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## Laparoscopic endoloop technique – A novel approach of managing iatrogenic caecal perforation and literature review

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## ABSTRACT

**INTRODUCTION:** An iatrogenic caecal perforation is rare, but a serious complication associated with significant morbidity and mortality. We present a 4 min and 50 s video on a new improvisation undertaken during laparoscopic management of post-polypectomy caecal perforation.

**PRESENTATION OF CASE:** Our patient presented with an acute abdomen following endoscopic polypectomy. At surgery, the site of caecal perforation was close to the appendicular base with devitalization tissue, secondary to diathermy usage. The hallmark of safety within this novel technique included fresh healthy tissue margins within the endoloop (detachable snare ligation) and ensuring no ischemic tissue was gathered. Complete freeing of the appendix and meso-appendicular base was required and securing three endoloops proximal to the site of perforation. The post-operative course was uneventful.

**DISCUSSION:** The World Society of Emergency Surgery (WSES) 2013 guidelines suggested an early laparoscopic approach is a safe and effective treatment for colonoscopy-related colonic perforation. There are no national guidelines and the management is dictated by the clinical condition of the patient, co-morbidity, size and site of perforation as well as the scale of bowel preparation, and surgical experience.

**CONCLUSION:** The endoloop technique described, undertaken during a laparoscopy is a novel approach. It is a simple and effective method, reminding clinicians to adapt techniques when necessary. Nevertheless, it is only limited to perforations around the appendicular base.

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## 1. Introduction

An iatrogenic caecal perforation is rare, but a serious complication associated with significant morbidity and mortality. Traditionally, it has been managed with exploratory laparotomy, primary closure, or bowel resection. The emergence of laparoscopy has allowed localized repair under direct vision with numerous benefits, such as reduction in pain, decrease length of hospital stay, and faster post-operative recovery. The risk of colonic perforation after diagnostic colonoscopy is reported as 0.03% [1]. In a recently published series of 110,785 diagnostic and therapeutic colonoscopy procedures (86,800 diagnostic cases and 23,985 therapeutic cases), a total of 14 incidents (0.012%) of colonic perforation were reported [2].

We present a 4 min and 50 s video on a new improvisation undertaken during laparoscopic management of post-polypectomy caecal perforation. A novel approach of endolooping (detachable snares) the site of perforation, as we present, has not been described in current literature and it could be applied for early perforations

that are within a short distance from the appendicular base. The procedure is completed under direct vision of freeing the appendix with healthy tissue margins prior to applying the endoloop process proximal to the small perforation. It is a new and effective surgical treatment option that has been successful under our care.

## 2. Presentation of case

A 66-year-old man with diabetes underwent an elective colonoscopy and caecal polypectomy. The polyp was 1.5 cm (centimeter) and sessile in nature. The procedure was carried out using conscious sedation, (midazolam and fentanyl) on a morning list by an experienced gastroenterologist. The bowel preparation was good, Ottawa Bowel Preparation Scale [3] and no other colonic pathology was identified. The polypectomy was completed using a classical technique of raising the polyp (with a mixture of normal saline, adrenaline, and tattooing) then snaring with low power coagulation (25 W). The polyp was completely excised and the histology was tubulovillous adenoma. The patient was discharged after 2 h of recovery time.

The patient was re-admitted 4 h later with severe constant right-sided abdominal pain and vomiting. On examination he had a tender, distended abdomen with generalized guarding and rigidity.

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Fig. 1. Showing free gas under the right hemi diaphragm.

Dullness to percussion was noted on the right side of the abdomen with absent bowel sounds. White blood cells (WBC) of 17,000 mL<sup>3</sup> (per cubic millilitre) (4–10 10<sup>9</sup>/L) and C Reactive Protein (CRP) of 115 mg/dL (milligrams per decilitre) (<1.0 mg/dL). The chest radiograph showed free gas under the right hemi diaphragm (Fig. 1). In view of his recent surgery urgent laparoscopy was recommended. The operation was explained to the patient and the consent was obtained.

At surgery, the site of caecal perforation was close to the appendicular base with devitalization tissue, secondary to diathermy usage. The hallmark of safety within this novel technique included fresh healthy tissue margins within the endoloop and ensuring no ischemic tissue was gathered. Complete freeing of the appendix and meso-appendicular base was required and securing three endoloops proximal to the site of perforation. The appendix was cut at the level of the base and removed. Being elderly with comorbidities, special precautions were undertaken. Having had an intra-abdominal drain placed and being closely observed, the post-operative period was uneventful. The patient was seen 1 year after the operation and had not suffered any complications related to the endolooping technique and is clinically well.

### 3. Discussion

Panteris et al. reported a 1/1400 chance of overall colonic perforation and a 1/1000 chance of perforation following therapeutic colonoscopy [4]. Reported causes of caecal perforations include trauma and organ injury, inflammatory conditions, ischemia, and malignancy [5]. In a review by Tam et al., more than two thirds of patients that had an endoscopic procedure related perforation could have been managed through a primary repair. However, a defunctioning stoma was created using the site of the perforation in 18% of patients [6]. Several studies of laparoscopic primary closure or wedge excision and suturing of the perforation have been reported [7–9]. Closure using endo-clips has also been described [4].

In 2006, the European Association for Endoscopic Surgery (EAES) announced its guidelines of laparoscopic management of acute abdomen without specific reference to colonoscopic perforation [10]. The World Society of Emergency Surgery (WSES) 2013 guidelines suggested an early laparoscopic approach is a safe and effective treatment for colonoscopy-related colonic perforation [11]. There are no national guidelines and the management is dictated by the clinical condition of the patient, co-morbidity, size and site of perforation as well as the scale of bowel preparation, and surgical experience [12–14].

Iatrogenic caecal perforation is a serious condition, however rare. The perforation site should be easily identified. Limited studies in current literature report the usage of sutures, linear stapling, or segmental resection. However, the most effective method for repairing in any given patient is not clearly defined. For example thermal perforations induced during polypectomy are usually

small and easily managed compared to perforations induced by pressure or traction on adhesions causing larger tears requiring an extensive repair method. Within our case, the endoscopic picture of the polypectomy site did not show extensive burns. If the tissue injury were greater than expected, especially with electrical burns. A staple caecotomy for greater tissue margin would be recommended.

Laparoscopic management using ENDO GIA™ Stapler or laparoscopic suturing and inversion of the perforation are valuable options and provide the benefits of the minimal access approach. The technique of laparoscopic suturing can be performed by continuous closure using absorbable sutures; a second continuous layer would add an extra safety element to the procedure. The endoscopic stapling technique can also be used. Cho et al. reviewed 22 patients who were treated with immediate endoscopic clips for an iatrogenic colonic perforation. Concluding, it can significantly reduce the frequency of surgery among patients. However, five patients developed post-operative complications and three required an open laparotomy with colonic resection [15]. The main disadvantages of clipping are due to the restricted opening distance between their jaws; being less useful for inflamed or large defects with low closure force and inability to capture deep tissue.

ENDOLOOP ligature is a manufactured detachable nylon loop snare device that is placed over a lesion that is tightened, forming a haemostatic ligature. It is a well-established technique used in different specialties, such as controlling a wide cystic duct or an appendix stump. Devascularisation with endolooping is a risk as in the majority of other techniques; however, the main aim is healing by fibrosis and mechanical haemostasis.

The motivation of using the endoloop technique was firstly, it is an easy application. Secondly, the perforation was very close to the appendix orifice, mimicking the known endoloop method for a classical laparoscopic appendicectomy. A simple cost effective method, such as intracorporeal suturing would require an additional port to close the perforation. In a review by Iishi et al. a randomized controlled trial of 89 patients with immediate and delayed post-polypectomy bleeding showed a reduction in hospital length stay with the use of endoloop ligation treatment [16].

Current literature has shown the endoloop technique has been successful in closure of gastrointestinal tract perforations identified during therapeutic endoscopy and access site closure. Mathews et al. described the use of endolooping for primary closure of transvisceral access incisions that were created in the colon and stomach. The study compared early healing of transcolonic and transgastric Natural Orifice Transluminal Endoscopic Surgery (NOTES) access sites. Incisions closed by endoloop were favored along colonic sites with intense granulation tissue filling of the defect and low rate of perforation compared to T-Tags and endoclips [17]. Von Renteln et al. reported on the comparison of using Over-The-Scope Clip (OTSC) or the endoloop technique used to secure the resection base, before endoscopic full-thickness resection was performed for en bloc resection of gastrointestinal lesions. Complete closure was secured with the endoloop technique, reducing complication rates [18]. An animal laboratory project led by Hucl et al. reported a novel double endoloop technique for endoscopic closure of gastrotomy incisions. Correct positioning and delivery of endoloop was achieved in all animals (10 pigs) and post-mortem examination reveals patient full-thickness gastric closure in all subjects, without any evidence of infection or necrosis [19]. As such, the double endoloop technique signified a novel, simple, and safe method within the gastrointestinal tract.

With our case, we have adopted an innovative approach of using endolooping for an early perforation that was within a short distance of the appendicular base, applied proximal to the site of the perforation. In our surgery, the area of ischemic injury can be easily visualized through the laparoscopy and including fresh and healthy

tissue margins in the loop is the hallmark of safety for this simple technique.

'Bunching up' of tissue that an endoloop creates can be a concern, in regards to principles of a good anastomosis. However, in certain anatomical areas, such as the caecum this is not an issue. For example, the anterior and posterior caecal arteries that arise from a vascular arcade, bridging the branches of the iliocolic artery create a dual blood supply. The risk of ischemia and leakage is relatively unknown. Our selective case is ideal, showing this method can work without complications. The patient had several risks factors for a leak following endolooping, being elderly with comorbidities, however, had no post-operative complications reported. To address the issue of safety, a case series of patients should be treated with this endolooping technique for small early perforations at the base of the appendix, though the condition is very rare and recruiting large number of cases could prove to be difficult. Nevertheless, it is only limited to perforations around the appendicular base. The endolooping technique may not be suitable for late presentation, large perforations with ischemic or friable tissue, and severe peritonitis. In such cases, the use of other methods, such as wedge resection or stapling would be safer.

#### 4. Conclusion

Our patient presented with an acute abdomen following endoscopic polypectomy. Laparoscopically a small caecal perforation close to the appendicular base was found. A novel approach using an endoloop technique has been described, within the surgical video. We agree that there are different methods to treat caecal perforation, such as laparoscopic suturing or the use of the endo GIA stapler. However, this does not mean that they are the only methods available. The endoloop technique described, undertaken during a laparoscopy, is a novel approach. It is a simple and effective method, reminding clinicians to adapt techniques when necessary.

#### Conflict of interest

The authors have no financial and personal relationships with other people or organizations that could inappropriately influence (bias) this submission.

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The authors have no extra or intra-institutional funding to declare.

#### Ethical approval

None.

#### Consent

Written informed consent was obtained from the patient for publication of this case report and its accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

#### Author contribution

Nabeel Merali was the major contributor in writing the case report and he was involved in the acquisition and analysis of lit-

erature review. Abdulzahra Hussain provided clinical care of the patient during his treatment and further follow-up as well as supervising the writing of the case report. Surgical video was courtesy of the Surgical Department with patient consents.

#### Guarantor

All authors read and approved the final manuscript with Abdulzahra Hussain giving the final approval of the manuscript for submission.

#### Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ijscr.2015.02.036>.

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