

# World Journal of *Surgical Procedures*

*World J Surg Proced* 2013 July 28; 3(2): 4-17



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<http://www.wjgnet.com/2219-2832/full/v3/i2/8.htm>  
<http://dx.doi.org/10.5412/wjsp.v3.i2.8>

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**NAME OF JOURNAL**  
*World Journal of Surgical Procedures*

**ISSN**  
ISSN 2219-2832 (online)

**LAUNCH DATE**  
December 29, 2011

**FREQUENCY**  
Four-monthly

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**PUBLICATION DATE**  
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## A simple alternative technique for harvesting split thickness skin grafts

Leonidas Pavlidis, Manousos-Georgios Pramateftakis, Nikolaos Costoglouidis, Georgia-Alexandra Spyropoulou, Efterpi Demiri

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Received: November 12, 2012 Revised: December 18, 2012

Accepted: December 22, 2012

Published online: July 28, 2013

### Abstract

**AIM:** To assess the use of a simple split skin graft harvesting technique, requiring only a scalpel and a swab.

**METHODS:** During the last 8 mo, we operated on a consecutive series of 52 patients (30 males, 22 females) with a mean age of 60 years (33-80). We used the technique we present in order to cover small skin defects. All procedures were performed under local anesthesia. Thirty-seven patients underwent bedside surgery, 8 patients were operated on in the outpatient department and the remaining 7 had their graft harvested in the operating room. After antiseptic preparation of the donor site, the margins of the graft were drawn by the use of a surgical marker. A No 15 scalpel was used for the graft elevation, under constant traction with a moist swab.

**RESULTS:** All procedures were completed successfully without immediate complications. The patients toler-

ated the procedure well. The mean operative time was 15 min. Twenty-four donor sites were left to heal by secondary intention, whereas 28 were sutured with interrupted 3/0 silk sutures in order to heal by primary intention. All 24 sites that were left to heal by secondary intention healed completely in approximately 14 d. For the sites that were sutured, the sutures were removed on the 10<sup>th</sup> postoperative day. Out of the 52 operated cases, 6 patients (11%) developed complications. In 4 patients, the split thickness skin grafts were partially lost, whereas in 2 patients the grafts were completely lost. Wound dehiscence was observed in 2 patients, which were treated with local antiseptic and antibiotic therapy.

**CONCLUSION:** The skin graft technique described is simple, costless and effective and can be performed even on an outpatient basis, without the need for special equipment.

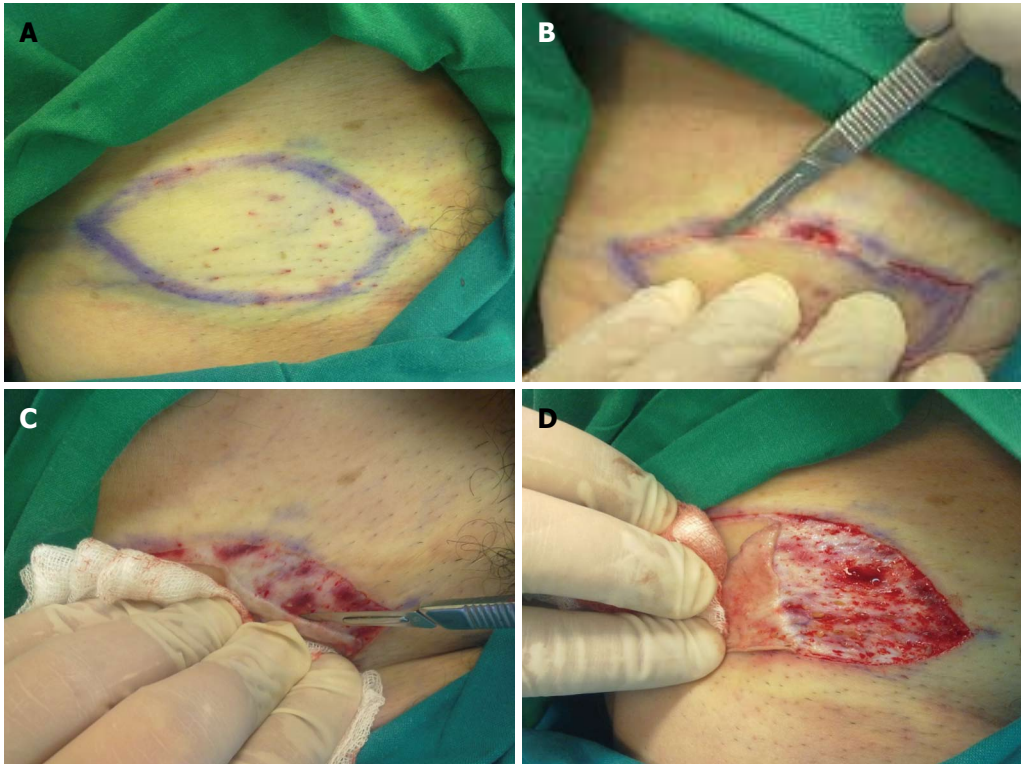
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**Key words:** Skin graft; Skin defect; Split thickness; Skin reconstruction; Dermatome; Tissue harvesting

Pavlidis L, Pramateftakis MG, Costoglouidis N, Spyropoulou GA, Demiri E. A simple alternative technique for harvesting split thickness skin grafts. *World J Surg Proced* 2013; 3(2): 4-7 Available from: URL: <http://www.wjgnet.com/2219-2832/full/v3/i2/4.htm> DOI: <http://dx.doi.org/10.5412/wjssp.v3.i2.4>

### INTRODUCTION

The reconstruction of skin defects with the use of split thickness skin grafts (STSG) is a mainstay technique in dermatological plastic surgery<sup>[1]</sup>. We present a new simple method of harvesting split thickness skin grafts using only a surgical blade and a swab/gauze. In contrast to



**Figure 1** Our technique procedures. A: Donor area (right groin) with the graft designed on it; B: Split thickness skin grafts edges elevated (shave excision); C: Skin graft separation from the underlying dermis; D: Moist swab repositioning exerts a gentle pull in a horizontal plane.

other techniques, the advantages of this technique include no requirement for special surgical equipment (such as a dermatome) and the simplicity of the procedure<sup>[2]</sup>. Moreover, cost is minimized as there is no need for sterilization of the dermatome or its blades.

## MATERIALS AND METHODS

In the last 8 mo (from February 2012 to October 2012), we used our technique in a consecutive series of 52 patients (30 males, 22 females) who required split thickness skin grafts for the covering of small defects. All procedures were performed under local anesthesia. Thirty-seven patients underwent bedside surgery, 8 patients were operated on in the outpatient department and the remaining 7 had their graft harvested in the operating room.

According to our technique, we first mark and inject local anesthetic at the donor area. Following that, the skin graft edges are elevated with a No 15 scalpel. The elevation is performed in a “shave excision” manner (Figure 1A, B). A moist swab/gauze exerts gentle traction on the raw area produced by the graft’s elevation, while the scalpel is being moved on a horizontal plane, in an oscillating fashion, in order to separate the skin from the underlying soft tissue at the level of the dermis (Figure 1C). Frequent repositioning of the moist swab is mandatory following the harvest of the skin graft (Figure 1D). The donor site can be sutured directly, as is the case following the traditional method of full thickness graft harvesting,

or it can be left to heal by secondary intention. The graft is placed on the recipient site immediately after harvesting. Meshing of the graft is possible if necessary.

## RESULTS

All procedures were completed successfully without immediate complications. The patients tolerated the procedure well. The mean operative time was 15 min. Twenty four donor sites were left to heal by secondary intention, whereas 28 were sutured to heal by primary intention. Forty-eight (96%) skin grafts were successfully taken on the acceptor site, whereas 4 were partially lost. The patients (4) whose grafts were partially lost were re-operated on 14 d after the initial operation following the same technique successfully. The donor sites that were left to heal by secondary intention healed in approximately two weeks. The remaining patients whose donor sites were sutured directly after the graft was harvested (primary intention donor sites) had their sutures removed on the 10<sup>th</sup> postoperative day.

Out of the 52 operated cases, 6 patients (11%) developed complications. In 4 patients, the split thickness skin grafts were partially lost, whereas in 2 patients the grafts were completely lost. Two partial wound dehiscences were treated with local antiseptic and antibiotic therapy.

All patients were followed up at the outpatient clinics of our department on the 1<sup>st</sup>, 3<sup>rd</sup> and 6<sup>th</sup> month postoperatively. All grafts were already integrated in the donor site successfully after the 1<sup>st</sup> month.



## DISCUSSION

Skin grafting has always been a valuable option in covering skin defects and soft tissue defects that cannot be closed primarily<sup>[3]</sup>. Split-thickness skin grafts contain varying thickness of dermis, whereas full thickness skin grafts contain the entire dermis. Freshly harvested skin grafts react primarily with contraction, mostly due to the elastin in the dermis<sup>[4]</sup>. The more dermis contained in a graft, the earlier that the contraction appears<sup>[5,6]</sup>.

The take of a skin graft depends on the graft nutrition, which is achieved through a process of revascularization<sup>[7-10]</sup>. Two time periods of skin graft or skin substitute adherence on the recipient area have been described<sup>[11,12]</sup>. The first starts immediately after the placement of the skin graft on the skin defect and is based on serum imbibitions<sup>[13-15]</sup>. Graft adhesion is based on fibrin formation. The second period starts 24 to 48 h after the graft placement and is based on vessel formation into the graft<sup>[16,17]</sup>.

During the last two decades, many different skin flap and graft transfer techniques have been developed<sup>[18,19]</sup>. Modern skin grafting research incorporates the cost parameter, as the latter represents an important factor influencing surgical planning<sup>[20,21]</sup>. The cost of surgical equipment used for split skin grafting can be minimized, especially when small defects can be treated on an outpatient basis or when the grafts can be harvested at a bedside<sup>[22,23]</sup>. Treatment of skin defects can become very expensive, especially in patients suffering with multiple burns<sup>[24-27]</sup>.

We believe that the technique of split skin harvesting we describe is inexpensive, easy to perform and suitable for small skin defects. It can certainly be performed on an outpatient basis. The possible disadvantages of this technique are the fact that the skin graft thickness cannot be estimated accurately and that it is operator dependent. Moreover, we would not recommend this method for larger skin defects because the operative time would be significantly prolonged.

## COMMENTS

### Background

Skin defects are a very common phenomenon in plastic surgery. The high frequency of this condition requires significant theater time and specific surgical equipment.

### Research frontiers

Split thickness skin grafts can be successfully harvested using the scalpel – gauge technique described. However, the exact thickness of the skin graft cannot be predicted, as is the case when an electrical dermatome is used. Moreover, this technique can be quite time consuming when used to cover larger skin defects which need to be operated on in an operating theater compared to the standard dermatome technique. In this study, the authors demonstrate a method which can be used to treat small and moderate defects.

### Innovations and breakthroughs

Recent reports have highlighted the importance of the cost factor when planning the covering of skin defects. This study suggests a new surgical technique based on simplicity and low cost parameters with proven good results on small and moderate skin defects.

## Applications

Given the fact that this new surgical technique presupposes a short learning curve, it may represent a useful and reliable tool which can be incorporated in everyday practice.

## Terminology

Split thickness skin grafts (STSG) include only a part of the dermis, whereas full thickness skin grafts contain the entire dermis. STSG are usually harvested by the use of specific surgical equipment, the dermatome. Donor sites are skin areas where skin grafts are harvested from and acceptor sites or skin defects are to be covered by skin grafts.

## Peer review

In this study, the authors presented a new surgical technique for covering skin defects, based on ease and simplicity. Theater operation time was significantly reduced since the patient can be operated on as an outpatient or “bedside” basis. The results are interesting and this technique may take its position among standard skin harvesting techniques.

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**P- Reviewers** Lin DK, Sun ZH **S- Editor** Huang XZ  
**L- Editor** Roemmele A **E- Editor** Lu YJ



## Reduced port surgery for appendectomy: Early experience and surgical technique

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Received: February 4, 2013 Revised: April 25, 2013

Accepted: June 5, 2013

Published online: July 28, 2013

### Abstract

**AIM:** To evaluate our experience and surgical technique of laparoscopic appendectomy *via* reduced port surgery (LARPS).

**METHODS:** Sixteen patients (8 men and 8 women; median age: 31.0 years) who underwent LARPS between November 2009 and May 2012 were included in the present study. We performed LARPS, in which access devices were inserted through an umbilical skin incision with 1 additional skin incision in the left lower abdomen. After setting access devices, pneumoperitoneum was maintained at 10 mmHg using CO<sub>2</sub> and a 3 mm trocar was positioned (or direct puncture was performed by the Endo Relief system) under laparoscopic

guidance. The mesoappendix was dissected using an ultrasonically activated device. After mesoappendix dissection, ligation was performed near the appendix base and the appendix was dissected using an ultrasonically activated device. The appendix was then removed. At the end of surgery, we administered local anesthesia with ropivacaine 1% (10 mL) for the skin incisions. The outcomes were evaluated in terms of operation time, intraoperative blood loss, length of postoperative hospital stay and surgical complications.

**RESULTS:** Our surgical procedure allowed operators to use instruments as in conventional laparoscopic appendectomy. The basic principle of triangulation of instrumentation was maintained to some degree. LARPS was performed in 9 patients with catarrhal appendicitis, 5 with phlegmonous appendicitis, and 2 with gangrenous appendicitis. The median surgery time was 60 min and the median intraoperative blood loss was 1.2 mL. The median length of postoperative hospitalization was 4 d. There were no conversions to open surgery, no operation-related complications or mortality.

**CONCLUSION:** Our experience and surgical technique suggest that LARPS is a safe and feasible procedure for patients with appendicitis.

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**Key words:** Reduced port surgery; Appendectomy; Laparoscopy; Cosmesis; Single incision

**Core tip:** Our experience and surgical technique suggest that laparoscopic appendectomy *via* reduced port surgery is a safe and feasible procedure for patients with appendicitis. Although the present study showed that this procedure offers cosmetic advantages and technical simplicity, the effectiveness and feasibility of this method should be assessed in randomized trials.

Mori S, Baba K, Yanagita S, Kita Y, Maemura K, Mataka Y, Uchikado Y, Okumura H, Nakajyo T, Natsugoe S, Takao S, Aridome K. Reduced port surgery for appendectomy: Early experience and surgical technique. *World J Surg Proced* 2013; 3(2): 8-12 Available from: URL: <http://www.wjgnet.com/2219-2832/full/v3/i2/8.htm> DOI: <http://dx.doi.org/10.5412/wjssp.v3.i2.8>

## INTRODUCTION

Laparoscopic appendectomy has become a commonly performed surgical procedure worldwide. It is safe, effective and minimally invasive. Compared with open appendectomy, laparoscopic appendectomy is associated with less overall morbidity, an acceptable operation time, a lower incidence of superficial surgical site infection, and a shorter hospital stay<sup>[1-5]</sup>. Single-incision laparoscopic surgery is a novel technique that may be performed when considering minimally invasive surgery and desiring a cosmetic benefit. Recently, single-incision laparoscopic appendectomy (SILA) has become a major focus of study<sup>[6-12]</sup> and prospective randomized studies were performed to compare the outcome of SILA and conventional laparoscopic appendectomy (CLA)<sup>[13-16]</sup>. The results showed the SILA approach to be similar in terms of perioperative outcomes. In the SILA group, wound cosmesis and satisfaction scores were better; however, the operative time was longer and worse pain scores were demonstrated upon exertion.

In the present study, we describe our experience and surgical technique in patients who underwent laparoscopic appendectomy *via* reduced port surgery (LARPS).

## MATERIALS AND METHODS

### Patients

Sixteen patients (male,  $n = 8$ ; female,  $n = 8$ ; mean age: 31.0 years; range, 16-49 years) who were admitted to our hospital from November 2009 to May 2012 were included in this study. Patients were excluded if they had high dense adhesions, perforated appendicitis, acute appendicitis with abscess, or American Society Anesthesiologist scores (ASA) of 4 or 5. All patients had appendicitis and underwent LARPS. Nine patients had catarrhal appendicitis, 5 had phlegmonous appendicitis, and 2 had gangrenous appendicitis.

### Surgical procedures

All patients underwent general anesthesia and were placed in the supine position. The operator and assistant stood on the left side of the patient. The skin was cut along a Z-line marked in the umbilical region (Figure 1A). We used an EZ-access with a Lap-Protector (Hakko Medical Inc., Chikuma, Japan) for the umbilical access device and an Endo Relief (Hope Denshi Co., Kamagaya, Japan) which has a 2.4 mm shaft with a 5 mm diameter head. Two 5 mm trocars were placed through the EZ-access for a 5 mm laparoscope and 5 mm instrument (Figure

1B). After setting the EZ-access with the Lap-Protector, pneumoperitoneum was maintained at 10 mmHg using CO<sub>2</sub> and a 3 mm trocar was positioned (or direct puncture was performed by the Endo Relief system) under laparoscopic guidance into the left lower abdomen (Figure 1B). Laparoscopic instruments were inserted and the mesoappendix was dissected using an ultrasonically activated device (Figure 2). After mesoappendix dissection, ligation was performed near the appendix base using 1 endoloop (Figure 3A) (Ethicon, PDS 0)<sup>[17]</sup> and the appendix was dissected using an ultrasonically activated device (Figure 3B). The appendix was then removed through the Lap-Protector without contacting the abdominal wall. We administered local anesthesia with ropivacaine 1% (10 mL) for the skin incisions at the end of surgery.

### Intraoperative and postoperative observations

Intraoperative information about the surgical duration, complications and blood loss was collected. Postoperative data comprised of complications, length of postoperative hospital stay, and pathological findings. We also conducted the interview post operatively about whether the operative scars were excellent, not bad or bad.

## RESULTS

Our surgical procedure allowed operators to use instruments as in conventional laparoscopic appendectomy and the basic principle of triangulation of instrumentation was maintained to some degree. The umbilical and another skin incision positioned on the left lower abdomen shrunk in the wrinkle (Figure 4). The mean surgical duration was 60 min (range, 35-150 min) and the mean amount of blood loss was 1 mL (range, 0-20 mL). The median hospital stay after surgery was 4 d (range, 3-7 d). No intraoperative complications developed in this series. One patient received 1 additional port because of dense adhesions; however, there were no conversions to open surgery. All patients were free of complications such as leakage of the appendix stump, bleeding, intra-abdominal abscesses and small bowel obstruction. There was no intraoperative or postoperative mortality. Additionally, 9, 5 and 2 patients had catarrhal, phlegmonous and gangrenous appendicitis, respectively. For our interview about the operative scars, all patients answered that the scars were excellent.

## DISCUSSION

Recently, SILA has been reported to demonstrate perioperative outcomes and safety similar to that shown by CLA<sup>[15,16]</sup> as a result of innovation and technological advances. It has been suggested that SILA results in better cosmetic outcomes than CLA<sup>[9-11]</sup>. However, SILA resulted in worse pain scores upon exertion, required a higher dosage of intravenous analgesics, and involved a longer operative time compared with CLA<sup>[15,16]</sup>. We performed LARPS to treat appendicitis by cutting the skin over the



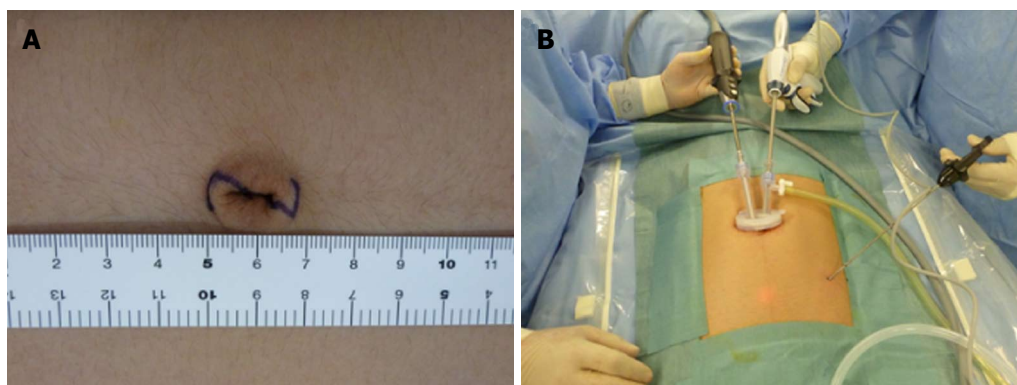


Figure 1 Design for umbilical Z-incision (A) and positioning of the EZ-access and Endo Relief (B).

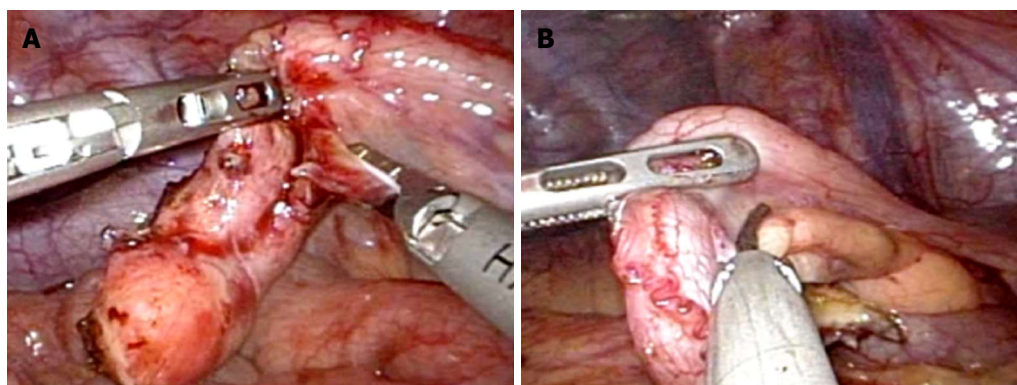


Figure 2 Dissection of the mesoappendix using an ultrasonically activated device.

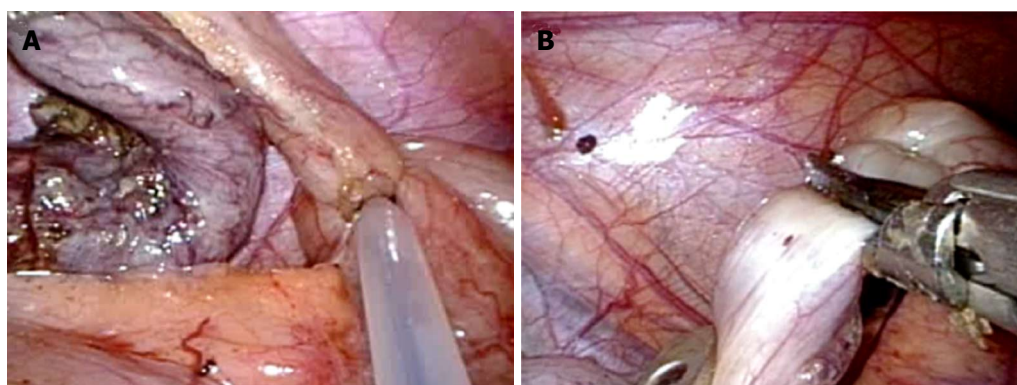


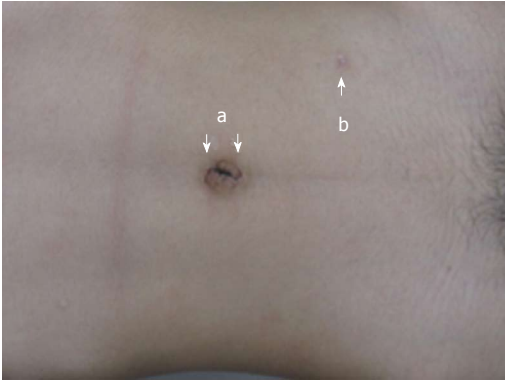
Figure 3 Placement of an endoloop near the appendix base (A) and dissection of the appendix using an ultrasonically activated device (B).

umbilicus with a 2 cm long Z-incision, inserting 2 trocars into the incision and placing another 3 mm trocar (or performing direct puncture by the Endo Relief system) into the left lower abdomen to assist the surgeon. The assisting surgeon usually operates the camera on left side of the patients. Because the appendix was adherent near the lower peritoneal midline, the assisting surgeon stood opposite the operator at the beginning of operation (Figure 1B). The skin incisions were almost hidden after surgery and most patients expressed satisfaction with the virtually scarless outcome. The potential advantages of our procedure are a well-balanced cosmetic outcome and technical

simplicity for laparoscopic appendectomy.

We performed LARPS, a novel surgical procedure, to treat appendicitis. This method yielded good short-term outcomes, including good cosmetic results and a technically simplified SILA. Generally speaking, single-incision laparoscopic surgery is somewhat ergonomically challenging to the operator because the basic principle of triangulation of instrumentation, which is applicable to conventional laparoscopic surgery, is lost to some degree and instruments often interfere with one another. Our surgical procedure allows operators to use instruments as in CLA. Both the triangulation of instrumentation and





**Figure 4 Operative scar 2 wk after surgery.** The arrows show operative scars of umbilical Z-skin incision (a) and Endo Relief (b).

eye-hand and hand-hand coordination are improved, resulting in less interference among instruments compared with SILA. We needed to insert an additional trocar into 1 patient with gangrenous acute appendicitis because of dense adhesions. The duration of surgery and volume of blood lost were 150 min and 20 mL, respectively. This patient did not develop any intraoperative or postoperative complications.

In our procedure, another 3 mm skin incision to assist the surgeon was positioned on the left lower abdomen. The skin incision shrunk in the wrinkle, resulting in a virtually scarless outcome. Positioning one instrument upon the left lower abdomen allowed the operator to maintain eye-hand and hand-hand coordination, maintain the basic principle of triangulation of instrumentation, and avoid interference of instruments. If drain placement was required, the drain could be inserted into the skin incision on the left lower abdomen. In this series, 2 patients required drain placement in the pouch of Douglas because of gangrenous acute appendicitis.

The specimens could be removed through the umbilical skin incision protected by the Lap-Protector. After removing the specimens, pneumoperitoneum was easily maintained using the EZ-access. After washing the intraperitoneal cavity, we removed the Endo Relief or trocar under laparoscopic guidance, closed the peritoneum and fascia at the umbilicus, and administered local anesthesia with ropivacaine 1% (10 mL) for the skin incisions. No patients required a higher dosage of intravenous analgesics postoperatively; the only additional analgesia comprised of oral non-steroidal anti-inflammatory drugs (NSAIDs).

Although our experience was limited to 16 patients, none experienced any intraoperative or postoperative complications, the operative time and length of postoperative hospital stay were acceptable, and the postoperative pain upon exertion was controlled with occasional NSAIDs.

In conclusion, our experience and surgical technique suggest that LARPS is a safe and feasible procedure for patients with appendicitis. Although the present study showed that this procedure offers cosmetic advantages

and technical simplicity, the effectiveness and feasibility of this method should be assessed in randomized trials.

## ACKNOWLEDGMENTS

The authors deeply appreciate the contributions of all colleagues and patients who participated in this study and thank the editors and reviewers for their help with this manuscript.

## COMMENTS

### Background

Laparoscopic appendectomy has become a commonly performed surgical procedure worldwide. It is safe, effective and minimally invasive. Compared with open appendectomy, laparoscopic appendectomy is associated with less overall morbidity, an acceptable operation time, a lower incidence of superficial surgical site infection, and a shorter hospital stay.

### Research frontiers

It has been suggested that SILA results in better cosmetic outcomes than conventional laparoscopic appendectomy (CLA). However, SILA resulted in worse pain scores upon exertion, required a higher dosage of intravenous analgesics, and involved a longer operative time compared with CLA.

### Innovations and breakthroughs

The authors' experience and surgical technique suggest that laparoscopic appendectomy *via* reduced port surgery (LARPS) is a safe and feasible procedure for patients with appendicitis.

### Applications

The authors performed LARPS, a novel surgical procedure, to treat appendicitis. This method yielded good short-term outcomes, including good cosmetic results and a technically simplified SILA.

### Peer review

The paper flows straight through and the authors present their experience well. Although the number of subjects is very small, they present the data as safe and feasible, recommending randomized trials to show any benefit. This is appropriate.

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**P- Reviewers** Mintz Y, Snyder B

**S- Editor** Zhai HH **L- Editor** Roemmele A **E- Editor** Lu YJ



## Screening for colorectal neoplastic lesions following acute diverticulitis: Would a sigmoidoscopy suffice?

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**Author contributions:** Tiong LU contributed to design of study, acquisition of data, data analysis and interpretation, drafting of the manuscript; Jalleh R, Travers EJ, Paxton T and Innes-Wong C contributed to acquisition of data, drafting of the article; Barreto SG and Williams R contributed to conception and design of study, data interpretation, critical revision for important intellectual content; all authors read and approved the final manuscript.

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Received: January 08, 2013 Revised: May 29, 2013

Accepted: June 5, 2013

Published online: July 28, 2013

### Abstract

**AIM:** To investigate the yield of colorectal malignant or premalignant lesions during colonoscopy performed following an episode of acute diverticulitis.

**METHODS:** A prospectively maintained electronic database of a public teaching hospital (Modbury Hospital, South Australia) was searched for international classification of diseases codes for acute diverticulitis from July 2007 to June 2011. The electronic database and each patient's medical records were reviewed for demographic data, clinical presentation, investigation results, colonoscopy details and surgical intervention.

**RESULTS:** Two hundred and nineteen patients were diagnosed with acute diverticulitis with a median age of 60 years (range 24-93). One hundred and thirty-nine patients (63.5%) had follow-up screening colonoscopy, with the

median interval between the episode of acute diverticulitis and colonoscopy being 8 wk (range: 1-66). Colonoscopy revealed polyps in 21 patients (15%) and no cases of colorectal cancer. Of the 21 patients with polyps, there were 14 patients (10%) with tubular/villous adenomas (13 in rectosigmoid region and 1 in descending colon).

**CONCLUSION:** Detection of colorectal cancer in patients undergoing routine colonoscopy following acute diverticulitis is rare. However, colonic polyps in the left colon are noted. A flexible sigmoidoscopy is an adequate screening tool in such patients. A complete colonoscopy reserved for patients with family history of colorectal cancer or with polyps detected on flexible sigmoidoscopy to evaluate the rest of the colon.

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**Key words:** Polyps; Surgery; Diverticulitis; Colonoscopy; Colorectal cancer

**Core tip:** This paper shows that of the 139 patients who underwent routine colonoscopy after an episode of acute diverticulitis, the incidence of adenomatous and malignant colonic polyps discovered were 10% and 0% respectively. These figures are similar to that in the general population. In addition all the polyps were discovered in the left colon, therefore a flexible sigmoidoscopy may be adequate for the purpose of excluding the presence of neoplastic lesions.

Tiong LU, Jalleh R, Travers EJ, Paxton T, Innes-Wong C, Barreto SG, Williams R. Screening for colorectal neoplastic lesions following acute diverticulitis: Would a sigmoidoscopy suffice? *World J Surg Proced* 2013; 3(2): 13-17 Available from: URL: <http://www.wjgnet.com/2219-2832/full/v3/i2/13.htm> DOI: <http://dx.doi.org/10.5412/wjsp.v3.i2.13>

## INTRODUCTION

Diverticulosis and colorectal cancer are 2 common diseases affecting the Western population which share many similar characteristics. For instance, both clinical entities have an increasing prevalence with advancing age<sup>[1,2]</sup>, they tend to affect the left side of the colon more often than the right side<sup>[3,4]</sup>, and have been associated with inadequate dietary fibre intake<sup>[5,6]</sup>. It has been advocated that a screening colonoscopy be performed for all patients following an episode of acute diverticulitis to exclude colorectal cancer<sup>[7]</sup>. However, the evidence in literature for such a practice is unclear. Some authors reported positive correlation between diverticulitis and colon cancer and therefore support routine screening colonoscopy<sup>[8,9]</sup>. Others, however, have found no increased risk of colon cancer in patients who were diagnosed with diverticulitis and thought that a screening colonoscopy was unnecessary<sup>[10-12]</sup>.

The aim of the current study was, thus, to retrospectively determine the yield of colonoscopy performed routinely following an episode of acute diverticulitis in detecting colorectal malignant or premalignant lesions in a consecutive cohort of patients diagnosed with diverticulitis.

## MATERIALS AND METHODS

A retrospective search of a prospectively maintained electronic database of a public teaching hospital was undertaken. International classification of diseases codes for acute diverticulitis over a 54-mo period, from January 2007 to October 2011 were analysed with the aim of identifying all patients treated for the disease at the hospital. The overall cohort included patients who were diagnosed and treated for acute diverticulitis. Each admission was reviewed within the electronic database. The case records of patients within the stated study period were manually reviewed.

It is a standard practice at the institute to advise all patients diagnosed with acute diverticulitis to undergo a colonoscopy within 8 wk of discharge so as to exclude a co-existent colorectal neoplastic/pre-neoplastic lesion.

### Variables collected for each patient

The main presenting symptoms, demographic data, blood investigations [white cell count (WCC), neutrophil count and C-reactive protein (CRP) levels], computed tomography (CT) scan, and length of hospital stay were recorded.

The basis for diagnosis of the episode as acute diverticulitis, viz., clinical impression, radiological features or a combination of both, was noted. The management of each patient was also assessed as to whether they required only conservative treatment with antibiotics, or whether more invasive procedures (*e.g.*, percutaneous drainage of diverticular abscess or surgery) were needed. In case of patients with recurrent diverticulitis, only the first episode was included in this analysis. The CT scan images of the abdomen were assessed with regards to the following features; presence and location of the diverticulae, signs of acute inflamma-

tion, and the presence of intra-abdominal complications, *e.g.*, perforation or abscess formation. The severity of diverticulitis was graded according to the European Association for Endoscopic Surgery classification<sup>[13]</sup>.

Additionally, complete data of the colonoscopic procedures were recorded. The colonoscopy reports were assessed with regards to: the time interval between the episode of acute diverticulitis and the colonoscopy, as well as the presence and location of any diverticulae, colitis, polyps, or cancer. The histological results were reviewed for polypectomies or biopsies performed. In patients in whom a colonoscopy was not performed, the reason for this was determined.

The operative notes, in patients who underwent surgery, were assessed for the details of the operation (elective or emergency; and the intra-operative findings). If bowel resections were performed, the histologic results were reviewed for the presence of diverticulitis and/or cancer.

### Patient excluded from the study

Patients who had episodes of per rectal bleeding since the investigation for this group of patients would normally include colonoscopy to exclude bowel cancer.

## RESULTS

A total of 219 patients were diagnosed with acute diverticulitis from July 2007 until June 2011. There were 114 males and 105 females respectively, with a median age of 60 (range 24-93) years. The median length of hospital stay was 3.5 d (range 1-58 d). The inflammatory markers were raised with median WCC of  $11.4 \times 10^9/L$  and CRP of 72.5 mg/L respectively. There were 129 (58.9%), 30 (13.7%) and 40 (18.3%) patients respectively with grade I, II and III diverticulitis according to the European Association for Endoscopic Surgery diverticulitis severity classification. Details of severity of diverticulitis were not available for 20 (9.1%) patients. 196 (89%) patients were managed conservatively, whilst 23 (11%) patients required emergency surgery for complicated diverticulitis; Hartman's procedure ( $n = 5$ ), anterior resection with loop stoma ( $n = 5$ ), right hemi-colectomy for right sided diverticulitis ( $n = 1$ ), open/laparoscopic washout of abscesses ( $n = 4$ ), and no data available ( $n = 8$ ).

### Patients who had colonoscopy

A total of 139 (63.5%) patients had follow-up screening colonoscopy. The median time lapse between the episode of acute diverticulitis and the colonoscopy was 8 wk (range 1-66). During colonoscopy, diverticulosis was confirmed in 120 (86%) of the patients. Of the 19 (14%) patients whose colonoscopy did not show diverticular disease, 8 had been diagnosed with diverticulitis on CT scan while the other 11 had been labelled to have acute diverticulitis based on clinical presentation and laboratory parameters. Five (4%) patients had inflammatory strictures secondary to the diverticulitis found during colonoscopy.



**Table 1 Colorectal polyps and cancer detection in 139 patients who had screening colonoscopy**

Polyps	n (%)
Yes	21 (15)
No	116 (84)
N/A	2 (1)
Histology	
Tubular adenoma	4 (2.9)
Tubular adenoma with low grade dysplasia	7 (5)
Tubulovillous adenoma	2 (1.4)
Sessile serrated adenoma	1 (0.7)
Others including benign polyps	3 (2.2)
N/A	4 (2.9)

N/A: Not available.

Table 1 provides a complete depiction of the findings of 139 patients who underwent colonoscopy. No colorectal cancer was found during the screening colonoscopy in all 139 patients. Polyps were discovered in 21 (15%) patients, of which 14 (10%) had tubular/villous adenomas and 3 (2.2%) had benign hyperplastic polyps. The polyps could not be retrieved in 4 (2.9%) patients and so no histological information was available. Of the 14 patients with adenomatous polyps, 13 (93%) had polyps excised from the recto-sigmoid area while 1 patient had a polyp excised from the descending colon.

#### **Patients who did not have screening colonoscopy**

There were 43 (19.3%) patients who did not have screening colonoscopy for various reasons as shown in Table 2.

#### **Miscellaneous**

Eighteen (8.2%) patients elected to be treated and followed-up by their private doctor, and therefore no further reports were available. Nineteen (8.7%) patients did not return for their colonoscopy or outpatient appointment, and therefore were lost to follow-up.

## **DISCUSSION**

The data from our study indicate that 14 (10%) of the 139 patients with acute diverticulitis who subsequently had a screening colonoscopy had colorectal polyps removed, all of which originated from the left colon. No colorectal cancer was found in this cohort of patients. Other studies have reported an incidence of 6%-10% and 1%-2% for colorectal polyps and cancer, respectively<sup>[8,10,12]</sup>.

Several clinical practice guidelines have been published in recent years on the indications for colonoscopy, some of which include lower gastro-intestinal bleeding, unexplained iron-deficiency anaemia, patients with significant family history of colorectal cancer, and inherited colorectal cancer syndromes, *e.g.*, familial adenomatous polyposis (FAP) and hereditary non-polyposis colorectal cancer (HNPCC)<sup>[14-16]</sup>. However acute diverticulitis is not listed as an indication for screening colonoscopy to exclude colorectal cancer.

**Table 2 Patient whose colonoscopy did not occur**

Reasons no colonoscopy was arranged	n (%)
Advanced age and severe co-morbidities	7 (16)
Had diverticulosis confirmed on colonoscopy previously	7 (16)
Emergency surgery	3 (7)
Deceased	3 (7)
Discharged directly from the emergency department	5 (12)
Transferred to another hospital	1 (2)
Unknown	17 (40)

There is evidence of a significant association between diverticular disease and colorectal polyps<sup>[17-19]</sup>, and research has shown that removal of adenomatous polyps significantly reduces the incidence of colorectal cancer<sup>[20-22]</sup>. Therefore routine colonoscopy after diverticulitis may facilitate early detection of these polyps, the removal of which may reduce the risk of developing a future cancer. On the other hand the association between diverticulitis and colorectal cancer is unclear; some authors reported a positive correlation and supported routine screening colonoscopy<sup>[8,9]</sup>, whilst the others have not<sup>[10-12]</sup>.

Colonoscopy in patients after an episode of acute diverticulitis is not without risks. The risk of perforation during colonoscopy in the general population has been reported to be about 0.1%<sup>[23]</sup>. Patients with diverticulitis have higher risk of complications as the nature of their disease makes the colonoscopy more difficult with strictures, spasms, muscular hypertrophy and colonic fixation<sup>[24]</sup>.

It would be more useful to identify risk factors that could better categorize the patients with diverticulitis who have an increased risk of having colorectal adenomas or cancer, and therefore warrant a colonoscopy. A recently published article reported that the risks of cancer was higher in patients with CT diagnosed left sided diverticulitis complicated by abscess [odds ratio (OR) = 6.7, 95%CI: 2.4-18.7], local perforation (OR = 4, 95%CI: 1.1-14.9) or fistula (OR = 18, 95%CI: 5.1-63.7)<sup>[8]</sup>. There are at least 2 other reports in the literature showing evidence of a higher incidence of left sided colon cancer in patients with diverticulitis<sup>[10,11]</sup>. Data from our own study showed that almost all of the adenomatous polyps (13 out of 14 patients) originated from the recto-sigmoid area, while the last one originated from the descending colon.

An alternative option worth considering is performing a flexible sigmoidoscopy instead of a full colonoscopy. A flexible sigmoidoscopy has the advantage of having less risks as it is easier to perform and can be done without sedation. In addition patients do not need to take a full bowel preparation; instead 1-2 rectal enemas can usually clear the left colon enough to provide satisfactory views. It can also be more cost-effective as the cost according to the current Australian Medicare Benefit Schedule<sup>[25]</sup> for a flexible sigmoidoscopy is \$109.25, which is less than half that of a colonoscopy (\$328.10). CT colonography is another option as it does not carry the risk of bowel perforation as colonoscopy does. Although CT colonography is a relatively new radio-imaging modality, there is



increasing evidence that it is useful for the screening of colorectal cancer. A recently published meta-analysis of CT colonography for the detection of colorectal cancer showed a sensitivity of 96%<sup>[26]</sup>. There is no data currently available on the usefulness of CT colonography as a screening tool for colorectal cancer in patients with acute diverticulitis, and therefore there is a need for further investigation in this area. The cost for a CT colonography (\$600) according to the Australian Medicare Benefit Schedules is much higher than those of a colonoscopy or a flexible sigmoidoscopy. Therefore, further studies are required to investigate the cost-effectiveness of CT colonography in comparison to colonoscopy or flexible sigmoidoscopy as a screening tool for colorectal cancer in patient with diverticulitis.

In conclusion, based on the findings of our study, the detection of colorectal cancer in patients undergoing routine colonoscopy following an acute episode of diverticulitis is rare. However, colonic polyps in the left colon are noted. Thus, a flexible sigmoidoscopy in patients without a family history of bowel cancer (sporadic or as part of a familial syndrome) could be a viable and possibly a time- and cost-effective option. In patients with a family history of colorectal cancer or those in whom pre-malignant polyps (serrated adenomas, tubulo-villous adenomas with moderate or high grade dysplasia) or many polyps are encountered in the recto-sigmoid region, a full colonoscopy would be justified.

## COMMENTS

### Background

Diverticulosis and colorectal cancer are two common diseases, which share similar characteristics, affecting the Western population. There is evidence of a significant association between diverticular disease and colorectal polyps.

### Research frontiers

The aim of the current study was, thus, to retrospectively determine the yield of colonoscopy performed routinely following an episode of acute diverticulitis in detecting colorectal malignant or premalignant lesions in a consecutive cohort of patients diagnosed with diverticulitis.

### Innovations and breakthroughs

This paper shows that of the 139 patients who underwent routine colonoscopy after an episode of acute diverticulitis, the incidence of adenomatous and malignant colonic polyps discovered were 10% and 0% respectively. These figures are similar to that in the general population. In addition all the polyps were discovered in the left colon, therefore a flexible sigmoidoscopy may be adequate for the purpose of excluding the presence of neoplastic lesions.

### Applications

The results from this study suggest that a flexible sigmoidoscopy may be adequate to exclude colorectal neoplasms in patients after an episode of acute diverticulitis.

### Terminology

Diverticulosis is the presence of outpouchings in the colon, most commonly affecting the sigmoid colon. Diverticulitis is acute inflammation of these outpouchings. Colonoscopy is the process of inspecting the lumen and mucosa of the colon using a flexible fibre-optic camera.

### Peer review

The authors reported the result of colonoscopy after acute diverticulitis. This paper may have consequences on each National health system policy. The conclusions are based on good data.

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**P- Reviewers** Lin DK, Kobayashi H, Agresta F  
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*World Journal of Surgical Procedures*

### ISSN

ISSN 2219-2832 (online)

### Launch date

December 29, 2011

### Frequency

Four-monthly

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- 1 **Jung EM**, Clevert DA, Schreyer AG, Schmitt S, Rennert J, Kubale R, Feuerbach S, Jung F. Evaluation of quantitative contrast harmonic imaging to assess malignancy of liver tumors: A prospective controlled two-center study. *World J Gastroenterol* 2007; **13**: 6356-6364 [PMID: 18081224 DOI: 10.3748/wjg.13.6356]

*Chinese journal article (list all authors and include the PMID where applicable)*

- 2 **Lin GZ**, Wang XZ, Wang P, Lin J, Yang FD. Immunologic effect of Jianpi Yishen decoction in treatment of Pixu-diarhoea. *Shijie Huaren Xiaobua Zazhi* 1999; **7**: 285-287

*In press*

- 3 **Tian D**, Araki H, Stahl E, Bergelson J, Kreitman M. Signature of balancing selection in Arabidopsis. *Proc Natl Acad Sci USA* 2006; In press

*Organization as author*

- 4 **Diabetes Prevention Program Research Group**. Hypertension, insulin, and proinsulin in participants with impaired glucose tolerance. *Hypertension* 2002; **40**: 679-686 [PMID: 12411462 PMCID:2516377 DOI:10.1161/01.HYP.0000035706.28494.09]

*Both personal authors and an organization as author*

- 5 **Vallancien G**, Emberton M, Harving N, van Moorselaar RJ; Alf-One Study Group. Sexual dysfunction in 1, 274 European men suffering from lower urinary tract symptoms. *J Urol* 2003; **169**: 2257-2261 [PMID: 12771764 DOI:10.1097/01.ju.0000067940.76090.73]

*No author given*

- 6 21st century heart solution may have a sting in the tail. *BMJ* 2002; **325**: 184 [PMID: 12142303 DOI:10.1136/bmj.325.7357.184]

*Volume with supplement*

- 7 **Geraud G**, Spierings EL, Keywood C. Tolerability and safety of frovatriptan with short- and long-term use for treatment of migraine and in comparison with sumatriptan. *Headache* 2002; **42** Suppl 2: S93-99 [PMID: 12028325 DOI:10.1046/j.1526-4610.42.s2.7.x]

*Issue with no volume*

- 8 **Banit DM**, Kaufer H, Hartford JM. Intraoperative frozen section analysis in revision total joint arthroplasty. *Clin Orthop Relat Res* 2002; (**401**): 230-238 [PMID: 12151900 DOI:10.1097/00003086-200208000-00026]

*No volume or issue*

- 9 Outreach: Bringing HIV-positive individuals into care. *HRS-A Careaction* 2002; 1-6 [PMID: 12154804]

### Books

*Personal author(s)*

- 10 **Sherlock S**, Dooley J. Diseases of the liver and biliary system. 9th ed. Oxford: Blackwell Sci Pub, 1993: 258-296

*Chapter in a book (list all authors)*

- 11 **Lam SK**. Academic investigator's perspectives of medical treatment for peptic ulcer. In: Swabb EA, Azabo S. Ulcer disease: investigation and basis for therapy. New York: Marcel Dekker, 1991: 431-450

*Author(s) and editor(s)*

- 12 **Breedlove GK**, Schorfheide AM. Adolescent pregnancy. 2nd ed. Wiczorek RR, editor. White Plains (NY): March of Dimes Education Services, 2001: 20-34

*Conference proceedings*

- 13 **Harnden P**, Joffe JK, Jones WG, editors. Germ cell tumours V. Proceedings of the 5th Germ cell tumours Conference; 2001 Sep 13-15; Leeds, UK. New York: Springer, 2002: 30-56

*Conference paper*

- 14 **Christensen S**, Oppacher F. An analysis of Koza's computational effort statistic for genetic programming. In: Foster JA,

Lutton E, Miller J, Ryan C, Tettamanzi AG, editors. Genetic programming. EuroGP 2002: Proceedings of the 5th European Conference on Genetic Programming; 2002 Apr 3-5; Kinsdale, Ireland. Berlin: Springer, 2002: 182-191

#### Electronic journal (list all authors)

- 15 Morse SS. Factors in the emergence of infectious diseases. Emerg Infect Dis serial online, 1995-01-03, cited 1996-06-05; 1(1): 24 screens. Available from: URL: <http://www.cdc.gov/ncidod/eid/index.htm>

#### Patent (list all authors)

- 16 Pagedas AC, inventor; Ancel Surgical R&D Inc., assignee. Flexible endoscopic grasping and cutting device and positioning tool assembly. United States patent US 20020103498. 2002 Aug 1

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Write as mean  $\pm$  SD or mean  $\pm$  SE.

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