

An innovative procedure of laparoscope combined with endoscopy for gastrointestinal stromal tumor resection and cholecystectomy: A case report and literature review

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Abstract. The present study reports a novel approach to laparoscopic and endoscopic cooperative surgery for gastric gastrointestinal stromal tumor (GIST) resection and cholecystectomy, and conducts a review of the associated literature. The novel surgical procedure was performed on one patient who was diagnosed with a GIST and cholecystic polypus. The GIST was resected using an insulation-tipped diathermic electrosurgical knife under the guide of an endoscope. Subsequently, a cholecystectomy was performed by inserting two more 5-mm trocars and instruments transumbilically, guided using an endoscope. The tumor and the gallbladder were exteriorized using a peroral approach and the incision lining of the stomach was sutured laparoscopically. The procedure was successfully performed and the patient experienced no discomfort during the 5-year follow-up. In conclusion, the present study demonstrates that laparoscopic and endoscopic cooperative surgery is feasible and would be an ideal choice for invisible abdominal scar surgery, in particular for multi-visceral resection.

Introduction

There has been an increasing interest regarding natural orifice transluminal endoscopic surgery (NOTES) since Kalloo *et al* reported transgastric peritoneoscopy in the year 2004 (1). NOTES can be performed with a flexible endoscope through the stomach, large intestine, vagina or bladder into the abdominal

cavity to diagnose and treat intra-abdominal diseases (2). NOTES was initially developed as a way to perform scarless surgery on the abdominal wall (3,4); however, the procedure is technically challenging unless access methods, retraction and closure methods, infection control and the direction of endoscopy are improved (5).

To date, the field of minimally invasive surgery has experienced enormous innovations, and future research is directed toward decreasing abdominal pain, minimizing the risk of infection, reducing the incidence of hernia formation and optimizing the cosmetic effect associated with the surgery (6). Following the emergence of novel technologies, including NOTES, transumbilical endoscopic surgery (TUES) and single-port laparoscopy (SPL) (7,8), an increasing level of attention has been paid to NOTES, representing a major paradigm shift to scarless surgery (9,10). However, NOTES is associated with a number of potential obstacles, as instruments must be improved in order to obtain safe access to peritoneal cavities, allow adequate exposure, ensure secure closure methods, manage infection control and allow correct orientation (11). The transumbilical approach is favored, as it decreases the disadvantages associated with NOTES; the transumbilical approach, using a flexible endoscope, is a promising, single-incision approach (12).

Based on a number of laboratory animal studies, a novel approach towards laparoscopic and endoscopic cooperative surgery was performed in accordance with the protocol and criteria formulated by the ASGE/SAGES Working Group (13). The present study reports a gastric gastrointestinal stromal tumor (GIST) resection and cholecystectomy that was successfully performed by adopting this novel approach.

Case report

A 62-year-old man was admitted to the Provincial Hospital Affiliated to Shandong University (Jinan, China) with a complaint of acid regurgitation lasting for 8 months, and the patient was diagnosed with cholecystic polypus by ultrasonography. Gastroscopy revealed a submucosal tumor mass (~1.3x1.0 cm) with a smooth surface located in the posterior wall of the lesser gastric curvature of the lower gastric portion. Computed tomography and ultrasonography inspection

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Figure 1. Gastroscopy identified the location of the gastrointestinal stromal tumor.



Figure 2. A hook knife resected the gastrointestinal stromal tumor, guided by endoscopy.

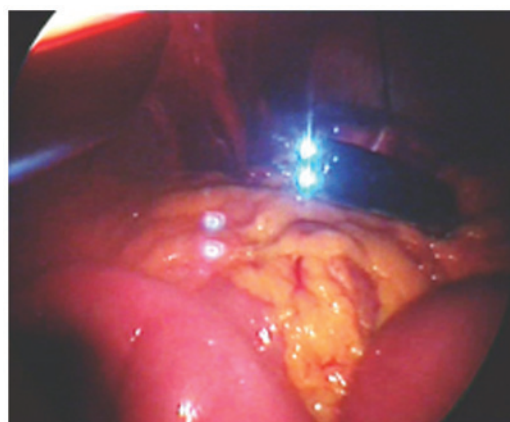


Figure 3. Endoscopy of the abdominal cavity was performed via the incision of the stomach.



Figure 4. A 15-mm trocar was placed transumbilically, on which the wrist portion of a sterile glove was wrapped.

revealed a cholecystic polypus measuring 0.5x0.5 cm, which occupied the neck of the gallbladder. The medical conditions which contraindicated a laparoscopic approach, such as coagulopathy, severe dysrhythmias or chronic obstructive pulmonary disease, were common exclusion criteria. This is because pneumoperitoneum pressure has an impact on cardiopulmonary function and the circulation system (14). Therefore, an electrocardiogram, chest X-ray and laboratory test are required for each inpatient, in order to identify whether a patient can endure the operation. If the tests are abnormal, further examinations, such as heart doppler ultrasound, pulmonary function tests and arterial blood gas analysis, are requested. At the same time, consultations are held with cardiologists, respiratory physicians or hematologists to assess the body function. Based on these reviews, different treatment methods for patients are adopted, for example drug therapy and aerosol inhalation to protect and improve cardiopulmonary function. Regarding the current study, the electrocardiogram, chest X-ray and other laboratory tests of the patient presented no obvious abnormalities.

The protocol for the procedure was approved by the ethical committee of the Provincial Hospital Affiliated to Shandong University, and written informed consent was obtained from the patient. Preoperative preparation and anesthesia were



Figure 5. Trocars (5-mm) were inserted into the fingertips of the glove.

performed using the same method adopted for conventional laparoscopic cholecystectomy (15). A gastroscope (EG2931; PENTAX Medical (Global), Tokyo, Japan), with a standard hook knife (KD-620LR; Olympus Corporation, Tokyo, Japan) and a trielcon, were used for endoscopic submucosal tumor resection.

The tumor location was confirmed by gastroscopy (Fig. 1) and ~2 cm around the periphery of the tumor was marked (16). Adrenaline (dilution, 1:10,000 with hypertonic



Figure 6. A trielcon was used to extract the gallbladder out of the mouth.

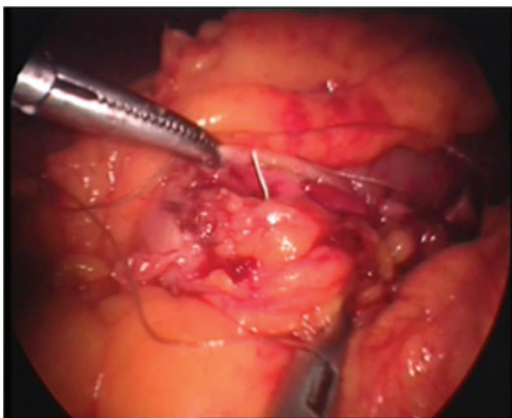


Figure 7. A 2/0 absorbable suture was used to hand-suture the lining of the stomach laparoscopically.



Figure 8. A view of the abdominal wall 3 months following the operation.

saline; Shanghai Harvest Pharmaceutical Co., Ltd., Shanghai, China) was injected into the submucosal layer, and an incision was made with a hook knife set at 100-W Endo-Cut mode. The hook knife resected the tumor, and the marked area surrounded the tumor was resected circumferentially (Fig. 2). Finally, the tumor was removed using the trielcon through the peroral approach, and the endoscope obtained access to abdominal cavity through the incision in the stomach (Fig. 3).

A simple method was used to establish the operation channel for the laparoscopic cholecystectomy (16). A 15-mm trocar was required, on which the wrist portion of a sterile glove was wrapped (Fig. 4). The fingertips of the glove were opened and 5-mm trocars were inserted, allowing a 5-mm laparoscope and two other instruments to be inserted through the channels (Fig. 5). The 15-mm trocar was placed through an arc-incision along the lower side of umbilicus. Two 5-mm laparoscopic instruments were introduced through the trocars fixed on the glove tips. Guided by the endoscope, the laparoscopic cholecystectomy procedure was performed, and the gallbladder was extracted from the mouth using a trielcon (Fig. 6).

In accordance with the criteria established by the NOSCART Consortium (13), the endoscope was removed and a 5-mm laparoscope was inserted through the trocar fixed on the glove tips. The incision then was hand-sutured laparoscopically using a 2/0 absorbable suture (Fig. 7).

The procedure was successfully performed in 178 min, with ≤ 20 ml blood loss. No postoperative complications, such as bleeding, leakage or infection occurred. The maximum postoperative temperature was $\leq 37.4^{\circ}\text{C}$. The postoperative defecation time was three days, and the stomach tube was withdrawn after defecation. The patient resumed free oral intake five days after the procedure and was discharged on day six with no laboratory abnormalities, such as white blood cell, neutrophil and red blood cell count, hemoglobin levels, albumin levels, and levels of K^{+} and Na^{+} . To date, the patient has not developed any wound infections or hernias, no discomfort has been experienced and the patient was satisfied with the cosmetic result at a follow-up three months after the operation (Fig. 8).

Discussion

Following the rapid development of laparoscopy, the field of minimally invasive surgery requires minimal skin incisions, reduced pain and complications, faster postoperative recovery periods, shorter lengths of hospitalization, improved cosmetic effects and faster recovery times (17). NOTES receives the attention and interest of surgeons and gastroenterologists as it is scarless and is relatively painless (18). However, NOTES faces a number of obstacles as a result of inadequate surgical instruments that do not allow safe access to the peritoneal cavity, and do not allow adequate exposure, secure closure methods, effective infection control and correct orientation (19,20).

In comparison with NOTES, TUES may be an ideal choice when attempting invisible abdominal scar surgery. A number of SPL procedures have been reported in recent years and have produced satisfactory results (21,22). It has also been reported that multi-visceral resection operations have been successfully performed by TUES (23,24). However, endoscopic cholecystectomy combined with gastric GIST resection has not previously been reported. Designed using a number of porcine model studies (25,26), the present report describes a novel, successful procedure of a cholecystectomy combined with gastric GIST resection using laparoscopy and endoscopy.

GISTs are rare, non-epithelial mesenchymal tumors with a potential for malignant transformation, accounting

for <3% of all gastrointestinal neoplasms (27), and the most common sites of occurrence is the stomach (40-60%) (28). Despite the development of a new chemotherapeutic agent, imatinib mesylate (29), surgical resection remains the primary alternative treatment for primary GISTs (30). A number of studies have demonstrated that survival is dependent on tumor size and histological features, rather than the extent of resection (31,32). Therefore, major anatomical resections are not required for a number of GISTs (33) in which case minimally invasive surgery is performed, particularly for gastric GISTs (34). The first report of a laparoscopically excised gastric GIST was published in 1992 (35), and there is evidence that the technique is effective with minimal morbidity and mortality (36). Endoscopic dissection is gaining acceptance as a new procedure for submucosal GIST and attains minimal morbidity and mortality (37).

A number of key factors limit the performance of endoscopic resection of GIST. With regards to multi-visceral resection, the procedure is dependent on the location of the GIST. Tumors that are located in the fundus or in the body of the stomach and along the greater gastric curvature are accessible by endoscopic resection, as there is sufficient space and mobility for extensive resection and manual sewing of the incision of the stomach (38). Endoscopic resection is also applicable for anterior lesions of the stomach as the endoscope can gain access to the peritoneal cavity via an incision in the stomach with clear broad vision (39,40). However, the endoscopic GIST dissection procedure is restricted to submucosal dissection due to unfavorable bleeding of the muscle layer (41). The final, most controversial limitation is the size of the tumor. It has been reported that a large submucosal tumor (diameter, ≥ 5 cm) was successfully resected (42). It is also reported that tumors <2 cm in diameter have a low risk of metastasis. However, using current surgical principles and instruments, it is recommended that only tumors <2 cm in diameter are suitable for endoscopic surgery (43,44).

Due to the rare occurrence of lymph node metastases of GIST, the resection of a tumor using a 2 cm periphery is sufficient for surgery (45,46). As conventional laparoscopic surgery, benign disease of gallbladder is confined to the cooperative surgery such as cholecystolithiasis and gallbladder polyps (47).

In contrast to NOTES, GIST is technically easier and provides more satisfactory cosmetic results, requiring only one small incision in the abdomen that can be concealed when the umbilicus is reconstructed (48). In addition, TUES results in reduced blood loss, a quicker flatus time, shorter periods of postoperative hospitalization and fewer complication in comparison with conventional laparoscopic surgery (49,50).

It has been previously reported that endoscopic submucosal dissection is prone to result in a large quantity of bleeding, given the rich blood supply of the stomach and the unfavorable control of bleeding endoscopically (51). However, studies have demonstrated that a standard hook knife in 100-W Endo-Cut mode does not result in excessive bleeding that could coagulate in small vessels and gain access to the abdominal cavity (52).

Secure closure of the visceral incision is a critical step in avoiding intra-abdominal infection (53,54). A number of devices have been developed and used in the clinic, such as flexible endo-stitch, endoscopic clips and G-Pros (55,56). However,

the incision in the stomach may be closed by hand-suturing, which has been proved to be a safe, easy and low cost method in comparison with other methods (57). To confirm the tightness of the stomach incision closure, a combination of intra-abdominal perfusion of saline and filling the stomach with air may be a good method to evaluate the closure of the incision by examining if there are bubbles out of the water.

Infection control is an increasing concern. A recent laboratory study from Case Western Reserve University demonstrated that NOTES may result in less impairment of the peritoneal immune system and thus improve the infectious outcome (58). The temperature of the patient in the present study reached no higher than 37.4°C, and the white blood cell and neutrophil (%) count were recorded as being within their normal ranges, indicating that there was no increased risk of infection during the operation.

In conclusion, the present study demonstrated that the novel method described in the present report is technically simple, feasible and safe with a reasonable operation time, reduced bleeding and rapid recovery period. The technique provides an alternative for minimally invasive surgery, in particular with regards to multi-visceral resection. However, a large sample is required in order to confirm its safety, and a longer follow-up period must be recorded in order to observe the long-term effects of the operation. In addition, patients must be carefully selected for the operation using strict criteria. Furthermore, more suitable instruments, greater experience of the surgeon and more refined techniques for the operation will facilitate this novel approach towards gastric GIST resection. It can be speculated that the novel method will become a popular use for laparoscopy and endoscopy.

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