Research Article

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An Innovative Method for Laparoscopic Colonoscopic Polypectomy Procedures

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ABSTRACT

Introduction : The endoscope cannot reach or properly place a large number of benign colorectal polyps for polypectomy. As a result, patients have the affected bowel surgically removed. Because of this, we have worked with pig models to create minimally invasive methods to help with endoscopic polypectomies. A grabbing mechanism is deployed by the MiniLap, a unique device, through a needle-tipped shaft. To help with this endeavor, we used this device for transcolonic insertion, dissection, exposure, and retraction.

Methods : Two 12mm ports are put (periumbilical and right lower quadrant) for a camera and instruments using a supine porcine model, with IACUC approval. To help with exposing, retracting, and dissecting, minilaps are placed. After the polypectomy site was made visible, the MiniLap was inserted (with the needle). presenting the polyp to the endoscope transcolonically. Following the polypectomy, the instruments were taken out and the colotomy was sealed with a purse string.

Results : For polyps that would typically be unreachable, we were able to imitate endoscopic polypectomies with transcolonic help from the MiniLap. To grip the polyp intracolonically, insert the MiniLap through a loop cautery. After that, the loop glides across the apparatus to the polyp's base. Another method makes the polyp visible to the endoscope by using the MiniLap to grab the proximal mucosa.

Conclusion : the MiniLap can help with the endoscopic removal of hard-to-reach polyps in the pig model. Ideally, this will result in fewer bowel resections, patient morbidity, and length of hospital stay for human patients.

Keyword

Benign polyps; Polypectomy

INTRODUCTION

Among the first to design and perform endoscopic polypectomies for the treatment of colorectal polyps were William Wolff and Hiromi Shinya [1]. Over the past ten years, a number of developments have been achieved to make this outpatient technique a secure therapeutic option. The initial line of treatment for colonic polyps is still endoscopic polypectomy [2]. Surgical resection is the alternate therapeutic option. If colonic polyps can be removed endoscopically, surgical excision may not require the high cost of hospitalization [3]. Endoscopic polypectomy is seen to be a safe treatment for these polyps, but it does have a higher risk of intestinal perforation and bleeding [3]. Complication rates following endoscopic polypectomies have been reported to range from 1 to 9% in previous studies [3]. During a colonoscopy, colonic polyps are usually Snares, either hot or cold, were used to extract or biopsy. Sometimes these polyps are so big or stubborn to get rid of that it is nearly impossible flat, putting one's intestines at risk of perforation. Furthermore, adhesion from prior surgeries or redundancy of the colon may make it difficult to access the polyp and difficult to remove. In the past, removing the polyp from these people would require a gut resection, which would entail significant side effects. Many cases of colon polyps that were not amenable to colonoscopic removal have been referred for surgical removal within the past ten years. This innovative method addresses the problem of needless intestinal resection for benign polyps head-on and permits operating room colonoscopies [4].

Because we can fix a perforation right away, we may do polypectomies with greater aggression. When necessary, laparoscopic aid is utilized for improved colonic visibility, bowel mobility, and, if necessary, adhesion removal. Polyps that were previously inaccessible with a conventional colonoscopy can now be accessed using this technique. technique supports any serosal rip and permits laparoscopic repair of any colotomy, so avoiding needless bowel resections. The MiniLap device can be utilized to assist in handling the colon itself and in mobilizing the colon without the need to install formal ports for conventional graspers, as we currently do. To capture the polyp itself, the MiniLap instrument was placed through the colon wall and into the colon lumen. In order to include colonoscopic removal, we could accomplish this by retracting the polyp towards the colonoscope. In the event that a colonoscopy is not practical, we employed the

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MiniLap to accurately identify and seize the polyp in order to do an open intestine resection by easy laparoscopic closure and colotomy. A look back 106 patients with benign polyps identified by colonoscopy underwent repeat intraoperative colonoscopies and repeat intraoperative colonoscopic polypectomies with laparoscopic assistance between March 2001 and September 2009, according to a review of our institution's charts [5]. There were 56% male patients and a median age of 65. Of these patients, seventy-four (70%) underwent a successful colonoscopic polypectomy; ten of these cases involved the colon being mobilized and positioned via laparoscopy.

Thirty-two patients underwent surgery, of which seventeen had colectomy, seven had cecectomies, five had transanal excisions, two had low anterior resections, and one had colotomy with mass excision. These individuals had official resections because of their size, difficulty of access, or worrisome appearance for cancer. Analysis revealed that there was a significant difference ($p<0.01$) in the duration of hospital stay between these two groups. The surgical group had a mean stay of five days (median 4), while the non-operative group's mean stay was less than one day (median 0). One patient experienced self-resolving continuous rectal bleeding following a colonoscopy, two carcinomas that were first identified as benign, one anastomotic leak, one perioperative surgical site infection, and one perforation during the colonoscopy. The advantages of repeating the colonoscopy intraoperatively with laparoscopic support seemed to be substantial. As a result, we hope that MiniLap will result in more treatments being successful. Furthermore, by using the MiniLap, we might be able to treat a large number of other patients with straightforward laparoscopic closure, polypectomy, and colotomy, avoiding an open formal bowel resection and the complications that come with it difficulties and an extended hospital stay. Five milestones in all were reached by the completion of this project. The goal of each milestone was to increase the surgeons' proficiency and understanding of the apparatus. You may find brief summaries of every milestone in (Table 1). This effort aimed to illustrate the function of the MiniLap instrument in laparoscopic aided colonoscopic polypexies. Our goal was to show how the gadget might make more patients qualified. Final Adjustments to the Pig Model. After seeing the recordings from the last session, we will make any last-minute changes to the protocols at this session. Any modifications to the protocols will then be documented in advance of their potential application in human trials and subsequent demonstrations. After that, we'll edit the film and get ready for any pote.

Supplies and Procedures

With permission from the Institutional Animal Care & Use Committee (IACUC), a swine (pig) model was used for this experiment. The pig started a bowel prep three days prior to the anticipated procedure in order to facilitate as much catharsis of fecal contents as possible. The pig was put under general anesthesia by skilled personnel from the animal lab on the day of the procedure. The supine position was assigned to the pig. Per rectum, a colonoscope was positioned. At the time of operation, laparoscopic ports were placed in the positions thought to be suitable. The colon was mobilized and dissected using the MiniLap devices, which were transabdominally implanted. Additionally, we intended to capture the lumen by passing the MiniLap devices through the colon wall.

We devised the appropriate methods for putting the gadget into the pig securely. We found that entry into the abdominal cavity may be accomplished safely without the requirement for a second stab incision. We discovered that effective triangulation for dissection was possible with independent MiniLaps placed into the left and right upper quadrants in addition to an umbilical camera port. During this procedure, we were also able to close the colotomy using a purse string closure and inject the MiniLap via the colon. We succeeded in finishing a simulation of a transabdominal, transcolonic polypectomy during the second session. We also discovered a new application for the MiniLap. After grasping viscera (such as the stomach), we employed many MiniLaps placed into the abdominal cavity as self-retaining retractors.

Additionally, we discovered that encircling the area where the colotomy will be done with a U-stitch allows for extra

minimizes any fecal contamination by allowing retraction and enabling the colotomy to be closed concurrently with the removal of the MiniLap from the colon (the suture is tightened as the device is removed). Additionally, we tried closing the colotomy with staples or clips, but we discovered that this was less successful and more challenging. Lastly, we tried to identify any potential problems with using the MiniLap. With some difficulty, we managed to damage the colon by using the MiniLap to grip too tightly and trap the colon inside the needle.

While full thickness injuries could not be produced, serosal injuries could.

Additionally, we attempted to puncture blood arteries located within the abdominal wall; however, we discovered that the vessels appeared to "roll" aside. We tried to hone and investigate alternative methods for transabdominal, transcolonic polypectomies by finishing the third session. We tried to place our U stitch and perform a colotomy closure using a straight needle placed through the abdominal wall and tie the knots intracorporeally, using only an umbilical port (which is similar to single incision surgery) and the MiniLaps. This proved to be very difficult in the narrow porcine abdomen, and we caused bowel injury before successfully closing the colotomy. Then, in order to replicate a single incision port, we modified our plan and positioned a port close to our umbilical port. We succeeded in closing. We succeeded in completing the transabdominal, transcolonic polypectomy using a single incision port during session four. We used a stiff, 30-degree, 5mm camera for this. We discovered that the colotomy closure was less accurate and that the technique was challenging. Although there was some out-

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ward stricturing of the gut due to the colotomy closures, there was little intraluminal narrowing as seen by the colonoscope, allowing the scope to pass through with ease. More improvements were required, even though we were able to show that the treatment could be completed with just one incision and the MiniLap (a flexible tipped scope would also be of immense help in this procedure). In the fifth and final session, we made an effort to apply the methods we had learned to accurately replicate a transcolonial and transabdominal polypectomy. Utilizing an umbilical port and a port in the right lower quadrant, we chose to employ a two port approach. We positioned a MiniLap in the low midline to serve as a bladder retractor that would self-retract. For retraction and exposure, we employed right upper and left upper MiniLaps; for the polypectomy, we used an infraumbilical MiniLap in the midline. It was the ideal exposure. The colotomy site was stitched up with a U stitch. The MiniLap was inserted into the lumen through the colon wall. Mucosa was lifted from beneath a fold and exposed to the colonoscope during a simulated polypectomy. The previously put U stitch was used to seal the colotomy. To guarantee an airtight closure, the instruments were then taken out. Our goal was for this simulation to run as smoothly as possible, therefore even though we had already demonstrated that it was conceivable, we didn't use a single incision technique and instead carried out this with the best exposure possible.

DISCUSSION

Every single goal that was established at the start of the project was accomplished. In the first session, we started by creating a "puncture" in the skin using a scalpel. Then, we easily inserted the MiniLap's needle point through the fascia and subcutaneous tissue into the abdominal cavity. But we also discovered that we could just insert the gadget without using the scalpel to make the "puncture." The MiniLap's needle tip was used to puncture the skin, subcutaneous tissue, and fascia. We positioned the device's shaft 2-4 cm in front of the needle tip in order to make sure the instrument did not damage viscera by penetrating the abdominal cavity too deeply. This procedure resulted in a substantially improved cosmesis. Furthermore, we made an effort to damage the superficial blood vessels in the abdominal wall (this can occasionally happen unintentionally when putting in laparoscopic ports). Using a scalpel made this task simple, but use a MiniLap made it unexpectedly challenging. The vessels appear to "roll," so it required some work and several tries to really puncture them and start bleeding. After looking at the belly with a laparoscopic camera in an umbilical port, we chose to insert our first MiniLaps in the upper quadrants of the right and left abdomen. We were able to effectively retract our bowel using these spots. Eventually, a second MiniLap was inserted into the transcolonic insertion site in the lower quadrant near midline. The location of the polyp that needs to be removed will determine where this is. Although we might attempt to finish the surgery without using either the left or right upper quadrant sites in the future, it seemed that these places were adequate. After that, the device was placed inside the colon. At first, transcolonic implantation was challenging. Unintended harm resulted from only putting the MiniLap through the colon wall and employing insufflation from the endoscope as counter resistance. The MiniLap would slide out of the planned insertion place despite several failed tries. Serosal ripping would result from this. Using another MiniLap, the colon was grasped just proximal to its planned insertion point, solving the problem. This offered sufficient counterforce to allow the other MiniLap to be placed where it is supposed to. While the MiniLap was successfully injected transcolonically, more technical advancements are still required.

Ultimately, we used an endostitch device to close the colotomy. We used a silk stitch to make a purse string closure. The colotomy was successfully closed as a result. From the endoscope, it was clear that the closure had very little constriction and was air tight (maintained insufflation). Even if the closure works well, we would like to improve it in next sessions. As the first session revealed, Direct insertion of the MiniLap device into the abdominal cavity is a safe method of implantation. Dissection is aided by a device that is put into the upper quadrants of the right and left. To aid in endoscopic polypectomies, the MiniLap can be transcolonically introduced. An efficient way to close the colotomy is with a purse string closure.

During the second session, we tried to mobilize, dissect, retract, and expose the colon. The small and large bowel need to be shifted in order to reveal the colon. We discovered that there were two ways to accomplish this: either use the grasper closed to sweep the bowel or use it with a soft closure and place the bowel in the proper quadrants. The pig in this session required electrocautery due to a chronic urachus dissection followed by a mild withdrawal. Using the MiniLaps and a single umbilical port incision (the camera and electrocautery were inserted through the same port), this was accomplished with ease. Unexpectedly, the MiniLap worked quite well as a self-retaining retractor. The MiniLap was used to grab the unusually big bladder, and retraction was enabled by positioning the device's extracorporeal disk flush with the abdominal wall. The right upper quadrant's bowel was treated with a similar strategy. At this time, the entire area that was going to be removed by polypectomy was exposed. To generate counter resistance, we next employed an additional MiniLap gripping proximal and a preplaced purse string suture. Under endoscopic viewing, the MiniLap's needle point was effortlessly inserted into the colon, and we were able to grab the mucosa at this point. We employed To remove mucosal segments, use snare cautery. We discovered there are two ways to accomplish this. The initial step was to take a piece of adjacent mucosa and show the endoscope the "polyp." In the second technique, the MiniLap was threaded through the snare's loop. Next, the tip of the "polyp" was grabbed, and the snare was moved over the MiniLap to the "polyp's" base. We identified possible enhancements at this point in the project, which ought to be investigated. We discovered that encircling the

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planned colotomy site with a U-stitch allows for more retraction and enables the colotomy to seal concurrently with the removal of the MiniLap from the colon (the suture is tightened as the device is removed). is eliminated), reducing potential fecal contamination. We made one successful and one unsuccessful attempt at using staples for colotomy closure. It was evident that the U-stitch approach was more efficient and less complicated. During this session, a number of possible risks were noted. Using the MiniLap gadget, we made a deliberate attempt to cause intestinal damage. We were not able to pierce the intestine or viscera, but we could produce extensive serosal tearing (mostly by drawing tissue into the needle-tipped shaft) by taking huge bites of bowel or viscera and closing the device. Additionally, we discovered that we could induce ischemia by grabbing a portion of the mesentery that houses the blood supply. When we first tried to execute suturing using a single camera-incision port, restricting the treatment to a single conventional umbilicus incision. Due to this challenging procedure, a significant colotomy was created as the suture sawed through the intestinal wall. After inserting a new port for the endostitch into the left bottom quadrant, the surgery was finished. In a later session, we would like to improve our skill and undertake the surgery as a single incision with MiniLap help (perhaps with a 5mm camera to allow for more room and ease of movement). As demonstrated in the second session, endoscopic polypectomy is possible when combined with transabdominal and transcolonic support from the MiniLap device. However, more method development is required.

The third session began with a 12 mm umbilical port. In order to implement a self-retained bladder retractor, the MiniLap devices should be inserted into the pelvis, the right and left upper quadrants, and the lower quadrant. After performing the transabdominal transcolonic insertion using a MiniLap in the lower midline, we proceeded to implant a straight needle via the lower right quadrant. Next, we used the straight needle to create a U stitch around the intended MiniLap insertion region. Then, right next to the original insertion site, the straight needle was advanced again out of the abdominal wall. The colon was tented up using the stitch on both sides to enable accurate MiniLap insertion through the colon wall. But the U stitch's proximal side was positioned too shallowly.and broke, resulting in a partial serosal rip.

At this stage, the polypectomy was finished and the MiniLap was still placed transcolonically. The colotomy was closed with an intracorporeal knot after the straight needle was backed into the abdominal cavity, the proximal stitch was formed with a deeper bite, the needle was removed, and the abdominal wall was advanced again. The application of an endostitch was the subject of our next discussion. We tried to replicate the colotomy closure that would be carried out in a single incision operation using the endostitch that was placed extremely close to our camera port. Using the same methods we had employed in sessions 1 and 2, we were able to close the colotomy really quickly (making the first throw). and then the second (during which the MiniLap was being removed in an effort to reduce fecal contamination). In fact, we performed our first patient's transabdominal transcolonic polypectomy using the MiniLap gadget. Even after the colon was fully mobilized laparoscopically, we were unable to fully reach the cecal polyp in this patient with our colonoscope. We transcolonically inserted the MiniLap device, gripped a neighboring mucosa, and held the polyp up to the endoscope's snare. We intend to employ the MiniLap in similar circumstances going forward to avoid the necessity for formal bowel resections, but regrettably, the polyp had high grade dysplasia at the margins, necessitating an ileocecectomy for the patient. Additionally, we want to create less invasive methods like single cut) to help with this undertaking. In session four, we implanted a single incision port in the umbilicus as opposed to using a 12mm umbilical port and a 12mm right lower quadrant port to gain access. For a self-retained bladder retractor, we continued to implant the MiniLap devices in the pelvis, upper quadrants of the right and left, and the right. Additionally, we continued to perform the transabdominal transcolonic insertion using a MiniLap in the lower midline. Through the single incision port, we introduced an endostitch and a sturdy, 30-degree 5mm camera. Our planned colonic insertion region was then surrounded by a U stitch made with the MiniLap for gripping. We did discover that it was more challenging to precisely put the stitch, particularly with the stiffcamera in the way, but it was executed successfully after a while.

Even though there were no serosal or transmural tears, we did discover that greater tension was applied to the colon when the suture was attempted to pass completely through the wall of the colon. The colonoscope and the transcolonic MiniLap were easily used to do the polypectomy. In order to avoid fecal contamination, the colotomy was once more closed by throwing two knots using the endostitch and withdrawing the MiniLap at the same time. After cutting the extra suture with endoshears, the closure seemed airtight. As previously indicated, due to some limited mobility, the U stitches placed during this session did not seem to be as exact as those done during earlier sessions. But the closures were airtight, and no discernible intralumenal constriction was seen. We actually performed three colotomy closures throughout this session's repetition of the experiment, and despite our best efforts, we were still able to pass the colonoscope through these regions rather easily.

We believe that we have conclusively shown that a single incision port plus a few extra MiniLaps can be used to execute transabdominal transcolonic polypectomies. We hope to improve this method in the future by using a flexible-tipped 5mm camera. In the previous session, we tried to replicate a transabdominal, transcolonic polypectomy as accurately as possible using the tools we had devised. Utilizing an umbilical port and a port in the right lower quadrant, we chose to employ a two port approach. We positioned a MiniLap in the low midline to serve as a bladder retractor that would self-retract.

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Using the MiniLap with a colonoscope, we were able to effectively execute a transabdominal, transcolonic polypectomy on one of our patients whose polyp was hidden behind a fold in the cecum. We intend to keep using the MiniLap in comparable circumstances to reduce the amount of time we spend doing colonoscopic polypectomies on patients who are currently receiving them in the operating room and to expand the pool of patients who qualify for these procedures.

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