap at the end of the endoscope and applied at the base of the endoloop. Additional 20 procedures were performed in 10 animals with defect closure subsequent to the resection (postresection closure method). Following resection, the edges of the colotomy were manipulated into the cap using a twin grasper (Ovesco Endoscopy, Tubingen, Germany) and one or more OTSCs were deployed to close the defect.

Subsequent 2 studies describe a modification of this preresection closure method [15,17]. In these studies, a transparent cap was placed at the end of a single-channel endoscope (EG-2940, PENTAX, Hamburg, Germany), preloaded with an OTSC and an electrosurgical snare. Grasping forceps (FG-42-L, Olympus, Hamburg, Germany) were used to manipulate the target area into the cap and the OTSC was deployed creating a pseudopolyp. The specimen was then snare resected by taking tissue superficial to the clip. In the latter study, this equipment had been developed into a single device (Ovesco FTRD; Ovesco Endoscopy, Tubingen, Germany) (Figure 4) [17].

Rieder et al [18] described a similar preresection closure method using the same OTSC mounted on a dual-channel gastroscope (GIF-2T-160, Olympus, Hamburg, Germany). All procedures