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Editorial

Tomaž Jagrič, *University Medical Centre Maribor*
Jan Grosek, *University Medical Centre Ljubljana*

Correspondence

Tomaž Jagrič
tomaz.jagric@gmail.com

Jan Grosek
jan.grosek@kclj.si

Surgery is one of the oldest and one of the most respected fields of medicine. Surgeons have always been forced to face challenging and debilitating diseases, and they have been forced to find ever new ways of treatment. The need to effectively treat these diseases has fueled the development of surgery. From its modest beginnings, the development of intensive care medicine, anesthesiology, and pharmacology, and not least of all the enormous development of technology, has allowed modern surgical practice to take shape. The vast technological innovations we have witnessed have enabled the development of endoscopy, interventional radiology, minimally invasive surgery, and robotic surgery. These have been able to reduce surgical trauma and further push the boundaries of surgery to its limits. The complexity of surgical approaches, treatment of surgical complications, reduction of surgical trauma, and better functional results are the offspring of new minimally invasive aspects of surgery. At the foundation of all this development was the desire to contribute to the well-being of humanity. All this progress could not have come about without dedicated surgeons continuously involved in research and publishing their work in medical journals. Research journals are the most fertile ground for new ideas and approaches—and, more importantly, the fundamental means of spreading new techniques, approaches, and ideas among colleagues. Journals can therefore be seen as the most vital conductor of surgical development. The journal Surgery and Surgical Endoscopy is a small link in the chain in the progress of surgical sciences. It is a journal intended for the international community in the fields of surgery, surgical oncology, and surgical endoscopy. Interested authors will be able to contribute articles to the journal in the form of original papers, review articles, case reports, short communications, letters to the editor, and comments. It is our firm belief that the contributions of surgeons, endoscopists, invasive radiologists, and researchers to the journal Surgery and Surgical Endoscopy will have a positive impact on the surgical community worldwide. We also believe that our authors and readers feel the same and will help us achieve our goals with their work and support. It is therefore our honor to present you with the first issue of the journal Surgery and Surgical Endoscopy

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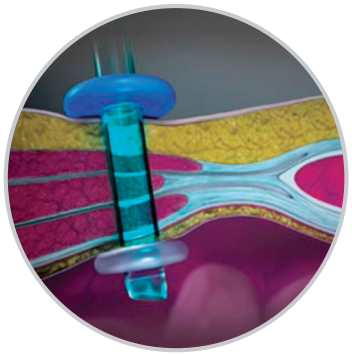

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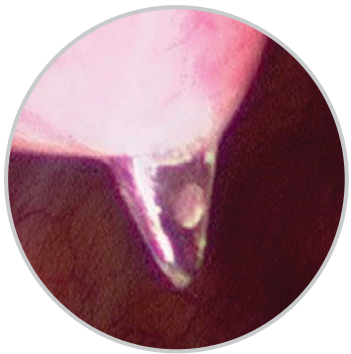

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The importance of preoperative tattooing before laparoscopic surgery

Zdravko Štor
Department for Abdominal Surgery, University Medical Centre Ljubljana

Correspondence

Zdravko Štor
zdravko.stor@kclj.si

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laparoscopy, colorectal surgery, preoperative tattooing

Original Article

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Abstract

Background. Laparoscopically assisted resections in patients with colorectal cancer have been established since randomized studies ascertained that early post-operative results after laparoscopic surgery were comparable to the results after open surgery.

Methods. We reviewed the literature for the currently most valid method of preoperative tumor marking and our experience.

Conclusion. In the case of laparoscopic resections, oncological principles must be followed, which, in addition to the removal of the primary tumor, also require radicular ligation of the blood vessels, thus removing the regional lymph nodes. However, identification of tumors during surgery can be difficult. The use of preoperative endoscopic tattooing can enable identification of the tumor and facilitate laparoscopic resection.

Introduction

The treatment method for colorectal cancer depends on the localization and size of the primary tumor, possible regional and/or distant metastases, and the patient's general condition. Radical resection (R0) is the only curative treatment. When radical resection is no longer possible, palliative resection of the tumor (R2) is preferred over non-resectional surgery.

Specific oncological therapy (neoadjuvant, adjuvant, or palliative), chemotherapy, and/or radiotherapy is important in the treatment of colorectal cancer patients [1–5]. In the last decade, neoadjuvant treatment of cancer of the middle and lower third of the rectum has gained in importance. Effective treatment planning is based on accurate estimation of the local and distant extent of the tumor [6]. Preoperative staging requires complete colonoscopy with biopsy, abdominal CT scan and chest radiograph, histological type of the tumor, differentiation grade (G1, G2, G3), and levels of tumor markers (CEA, CA 19-9). In the case of rectal cancer, MRI, urography, and cystoscopy are sometimes also required for proper preoperative evaluation [7–10].

Before the surgery, local preparation of the bowel is required. Orthograde cleansing is currently still recommended only before a low anterior resection. The concept of accelerated recovery ("fast-track" surgery) is gaining ground. Perioperative antibiotic and antithrombotic prophylaxis remain standard. The latter is also extended to the time after discharge, for up to 3 weeks after surgery [11, 12].

Standard radical operations for colon cancer are: right and extended right hemicolectomy, transverse resection, left and extended left hemicolectomy, sigmoid resection, and subtotal and total colectomy. Every standard resection includes interruption and ligature of lymphovascular pedicles for the area of the colon where the tumor is located and removal of the entire section of the intestine with the attached mesentery (lymphadenectomy). Standard radical surgeries for rectal cancer are anterior resection and low anterior resection with total mesorectal excision, abdominoperineal resection of the rectum, extended abdominoperineal resection of the rectum with removal of the uterus, the posterior vaginal wall, and/or the posterior wall of the bladder, and, exceptionally, the evisceration of the lesser pelvis [13–15]. For a well-differentiated (G1) T1 rectal tumor with a diameter of up to 2 cm, a radical as well as a transanal local excision of the tumor can be performed [16].

Laparoscopic surgery of colorectal cancer in the lower stages is becoming increasingly popular worldwide. The laparoscopic approach has some advantages over standard open surgery; apart from improved cosmesis, the postoperative ileus after laparoscopic surgery is shorter, normal pulmonary function is restored faster, and less morbidity and shorter postoperative hospitalization are observed [17–19].

The potential benefit of a laparoscopic approach for cancer patients is that it lessens surgical trauma and the impact on the immune system, which potentially reduces the number of recurrences of the disease and also benefits operated patients' quality of life. A number of randomized studies were carried out that did not indicate any differences in survival between laparoscopically assisted resections and conventional surgery in colorectal cancer patients [20].

Colonoscopy is a well-established gold standard for diagnosing and preoperative localization of malignant lesions in colorectal cancer. However, with colonoscopy inaccurate tumor localization occurs in 11.3 to 21% of cases [21–23]. Colorectal tumors are increasingly discovered in the early stage through the SVIT screening program, which was implemented over a decade ago. Small tumors are often poorly visible on the serosa, whereas tactile feedback is reduced during laparoscopy. Hence, it is particularly difficult to determine the exact location of smaller flat lesions.

The location of tumors can be determined with preoperative colonoscopy, but in some locations, such as in the transverse colon, it is completely inaccurate, with a reliable tumor site found in only 37.5% [24]. Even lesions that during endoscopy seem to lie in the cecum often proved to be incorrectly located [25]. In one series, the intraluminal measurements from the anocutaneous line onward were incorrect in most patients [26].

Correctly performed preoperative endoscopic tattooing is a safe and effective way of identifying tumors before a laparoscopic resection [27]. Among several methods for preoperative localization of tumors, endoscopic labeling is the most reliable [28]. Placement of endoscopic clips on the mucosa of the colon is also described, followed by X-ray imaging to show the lesion site [29]. However, it has been shown that the clips detach after about 10 days [30]. In a study of 63 patients, it was found that, with preoperative tattooing, tumor localization was successful in 62 (98.4%) patients [31]. Intraoperative colonoscopy as another option significantly extends the surgery time and may reduce visibility during surgery [32]. Preoperative marking is not always successful, and it can make the search for the marked lesions very difficult when done incorrectly. Abbosy reported difficulties with intraoperative identification of pathological changes in 31.5% of patients during a laparoscopic procedure. During histological examinations of the resected tissue, no dye was found in 26.4% of the samples [33].

Preoperative tattooing techniques

Various tattooing techniques are described, among them marking the proximal and distal parts of the lesion, or both. A special challenge arises when a lesion is marked both proximal and distal. If only one marked spot is visible during laparoscopy, the surgeon would assume that the distal part of the lesion is marked, which would lead to inadequate resection. Standard marking with a tattoo 1 to 2 cm distal from the tumor is appropriate for cases where the tumor completely closes the lumen [34,

35]. The lesion must be marked on at least two of the four bowel quadrants because a single tattoo is not always visible during laparoscopy if it lies on the retroperitoneal or on the mesenteric side of the intestine. Marking two or more of the four quadrants ensures that at least one tattoo is visible during surgery. First, 0.5 to 1 ml of saline is injected into the submucosa, and then the infiltrate is injected with the same amount of Spot dye. This technique typically reduces the possibility of intraperitoneal spillage, which may cause difficulties in identifying the tumor, blur the anatomical layers, and consequently hinder the laparoscopic resection. The needle can be left in place while the syringes are changed, avoiding numerous punctures in the gut wall [34, 36, 37].

Which lesions should me marked?

There is no need to mark lesions that have the appearance of benign lesions and benign lesions that are endoscopically removed to healthy tissue. Over-intense marking may cause problems during laparoscopic surgery. The marking decision can be left to the endoscopist, who must mark all lesions with a suspicious appearance. Marking is also important for later endoscopies, when one cannot completely excise small lesions endoscopically, but an additional endoscopic resection is planned [38]. It is not necessary to mark lesions in the cecum if anatomical characteristics such as the entrance to the appendix and the terminal ileum are clearly visible. However, they must be marked if there is any doubt about the localization of the lesion in the right colon [24]. Lesions in the rectum are usually not marked by tattooing during the initial diagnostic endoscopy because most lesions are identified and marked, if necessary, in later rectoscopy. Excessive amounts of dye may reduce the success of planned transanal excision and may lead to resection problems [38]. In the Bretagne study, based on the French screening program, high levels of dysplasia with incidence at 2.8%, 15.5%, and 46.8% with polyp sizes of 5 mm, 6 to 9 mm, and less than 10 mm were found, respectively [39]. Zafar describes a malignant polyp incidence of 0.7%, 2.4%, and 13% for polyp sizes less than 10 mm, 10 to 19 mm, and greater than 19 mm, respectively [40]. Based on these results, it is reasonable to mark all lesions larger than 10 mm. Moreover, it is necessary to consider marking suspicious lesions that are smaller than 10 mm and were not removed completely [38].

Types of ink and potential pitfalls

Ponski and King first described the use of commercial India ink to mark colon lesions in 1975 [41]. Commercial India ink contains stabilization additives to facilitate smooth flow. The additives are propylene glycol, ethylene glycol, sodium tetraborate decahydrate, ammonium hydroxide, surfactant, and gelatin [27]. The most common problem, due to awkward injection, is ink spillage along the abdominal cavity. Botoman described a patient that became febrile after injection of ink, with tension of the abdominal wall and leukocytosis. The patient was treated intravenously with antibiotics. During the procedure, a perforation of the intestine was not found; however, ulcers were found at the site of the biopsy, due to which India ink was not a reliable cause of the patient's problems [42]. Spot dye is a substance approved by the Food and Drug Administration (FDA) and is suitable for marking mucosa. It is a dilute form of India ink that is sterile and does not contain phenol or ethylene glycol. It has been confirmed to be safe and effective both by endoscopy and laparoscopy. No side effects, necrosis, or abscesses caused by the dye have been detected [41]. The most common problems arise when the Spot dye spills across the abdominal cavity. This usually happens when the dye is injected perpendicularly into the wall of the intestine, which can cause adhesion and darkening of the site of the predicted resection. Other dyes such as indocyanine green (ICG) and toluidine blue (TB) are known. Unfortunately, these coloring agents stain the colon only for a few days and are not suitable for patients when the marking and surgery are more than a week apart. The literature also describes individual examples of fat necrosis with the formation of inflammatory pseudotumors, colon abscesses, and localized peritonitis with the use of these dyes [43, 44].

Clinical pathway for endoscopic tattooing

Based on the current literature review, the following advice could be given regarding preoperative endoscopic tattooing:

- Mark only distally from the tumor.
- Mark at least in two places distally from the tumor, 180° apart so as to avoid locations that are not seen during surgery (retroperitoneal or mesenteric).

- The standard marking technique is to first inject saline solution into the submucosa, and then replace the syringes and inject 0.5 to 1 ml of Spot dye into the infiltrate on each side. The needle should be inserted at an angle of 45° and to a depth of 5 mm to ensure infiltration into the submucosa. If the needle is inserted perpendicularly to a depth of 8 mm, it is enough to penetrate the wall of the intestine and cause dye spillage.
- If the anatomical features of the cecum are clearly visible and the endoscopist is certain that they are in the cecum, there is no need for marking with a tattoo. If there is any doubt about the accuracy of the location, the lesion should be marked distally.
- Do not mark the rectum at the initial endoscopy. The surgeon will mark the lesion later, during rectoscopy.
- Avoid over-marking in numerous places during the screening program when polyps are found. Not all benign lesions should be marked, especially small polyps, which are removed completely.
- It is important to record every tattoo.

Conclusion

The standard procedure for endoscopic tattooing prevents confusion during laparoscopic surgery. The key is to enable optimum resection according to all oncological principles by means of marking. Although marking with a tattoo is relatively easy, it can cause problems if done incorrectly.

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Shaping the future of surgery

Acute calculous cholecystitis with complications in octogenarians: is laparoscopic cholecystectomy the method of choice?

Miha Petrič, David Badovinac, Tadeja Pintar, Aleš Tomažič
Department for Abdominal Surgery, University Medical Centre Ljubljana

Correspondence

Aleš Tomažič
ales.tomazic@kclj.si

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acute cholecystitis, octogenarians, laparoscopic cholecystectomy, comorbidities

Original article

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Abstract

Background. Surgical interventions as treatment modalities of acute cholecystitis in an advanced age group of patients with a wide range of comorbidities remain unclear. The high incidence of surgical and non-surgical complications clearly indicates the need for a protocol to avoid possible complications in octogenarians and to reduce the high incidence of mortality and hospital stay. The aim of the study was to evaluate the safety and efficacy of laparoscopic cholecystectomy (LC) in octogenarians with acute cholecystitis or symptomatic gallbladder disease in comparison to open cholecystectomy (OC).

Methods. A retrospective analysis of 160 octogenarians with calculous gallbladder disease was performed; among them, 135 patients had acute cholecystitis and 25 had symptomatic calculous gallbladder disease. The mean age was 84.84 years, and an ASA score of 3 or 4 was observed in 84.5% of patients (109/130).

Results. Laparoscopic cholecystectomy was performed in 99 cases (61.9%), OC was performed in 31 (19.4%) patients, and 30 patients (18.7%) were treated conservatively with an antibiotic-based treatment. The conversion rate in the LC group was 18.2% (18/99). In the emergency group, hospitalization (5.84 vs. 17.06 days) and morbidity (20.7% vs. 35.2%, p = 0.001) were lower with LC compared to OC, although the operation time was longer (62.19 vs. 56.87 min). Two patients (1.5%) suffered a bile duct injury. Emergency LC had lower mortality compared to OC (5.2% vs. 16.1%). None of the patients died in the elective group.

Conclusion. Laparoscopic cholecystectomy is associated with shorter hospitalization and a lower morbidity and mortality rate when compared to OC. As a result, LC should be the method of choice unless absolute contraindication is present in octogenarians with calculous gallbladder disease.

Introduction

Laparoscopic cholecystectomy (LC) is a method of choice in the management of calculous gallbladder disease in the general population [1, 2]. The advantages of this minimally invasive procedure over an open surgical procedure are less postoperative pain, earlier mobilization, less pulmonary function impairment, reduced operative stress, and a shorter hospital stay [3]. Octogenarians often present with several comorbidities such as chronic heart failure, diabetes mellitus, impairment of renal function, and chronic obstructive pulmonary disease, and they are considered high-risk surgical candidates. Open questions in managing octogenarians with acute cholecystitis and related complications result in different clinical practices with insufficient clinical results [2, 4]. This study evaluates the safety and efficacy of LC in octogenarians with acute cholecystitis or symptomatic gallbladder disease.

Methods

Patients

We retrospectively collected data from patients over 80 with acute cholecystitis or symptomatic gallbladder disease that were hospitalized at our institution between September 2013 and September 2015.

The following patient data were recorded: age, sex, ASA classification score, and comorbidities. Comorbidities were divided into cardiovascular disease (arterial hypertension, ischemic cardiac disease, chronic cardiac failure, peripheral arterial occlusive disease, history of a heart attack or heart surgery, or chronic atrial fibrillation), pulmonary disease (chronic obstructive pulmonary disease, emphysema, asthma, or fibrothorax), and renal disease (all stages of renal failure or treatment on hemodialysis). The duration of symptoms in acute cholecystitis, type of treatment, conversions to open surgery, duration of operation, length of hospital stay, postoperative complications, and mortality were also recorded.

Diagnosis of acute cholecystitis was established with clinical examination, laboratory parameters, and abdominal ultrasound. In the case of uncertain diagnosis, a CT scan was performed. In patients with symptomatic calculous gallbladder disease or a history of biliary colic, a clinical examination, laboratory test, and abdominal ultrasound were performed. An endoscopic ultrasound was performed in the case of suspected choledocholithiasis and, if needed, endoscopic retrograde cholangiopancreatography (ERCP) was performed. The type of treatment was determined by a consultant surgeon or during consultation morning meetings. All patients scheduled for surgery were viewed by an anesthesiologist and an ASA classification score was assessed. If necessary, preoperative investigations and procedures (e.g., spirometry, dialysis, and heart ultrasound) were performed. All patients received standard antibiotic treatment according to the accepted national guidelines.

Operative technique

Laparoscopic cholecystectomy was performed using a standard four-port technique (one 12 mm umbilical port, one 10 mm epigastric port, and two 5 mm right subcostal ports). Pneumoperitoneum of 12 mmHg was made with a Veress needle or by an open approach according to the surgeon's preference. If necessary, conversion to an open procedure was performed. A drain was placed according to the surgeon's decision. Open cholecystectomy (OC) was performed with a subcostal incision or using previous surgical incisions. Intraoperative cholangiography was performed in uncertain clinical findings or conditions. Removed gallbladders were sent for histopathological evaluation.

Statistical analysis

Statistical analysis was performed using a chi-square test, Fisher's test for categorical variables, and Student's t-test for the analysis of ordinal variables. Results were considered statistically significant at $p < 0.05$.

Results

In the 2-year period we treated 160 patients over age 80. Among them, 135 patients had acute cholecystitis and 25 patients had symptomatic gallbladder disease. There were more men than women (90 vs. 70). Mean age was 84.84 years. The prevalence of cardiovascular comorbidities was

76.2%, followed by renal (12.5%) and pulmonary (11.2%) comorbidities. The majority of patients were treated with a surgical procedure (130/160; 81.2%). Most of the patients were ASA 3 (76%), followed by ASA 2 (14.7%), ASA 4 (8.5%), and ASA 1 (0.8%). The results are listed in Table 1.

All patients in the emergency group (135) had an ultrasound of the abdomen during the initial examination. A CT scan was used in only 7.4% of the patients (10/135). Fifteen patients underwent ERCP with endoscopic papillotomy (EPT) (15/135; 11.1%). In three patients ERCP with EPT was the only intervention needed, and 12 had subsequent surgical intervention. The duration of symptoms in the emergency group is listed in Table 2.

Overall in the emergency group, LC was performed in 74 patients (74/135; 54.8%) with conversion to an open procedure in 16 patients (21.6%). No difference between sex (p = 0.774), duration of symptoms (p = 0.624), or ASA score (p = 0.897) was observed between the LC and the conversion group. An open procedure was performed in 31 patients (31/135; 23%). There was no statistically significant difference between sex (p = 0.629), duration of symptoms (p = 0.273), or ASA score (p = 0.407) among different treatment modalities. In the emergency group, we started antibiotic-based conservative treatment in 46 patients (46/135; 34.1%). Failure of conservative treatment resulted in subsequent surgical intervention in 16 patients (16/46; 34.8%). Nine patients (9/16; 56.2%) from the failure group had a successful LC performed, and in two cases (2/11; 18.2%) a conversion to OC was needed. A successful conservative treatment was achieved in 30 patients (30/135; 22.2%). The treatment modalities and results are listed in Table 3.

Operation time in emergency LC was longer (62.19 minutes) compared to OC (56.87 minutes) and shorter compared to the conversion group (96.63 minutes). Hospitalization after LC was 5.84 days, followed by the conversion group and OC (11.3 and 17.06 days, respectively). Postoperative morbidity was lowest in emergency LC (20.7%), followed by the OC and the conversion group (35.2% and 43.8%, respectively). Statistical analysis confirmed a statistical significance between different types of operation and postoperative complications (p = 0.001). The ASA score and postoperative complications showed no correlation (p = 0.08). Types of complications according to the Clavien–Dindo classification are listed in Table 4. There were two patients with bile duct lesions in LC (2.7%). The duration of the symptoms was not related to bile duct lesion (p = 0.213).

Thirty-day mortality was higher in the OC group (five patients; 16.1%) compared to the LC group (three patients; 5.2%). Comparing the conservatively treated emergency group to the surgically treated emergency group, the mortality rates were similar (three patients; 10% vs. 10 patients; 9.5%). There was no significant association between ASA score and 30-day mortality (p = 0.304).

Table 1. Patients' demographic data.

Parameter	Value
Total number of patients	160
Emergency cases (n, %)	135 (84.4%)
Symptomatic disease (n, %)	25 (15.6%)
Sex (n, %)	
Male	90 (56.3%)
Female	70 (43.7%)
Age (mean ± SD)	84.84 ± 3.788
Comorbidities (n, %)	
Cardiovascular	122/160 (76.2%)
Pulmonary	18/160 (11.2%)
Renal	20/160 (12.5%)
ASA (n, %)	
1	1/130 (0.8%)
2	19/130 (14.7%)
3	98/130 (76.0%)
4	11/130 (8.5%)

Table 2. Duration of symptoms in the emergency group. All values are expressed as the number and percentage of patients.

Duration	Value
0–24 h	38/135 (28.2%)
25–48 h	28/135 (20.8%)
49–72 h	23/135 (17.0%)
73–96 h	5/135 (3.7%)
> 96 h	16/135 (11.8%)
Unknown	25/135 (18.5%)

Table 3. Treatment modalities and results. uLC = urgent laparoscopic cholecystectomy, uLCc = urgent laparoscopic cholecystectomy with conversion to open cholecystectomy, uOC = urgent open cholecystectomy, eLC = elective laparoscopic cholecystectomy, eLCc = elective laparoscopic cholecystectomy with a conversion to open cholecystectomy.

Treatment category	Conservative	uLC	uLCc	uOC	eLC	eLCc
n (%)	30 (22.2%)	58 (43.0%)	16 (12.0%)	31 (23.0%)	23 (17.1%)	2 (1.5%)
Surgery duration (minutes)	–	62.19	96.63	56.87	46.09	107.5
Hospital stay (days)	6.2	5.84	11.31	17.06	3	13
Postoperative complications n (%)	–	12 (20.7%)	7 (43.8%)	19 (35.2%)	3 (13%)	1 (50%)
Surgical complications n (%)	–	3/58 (52%)	1/16 (6.2%)	4/31 (12.9%)	0 (0%)	0 (0%)
Bile duct lesions n (%)	–	2/74 (2.7%)	– (0%)	0/31 (0%)	0/25	–
Overall mortality in acute cholecystitis n (%)	3	10 (10%)	(9.5%)			

Table 4. Surgical complications using the Clavien–Dindo score system in the observed cohort group. All values are expressed as the number of patients and their percentages. CD = Clavien–Dindo classification, uLC = urgent laparoscopic cholecystectomy, uLCc = urgent laparoscopic cholecystectomy with conversion to open cholecystectomy, uOC = urgent open cholecystectomy, eLC = elective laparoscopic cholecystectomy, eLCc = elective laparoscopic cholecystectomy with a conversion to open cholecystectomy.

CD	uLC	uLCc	uOC	eLC	eLCc
Grade I	5 (8.5%)	1 (6.2%)	1 (3.1%)	0 (0%)	0 (0%)
Grade II	5 (8.5%)	4 (25%)	13 (40.3%)	2 (17.4%)	1 (8.7%)
Grade IIIa	3 (5.1%)	2 (12.4%)	6 (18.6%)	0 (0%)	0 (0%)
Grade IIIb	3 (5.1%)	1 (6.2%)	4 (12.4%)	0 (0%)	0 (0%)
Grade IVa	1 (1.7%)	1 (6.2%)	0 (0%)	0 (0%)	0 (0%)
Grade IVb	2 (3.4%)	0 (0%)	5 (15.5%)	0 (0%)	0 (0%)
Grade V	2 (3.4%)	1 (6.2%)	4 (12.4%)	0 (0%)	0 (0%)

In the elective group, all the patients were treated with LC, with a conversion rate of 8% (2/25). In one patient, conversion to an OC was performed due to Mirizzi syndrome and the second patient was intraoperatively diagnosed with gallbladder cancer. The average hospital stay was 3 days for the LC group and 13 days for the conversion group. Morbidity was lower in the elective LC group (3/23; 13%) compared to emergency LC. There was no statistical significance between the types of operation and postoperative complications in the elective group ($p = 0.300$). None of the patients died in the elective group.

We found a longer operative time in the acute laparoscopic group compared to the elective laparoscopic group (65.02 minutes vs. 46.09 minutes, $p = 0.008$) and a shorter hospital stay in the elective group (3.39 days vs. 5.84 days, $p = 0.037$). No significant difference in postoperative complications ($p = 0.537$) and bile duct lesions ($p = 0.999$) between the acute and the elective laparoscopic group was observed. There was also no statisti-

cally significant difference in the mortality rates (3/58 vs. 0/23; p = 0.588).

Discussion

Laparoscopic cholecystectomy is accepted in the surgical community as a gold standard for treating calculous gallbladder disease [1, 2]. It is feasible and safe in elective or acute settings. Reduced postoperative pain, early mobilization, lower incidence of surgical site infection, and less pulmonary function impairment result in earlier return to normal daily activities [3]. The literature is mostly inconclusive on whether early cholecystectomy is preferred over delayed cholecystectomy. Most studies have shown that early LC in an acute setting is feasible and safe [5, 6]. In his report, Gutt argues that LC should be offered up to 10 days after the beginning of symptoms [4]. Other studies show that earlier surgery is associated with a shorter hospital stay and fewer complications [7, 8].

Special considerations are needed in patients over 80. Octogenarians frequently have associated cardiac, pulmonary, metabolic, or renal comorbidities. Older patients also tend to have long histories of calculous gallbladder symptoms, which results in chronic inflammation and scarring. Reports from the literature show a higher incidence of severe complication of calculous gallbladder disease in the elderly (11.4–69%) such as gangrenous inflammation, empyema, or xanthogranulomatous inflammation [9]. Compared to a younger population, morbidity (38.3% vs. 17.6%, OR 2.39) and mortality (3.2% vs. 0.4%, OR 5.91) are higher in this group of patients in any type of treatment [10]. Historically, older and/or high-risk patients were treated conservatively or an open cholecystectomy was performed [11, 12]. Despite evidence that LC is associated with lower morbidity and mortality rates, and lower cardiac and respiratory complications compared to OC, still up to 55% of octogenarians with acute cholecystitis are treated with OC [13, 14]. In the last decade, there has been growing momentum in the surgical community for a laparoscopic approach in octogenarians in an acute setting [14–16]. Reports from the literature show that LC is feasible and safe even in high-risk patients with symptomatic calculous gallbladder disease or complicated calculous gallbladder disease [2, 10, 13, 15]. Laparoscopic cholecystectomy is shown to be superior to any other treatment modality, including OC, percutaneous cholecystostomy, or conservative treatment [2]. This was also confirmed by our results. Patients treated with LC had shorter hospitalization compared to the open procedure (5.84 vs. 17.06 days) with lower morbidity (20.7% vs. 35.2%, p = 0.001). Looking specifically at the surgical complications, LC is again superior to OC (3/58 (5.2%) vs. 4/31 (12.9%)).

There are several main concerns with the laparoscopic approach. First, there is a high conversion rate in older and high-risk patients. Reports in the literature show conversion rates between 5 and 27.2% in high-risk patients [9, 10, 17, 18]. The main reason is chronic inflammation, which causes scarring of Calot's triangle [19, 20]. Another reason for conversion is a higher incidence of intraoperative bleeding as well as a higher degree of gallbladder inflammation. In our study, the overall conversion rate was 18.2% (18/99). In the emergency group, conversion to OC was performed in 21.6% of the patients (16/74). The conversion rate is relatively high but comparable to other published results. One of the possible reasons for the high conversion rate in our cohort is that, unless an absolute contraindication was present (septic shock, or severe cardiac or severe pulmonary comorbidity), we always started with a laparoscopy. In unclear circumstances (adhesions, severe inflammation, bleeding, or anatomical difficulties), we converted to an open procedure. The other reason is that the majority of patients were operated on by younger surgeons, who had limited experience in the advanced laparoscopic approach and are more prone to conversion. Conversion to an open procedure is not associated with a substantial increase in morbidity and mortality, and it should always be considered as an alternative [21]. According to the World Society of Emergency Surgery (WSES) guidelines. conversion is recommended in cases of severe inflammation, adhesions, or bleeding in Calot's triangle, or when bile duct injury is suspected [2].

Another concern is bile duct injuries. Initial reports showed a higher incidence of bile duct injury in LC when compared to the open procedure (0.85% vs. 0.30%) in the general population. This was, however, probably associated with the initial development of the laparoscopic technique and a lack of experience. Recently published data suggest that in the general population the incidence of bile duct injury is similar or even lower with LC compared to the open procedure (0.3–0.6%). In

our study we had two (2/130, 1.5%) bile duct lesions. In the first patient, a lesion of the common bile duct was suspected intraoperatively and conversion to an open procedure was performed. Exploration showed that the common bile duct was transected without any defects in its length. End-to-end anastomosis of the bile duct with a T-drain was performed. In the second patient, a bile duct lesion was suspected because of bile drainage on the second postoperative day. Only the distal part of the common bile duct was seen upon ERCP. During an open exploration, a lesion of the common bile duct was found with a 2 cm long defect. A reconstruction with a Roux-en-Y loop was performed. The postoperative period was uneventful in both cases. Patients with bile duct lesions were primarily operated on by an experienced surgeon. In the first case, the surgeon reported severe inflammation and scarring in Calot's triangle with subsequent anatomical misinterpretation of the bile duct. In the second case, the report of LC was uneventful. Our incidence of bile duct lesions is higher compared to the published data. Comparison is difficult, however, because of our small group of patients and because they were markedly old. Data regarding bile duct lesions in octogenarians are lacking in the literature. From the reports available, it seems that bile duct injury occurs more often in markedly old patients. Hazzan and Sang-Ill Lee reported an incidence of 1.5% [16, 22]. Longstanding gallstone disease with chronic inflammation and consequently scarring of Calot's triangle combined with a higher incidence of severe complication of calculous gallbladder disease makes this population more vulnerable to possible bile duct injury.

Most octogenarians have impaired lung or heart functions. At the beginning of the laparoscopic era, there were concerns about the effects of pneumoperitoneum using carbon dioxide and subsequent respiratory functions. However, recent reports conclude that LC has less impact on postoperative lung function and is favored over OC, even for patients with relatively deranged lung function [23]. One of the main reasons for this is probably lower postoperative pain and early mobilization after laparoscopic treatment. Under the defined circumstances, lower intraabdominal working pressure can permit a safe operation that is not time consuming. The approach described is important and can be reflected in cardiovascular and respiratory functions after surgery (i.e., reduced complications). Even though an open approach is more frequently used in patients with chronic heart failure, laparoscopy seems to offer a safe alternative in appropriately selected patients [24].

Higher morbidity and mortality in octogenarians are usually a consequence of aggravated systemic inflammation response and deterioration of comorbidities with low physiological reserve. Machado et al. showed that elderly patients develop an exaggerated inflammatory response after surgery due to their proinflammatory status [25]. The overall mortality rate in our study was 9.5% (10/105) in the emergency group of patients that were treated surgically. This is a relatively high incidence and is probably a consequence of a patient population in worse health with numerous associated comorbidities. This statement is supported by mortality in the conservative group (3/10; 10%) and no mortality in the elective group of patients. The main reason for mortality in our study population was the development of multiple organ failure (6/13; 46.2%) as a consequence of exaggerated inflammatory response with a subsequent cardiorespiratory failure.

As already mentioned, there are several alternatives to operative treatment. One of them is percutaneous cholecystostomy (PC), which is a treatment of choice at some centers for very old patients with comorbidities and acute gallbladder disease. Viste et al. published the results of 104 percutaneous cholecystostomies in high-risk patients with acute cholecystitis [26]. The majority (82.7%) of patients had calculous cholecystitis. The study showed that PC in high-risk patients is feasible, with minimal complication rates and acceptable morbidity and mortality (3.6%). However, PC does not offer a definitive resolution of the problem, and only 30% of the patients had a subsequent cholecystectomy. Up to a quarter of patients were readmitted because cholecystitis recurred or other biliary problems arose [27]. Currently, PC offers a bridging therapy to cholecystectomy in severe cholecystitis in high-risk patients. After relief of symptoms, a cholecystectomy should be offered. The success rate of LC (94.1%) after PC is acceptable, and conversion rates could be lowered by performing LC as early as possible [28, 29], which is also confirmed with our own experience.

The next treatment modality is antibiotic-based conservative treatment. However, this type of treatment is associated with a high recurrence rate, and up to 23% of patients need an emergen-

cy operation because conservative treatment fails [2]. There are several known predictors for failure of conservative treatment. Patients older than 70 with diabetes and a distended gallbladder should be considered for early cholecystectomy [30]. Failure of conservative treatment with subsequent surgical intervention in our study was 34.8% (16/46). This group consisted of patients with an early stage of cholecystitis or patients with severe comorbidities. One of the patients in this group died (5.9%; 1/16) after surgical intervention due to sepsis and multiple organ failure. Close surveillance is needed, and signs of clinical deterioration demand rapid surgical intervention. Antibiotic treatment should be prompt and based on clinical presentation, concomitant diseases, and data on colonization from previous hospitalization.

Data from Trust et al. show that patients benefit from cholecystectomy as a definitive treatment modality [31]. Older patients with biliary pancreatitis that underwent cholecystectomy had better 2-year survival compared to the no-cholecystectomy group. The readmission rate was 44% for biliary complications compared to 4% in the cholecystectomy group. Gallstone pancreatitis was the reason for readmission in 48% of cases, whereas 52% of patients were readmitted for other gallstone-related complications. This study concluded that elderly patients should be offered a cholecystectomy unless there are absolute contraindications for the procedure. The timing of surgery is another important factor of influence.

Finally, we should mention the main drawback of our study. Its retrospective nature without randomization does not offer high-grade quality of evidence. However, our data support the current clinical practice of performing LC in elderly patients with complicated calculous gallbladder disease.

Conclusions

Our study shows that LC is associated with shorter hospitalization and lower morbidity and mortality rates when compared to OC. This confirms the published data regarding the safety and feasibility of the laparoscopic approach in octogenarians with symptomatic or complicated calculous gallbladder disease. Conversion to an open procedure is mandatory in cases of severe inflammation, adhesions, or bleeding in Calot's triangle to avoid bile duct injuries. Another important conclusion is the need to develop a standardized clinical evaluation and urge a prompt decision in elderly patients with complicated calculous gallbladder disease. Large randomized controlled trials are necessary to establish a proper treatment algorithm in this group of patients.

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The impact of modifying the laparoscopic lymphadenectomy technique on the extent of lymphadenectomy in laparoscopically operated gastric cancer patients. A single-center study.

Tomaž Jagrič
Department for Abdominal and General Surgery, University Medical Centre Maribor

Correspondence

Tomaž Jagrič
tomaz.jagric@gmail.com

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Abstract

Background. When we introduced laparoscopic surgery for gastric cancer at our center, we felt that the lymphadenectomy was insufficient for implementation of laparoscopic surgery in locally advanced gastric cancer patients. In order to refine our method, we modified our technique. We analyzed the results of the modified technique to determine whether laparoscopic gastrectomies could potentially be applied in locally advanced gastric cancer.

Methods. From 2015 onward, 23 patients were laparoscopically operated on for gastric cancer. Patients were divided into two groups depending on the method of laparoscopic lymphadenectomy. Seven patients were included in the first period (P1). In the second period (P2), the lymphadenectomy technique was modified. Sixteen patients were included in P2.

Results. The number of lymph nodes extracted was significantly higher in P2 (11.8 ± 8.3 lymph nodes in P1 vs. 22.9 ± 10.6 lymph nodes in P2; $p = 0.036$). The duration of the operation and the duration of the hospitalization were similar in both periods. The complication rate rose significantly in P2 ($p = 0.027$). The TNM distribution also changed significantly in P2 ($p = 0.049$). Whereas most of the operated patients in P1 had either GIST (28.6%) or pT1a adenocarcinoma (28.6%), most patients in P2 had pT3 adenocarcinoma (43.8%).

Conclusion. Although the observation time is too short for evaluation of long-term results, we believe that in the case of early and locally advanced gastric cancer laparoscopic gastrectomy is a viable alternative in selected patients and in the hands of experienced surgeons.

Introduction

The introduction of laparoscopy in recent years has shown many potential benefits such as faster postoperative recovery, shorter hospital stay, better cosmesis, and better quality of life [1–3]. Many centers would like to translate these benefits to gastric cancer patients. Despite growing experience, laparoscopy has only slowly been implemented for gastric cancer treatment [1–11]. The introduction of laparoscopy in treating gastric cancer patients has encountered some obstacles. The reconstruction of an esophago-jejunostomy is very demanding and can be performed safely only by surgeons skilled in laparoscopy [12]. Even more so, a D2 lymphadenectomy is extremely challenging. Therefore, laparoscopic gastrectomies were first introduced for distal early gastric cancer, in which less challenging gastro-jejunostomy and less extensive lymphadenectomy removing only perigastric lymph nodes are performed [1]. It rapidly gained popularity, especially in Asian centers, where randomized controlled studies clearly confirmed benefits for laparoscopic distal subtotal gastrectomies compared to open surgery. Consequently, laparoscopic distal subtotal gastrectomy is now acknowledged as standard care in Japanese guidelines [3, 13]. The cornerstone of therapy for locally advanced gastric cancer, however, is extensive lymphadenectomy that eradicates all potential metastatic lymph nodes. Therefore, a D2 lymphadenectomy for all stages of gastric cancer except for early gastric cancer is recommended in gastric cancer guidelines [13]. Extensive laparoscopic D2 lymphadenectomy presents a considerable challenge to date even for experienced laparoscopists [6, 9].

Laparoscopic gastrectomies were introduced at our center in 2015. Similar to other centers, this technique was at first reserved for patients with early distal gastric cancer. The lymphadenectomy of stations 4sb, 5, and 2a in particular has been insufficiently performed. Dissatisfied with the extent of the lymph node (LN) clearance, we were reluctant to implement laparoscopic surgery for locally advanced gastric cancer patients. In order to refine our method, we modified our technique as proposed by Huang et al. [14]. This article reports our results using the modified technique to determine whether laparoscopic gastrectomies could potentially be applied in locally advanced gastric cancer.

Methods

Patients

Since 2015, 23 patients have been laparoscopically operated on for gastric cancer. These patients were included in our study. All patients had histologically verified adenocarcinoma of the stomach or a gastrointestinal stromal tumor of the stomach. The preoperative workup included upper gastrointestinal endoscopy, abdominal ultrasound, chest X-ray, endoscopic ultrasound for early lesions (T1a = tumor involving the lamina mucosa, T1b = tumor involving the lamina submucosa), abdominal CT for locally advanced gastric cancer (T2 or higher = tumor infiltrating beyond lamina muscularis propriae), chest CT for tumors infiltrating the upper third of the stomach, or suspicion of mediastinal or pulmonary metastases.

Patients were discussed at a multidisciplinary board meeting, where the decision was made whether patients should receive preoperative chemotherapy or not. Patients without contraindications for laparoscopy were considered for laparoscopic resection. Patients with tumors infiltrating other organs, extensive retroperitoneal lymphadenopathy, or morbidly obese patients were considered unfit for laparoscopic resection. All laparoscopic operations were carried out by the same surgeon (TJ), who is experienced in laparoscopy for gastric cancer. All patients gave their informed consent before the operation. Patients were divided into two groups depending on the method of the laparoscopic lymphadenectomy. In the first period (P1), lymphadenectomy was performed similarly as in open surgery. Seven patients were included in P1. In the second period (P2), the lymphadenectomy technique was modified. Sixteen patients were included in P2.

The tumor stages, locations, duration of the procedure, number of LNs extracted, BMI, time to first stool passage, and duration of intravenous analgesic treatment were noted. All data were stored prospectively in a hospital database. The patients gave their written consent. The study was approved by the local ethics committee.

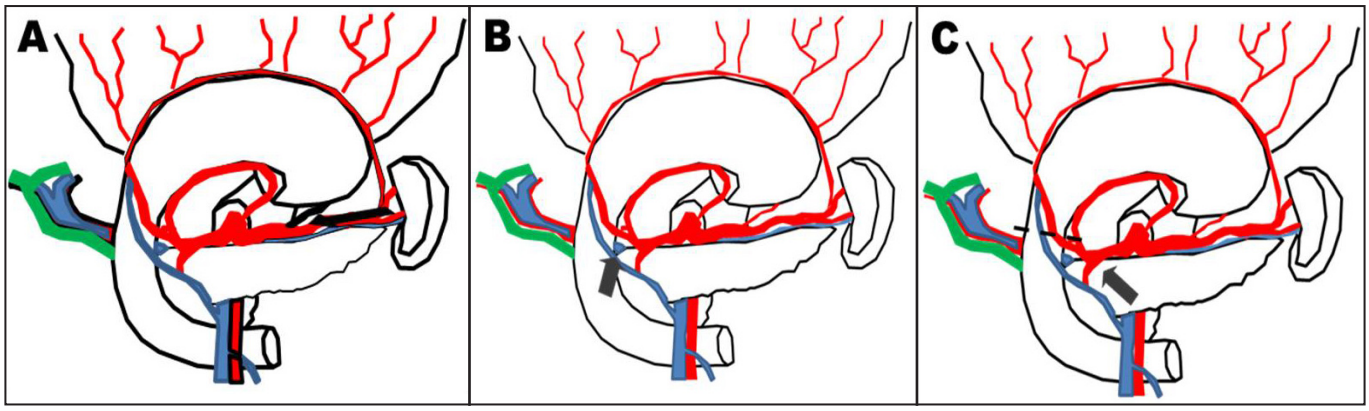

Figure 1. Surgical steps of the modified laparoscopic lymphadenectomy. A) The lymphadenectomy starts on the left with dissection of the left gastroepiploic artery. The surgeon follows the splenic vein toward the splenic hilum and dissects the left gastroepiploic vein and artery at their origin. This is the starting point for the lymphadenectomy of the distal part of the splenic artery. B) The dissection moves toward the right. Over the head of the pancreas, the distal part of the gastroduodenal artery, right gastroepiploic artery, and vein are dissected. C) After duodenal transection, traction is exerted on the hepatogastric ligament over the right gastric artery.

Surgical technique for laparoscopic lymphadenectomy

Since 2015, 23 patients have been laparoscopically operated on for gastric cancer. Patients with tumors in the distal third of the stomach or well-differentiated tumor histology underwent a distal subtotal gastrectomy providing that sufficient macroscopic margins could be obtained (6–8 cm). Patients with tumors located in the middle third received a total gastrectomy. A side-to-side anastomosis using an Endo GIA 60 mm linear stapler was performed for reconstruction after distal subtotal gastrectomy. The opening was closed with a continuous 3-0 vicryl suture. Reconstruction after total gastrectomy was a side-to-side anastomosis, using Endo GIA linear stapler anastomosis. The opening was closed with a continuous 3.0 vicryl suture. In two patients, the surgeon was not satisfied with the esophago-jejunal anastomosis, and therefore laparoscopically assisted circular 25 mm stapled anastomosis was performed through a small midline incision. In one patient a proximal subtotal gastrectomy was performed. The reconstruction was performed using a transorally inserted anvil with an OrVil circular stapler. In this case, an esophago-gastrostomy was fashioned.

In the first seven cases, lymphadenectomy was performed in a similar fashion as in open surgery. Usually a monopolar hook was used for the LN dissection. The dissection started with the dissection of the hepatoduodenal ligament. After the clearance of the LN on the anterior side of the proper hepatic artery, the origin of the right gastric artery was dissected. Once the origin of the right gastroepiploic artery was dissected, the duodenum was transected and the lymphadenectomy was carried out toward the coeliac axis. The left gastric vein and artery were clipped and transected. The final stages were the dissection of the left gastroepiploic artery and short gastric arteries.

The modified technique was carried out as suggested by Huang et al. [14] in 16 patients. The dissection began in reverse order starting with the opening of the gastrocolic ligament and the mobilization of the splenic flexure of the colon. The left gastroepiploic artery was dissected at the origin of the distal splenic artery. The dissection continued toward the greater curvature with the clipping of the short gastric arteries. The next step was the dissection of the distal part of the splenic artery continuing toward the tripus coeliacus. Moving toward the right, the distal part of the gastroduodenal artery was dissected and followed toward the origin of the right gastroepiploic artery and vein. The dissection was continued above the gastroduodenal artery, exposing the distal part of the common hepatic artery, the proper hepatic artery, and the right gastric artery retroduodenally. Afterward, the duodenum was transected. Pulling

the preserved right gastric artery, traction was exerted on the hepatoduodenal ligament, allowing safer and more precise dissection of the hepatoduodenal ligament. Before the dissection of the posterior LN around the portal vein, the right gastric artery was clipped. Finally, the common hepatic artery was dissected and clipping of the left gastric artery and vein was performed. The sequence of the steps is depicted in Figure 1.

Statistical analysis

Continuous data are expressed as means ± SD and median ± IQR, and categorical variables are given as percentages. The Shapiro–Wilk test was used to determine whether the continuous data were normally distributed. Comparisons of continuous variables were carried out with Student's t-test for parametric data and the Mann–Whitney U test for nonparametric data. A chi-square test was used for comparisons of discrete variables. SPSS version 20 for Windows 10 and Microsoft Excel 2010 for Windows were used for the statistical analysis.

Results

Clinicopathological characteristics

The clinicopathological characteristics are presented in Table 1. The patients operated on laparoscopically had a mean age of 67.9 ± 10.6 years, 47.8% were male, and 52.2% were female. Most of the patients had minor comorbidity, and 21.7% of them had more than one accompanying disease. The BMI was above normal in most of the operated patients, and the average BMI was 24.8 ± 3.8 kg/m^2. Most of the patients had a pT3 tumor (30.4%), followed by pT1b (21.7%). The average number of LNs extracted per operation was 19.7 ± 11.1. The majority of the patients had a pN0 disease (65.2%). The average hospital stay was 15.8 ± 18.1 days.

Comparison of two periods of laparoscopic lymphadenectomy

Of the 23 laparoscopic patients, seven were operated on in P1 and 16 in P2. The characteristics of the patients from both periods are presented in Table 2. Patients were comparable with regard to

Table 1. Clinicopathological characteristics of laparoscopic patients for gastric cancer. LN = lymph node.

Variable	Value
Age	67.9 ± 10.6 years
Sex	
Male	47.8%
Female	52.2%
BMI (kg/m^2)	24.8 ± 3.8
Days to passage of stool	3.6 ± 1
Days of intravenous analgesics	4.5 ± 1
ASA (n, %)	
I	6 (26.6%)
II	10 (47.6%)
III	5 (23.8%)
T stage (n, %)	
Benign	3 (13%)
T1a	5 (21.7%)
T1b	3 (13%)
T2	3 (13%)
T3	7 (30.4%)
T4a	2 (8.7%)
N stage (n, %)	
N0	15 (65.2%)
N1	2 (8.7%)
N2	4 (17.4%)
N3	2 (8.6%)
Number of harvested LNs	19.7 ± 11.1
Number of positive LNs	2 ± 4
Hospital stay (days)	15.8 ± 18

Table 2. Comparison of patients operated on before and after modification of laparoscopic lymphadenectomy. P1 = first period, P2 = second period, NS = non-significant, LN = lymph node.

Variable	P1	P2	p
Age (years)	69.3 ± 10.5	67.3 ± 11	NS
Sex (n, %)			
Male	2 (28.6%)	9 (56.2%)	NS
Female	5 (71.4%)	7 (43.8%)	
BMI (kg/m^2)	25.3 ± 5.6	24.4 ± 2.8	NS
Days to passage of stool	4 ± 1.2	3.4 ± 0.9	NS
Days of intravenous analgesics	4.6 ± 0.9	4.4 ± 1.5	NS
ASA (n, %)			
I	1 (14.3%)	5 (35.7%)	NS
II	4 (57.1%)	6 (42.9%)	
III	2 (28.6%)	3 (21.4%)	
T stage (n, %)			
Benign	2 (28.6%)	1 (6.2%)	
T1a	2 (28.6%)	3 (18.8%)	
T1b	0 (0%)	3 (18.8%)	p = 0.049
T2	2 (28.6%)	1 (6.2%)	
T3	0 (0%)	7 (43.8%)	
T4a	1 (14.3%)	1 (6.2%)	
N stage (n, %)			
N0	6 (85.7%)	9 (56.2%)	
N1	0 (0%)	2 (12.5%)	NS
N2	1 (14.3%)	3 (18.8%)	
N3	0 (0%)	2 (12.5%)	
Number of harvested LNs	11.8 ± 8.4	22.9 ± 10.6	p = 0.027
Number of positive LNs	0.6 ± 1.5	2.7 ± 4.7	NS
Hospital stay (days)	10.7 ± 6.2	18.2 ± 21.4	NS
30-day mortality (n, %)	0 (0%)	0 (0%)	NS
Complications (n, %)			
No	5 (71.4%)	10 (62.5%)	NS
Yes	2 (28.6%)	6 (37.5%)	

age, comorbidities, sex, and BMI in both periods. The number of LNs extracted, however, was significantly higher in P2 (p = 0.036). The number of LNs extracted was 11.8 ± 8.3 in P1, compared to 22.9 ± 10.6 in P2. Even though the lymphadenectomy was more extensive, the duration of the operation and the duration of the hospitalization were similar in both periods. However, there were more complications in P2 (p = 0.027). The TNM distribution also changed significantly in P2 (p = 0.049). Whereas most of the operated patients in P1 had either a gastrointestinal stromal tumor (28.6%) or pT1a adenocarcinoma (28.6%), most patients in P2 had pT3 adenocarcinoma (43.8%).

Discussion

Laparoscopic gastrectomy was introduced in 1991 by Kitano et al. [11], but the technically demanding nature of esophago-jejunal reconstruction and especially laparoscopic lymphadenectomy have stood in the way of wider use of laparoscopy for gastric cancer patients. Laparoscopic gastrectomy is mainly performed at high-volume centers by experienced surgeons, where the first results have shown that this operation confers many functional advantages compared to open surgery [1–11]. Many surgeons are still struggling with laparoscopic D2 lymphadenectomies. They therefore settle for a less extensive lymphadenectomy and for patients with early gastric cancer in whom a more conservative surgical approach can be taken. However, the undoubtedly better functional results should not outweigh the importance of precise lymphadenectomy. Although a modified lymphadenectomy suffices for early gastric cancer, patients with advanced gastric cancer can only be cured with a D2 lymphadenectomy.

When we introduced laparoscopy for gastric cancer at our center in 2015, we had doubts about the adequacy of the laparoscopic lymphadenectomy. Hence, we only used this approach for early gastric cancer patients. In our opinion, especially the dissection of the hepatoduodenal ligament, the common hepatic artery, and the left gastroepiploic artery were insufficient to safely use laparoscopy for locally advanced gastric cancer patients. To improve the lymphadenectomy, we adopted a technique for laparoscopic lymphadenectomy that was advocated by Huang et al. [14] and has been used in many centers across Asia [6, 9, 14]. In this article we evaluated whether this modification of laparoscopic lymphadenectomy has yielded the desired improvement in lymphadenectomy quality.

The patients selected for laparoscopy were not subjected to any selection; therefore they had the same clinical and pathological characteristics as patients operated on with open surgery. We consider this an advantage of our study because, with this selection bias eliminated, the results have a greater weight. The patients in our study are therefore characteristically similar to patients operated on with open surgery. Even so, the duration of hospitalization and the duration of the operation were found to be comparable to other centers performing laparoscopic and open surgery [1–11]. Our experience was that patients recovered extremely well after laparoscopic gastrectomies and were satisfied with the functional results.

The main question of our analysis was whether the lymphadenectomy could be made more efficient by modification of the laparoscopic technique. Therefore, we compared the number of LNs extracted before and after the modification of lymphadenectomy. The results confirmed that the average number of lymph nodes extracted was significantly higher after the modification of the technique. Moreover, the average number of LNs extracted was similar to the number defined by the seventh TNM classification as D2 lymphadenectomy [15]. Regardless of the number of the LNs extracted per operation, an even more important factor of lymphadenectomy quality is the anatomical completeness of the LN station removal defined as D2 lymphadenectomy in the revised Japanese classification [13]. During the operation, the clearance of each LN station was video documented, which was clearly mirrored by the more efficient LN yield. We successfully extracted all LN stations defined as the D2 lymphadenectomy.

The better lymphadenectomy quality in P2 did not prolong the operation times compared to P1. This is a testimony to the proficiency of the modified technique, which uses the ability of laparoscopy to work in confined spaces and magnification to its advantage. The more aggressive LN dissection, however, resulted in a moderate rise in the morbidity rates in P2. Although the mortality was similar in both periods, the rise in morbidity is surely attributed to the learning curve phenomenon. With more operations we will become more skilled

and the rate of complications will eventually be similar to open surgery.

The main drawback of this study is the small number of patients included and the non-randomized nature of the study. Although we agree that the small number of patients is insufficient to allow a definite evaluation of the modified laparoscopic lymphadenectomy technique, it clearly shows an improvement of the laparoscopic gastrectomy technique that can be achieved even at a less experienced center. Although the observation time is too short to evaluate the long-term results, we believe that for early and locally advanced gastric cancer laparoscopic gastrectomy could be a viable alternative in selected patients and in the hands of experienced surgeons.

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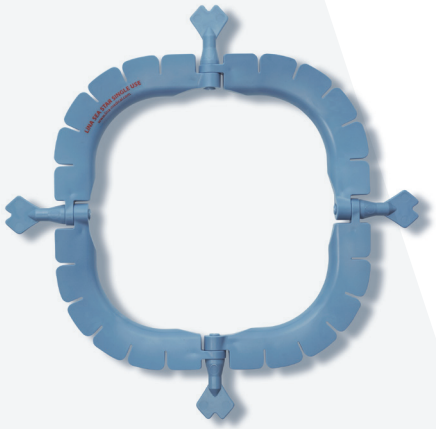

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A surgical technique for providing peritoneal dialysis access at the University Medical Center Ljubljana

Jurij Janež
Department for Abdominal Surgery, University Medical Centre Ljubljana

Correspondence

Jurij Janež
jurij.janez@kclj.si

Key words

end-stage renal disease, peritoneal dialysis, peritoneal dialysis catheter insertion, laparoscopy

Original article

SURGERY SURG ENDOS 2019;1: 1-

Abstract

Background. Dialysis is becoming more common as the number of patients with end-stage renal disease increases. Two main modalities of dialysis are hemodialysis and peritoneal dialysis. Continuous ambulatory peritoneal dialysis has been used as a major renal replacement therapy since the early 1980s.

Methods. This article presents a brief review of current peritoneal dialysis catheter placement techniques, such as the open surgical technique, peritoneoscopic technique, blind percutaneous technique, and laparoscopic technique. Peritoneal dialysis has several advantages over hemodialysis, such as increased patient mobility, fewer dietary restrictions, improved preservation of residual kidney function, and no required systemic anticoagulation. An important aspect for successful peritoneal dialysis is to provide quality peritoneal dialysis access.

Conclusion. At our institution, laparoscopic insertion of a peritoneal dialysis catheter has become a standard method for providing peritoneal dialysis access in adults.

Introduction

Continuous ambulatory peritoneal dialysis (CAPD) is a validated and generally accepted alternative method to hemodialysis (HD) for treating patients with end-stage renal disease (ESRD). A very important aspect for successful peritoneal dialysis (PD) is the presence of a functioning PD catheter that allows adequate inflow and outflow of the dialysate solution [1]. In 1959, Richard Ruben was the first to use PD successfully in a patient with ESRD for 6 months. In 1968, Henry Tenckhoff developed the PD catheter, which was inserted with an open surgical technique. PD was later popularized by Popovich and Moncrief, who developed the concept of CAPD. Several advantages of PD over HD have been described, including better quality of life due to patient mobility and independence, its simplicity of use, maintenance of resid-

ual renal function, and lower mortality in the first years after the beginning of PD [2].

Types of peritoneal dialysis catheters

Most PD catheters are made of silicone, but some of them are made of polyurethane (e.g., the Cruz catheter). The advantage of silicone is reduced irritation to the peritoneum; however, polyurethane catheters are stronger and can thus be thin-walled with larger lumens [3]. At our institution we use straight Tenckhoff PD catheters with a coiled tip and two Dacron cuffs (Figure 1). The PD catheter can be divided into three segments. The intraperitoneal segment is the part of the PD catheter lying within the peritoneal cavity. The intramural segment is the segment between both cuffs and is located within the abdominal wall. The external segment is located outside the abdominal wall (Figure 2). The cuffs induce a local inflammatory response and tissue fibrosis that serve to anchor the catheter, prevent leaks around the catheter, and prevent bacterial migration from the exit site or from the peritoneum into the subcutaneous tunnel. Double-cuffed catheters are favored over single-cuffed catheters in adults because they anchor better in the abdominal wall, and they minimize exit site infections, tunnel infections, and peritonitis [3, 4].

Peritoneal dialysis catheter insertion technique

At our institution, for the past few years, the standard technique for providing PD access in adult patients is laparoscopically assisted insertion of the PD catheter. The procedure is performed under general anesthesia, and the patient must be fit for it. If there is any contraindication for general anesthesia, then the laparoscopic insertion is contraindicated [6].

The patient is placed in a supine position and general endotracheal anesthesia is induced. Perioperative antibiotic prophylaxis with cefazolin is administered 30 to 60 minutes prior to skin incision. The patient's abdomen is prepared and draped in the standard sterile fashion. The upper border of the curved catheter tip is aligned with the upper border of the pubic symphysis and the positions of the deep cuff, subcutaneous cuff, and skin exit site are marked with a sterile pencil (Figure 3). The first incision is 5 mm in length just above the umbilicus. A Veress needle is inserted and pneumoperitoneum with carbon dioxide (CO_2) is created. The intra-abdominal CO_2 pressure is maintained around 12 mmHg. A 5 mm trocar and a 5 mm 30-degree laparoscope are inserted. Laparoscppy is performed, and the pelvic region in particular is inspected for possible adhesions or any other pathology. Then the second 5 mm trocar is inserted in the right or left mesogastrium, depending on the side of skin exit site, and the laparoscope in moved to the second port (Figure 4). Another skin incision is made at the point of external cuff location, and rectus sheath tunneling is performed with a special trocar (Figure 5). Under laparoscopic guidance, the abdominal cavity is entered with a special trocar and a PD catheter is inserted through the trocar (Figures 6 and 7). Prior to the insertion, the PD catheter is soaked in saline. The curved tip of the catheter is placed into the Douglas pouch, the internal cuff should be in a preperitoneal space, and the external cuff should be placed subcutaneously. The pneumoperitoneum is released so that the subcutaneous tract can be created with the abdomen in a normal contour without the distortion that occurs with insufflation. After placing the catheter in the

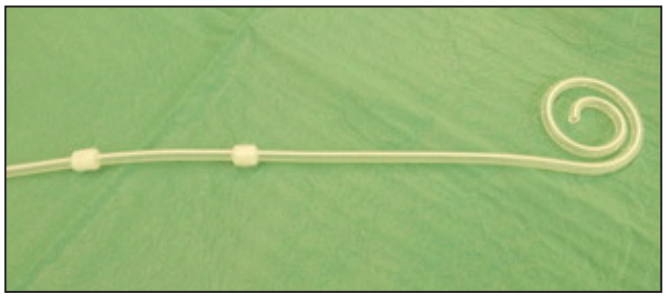

Figure 1. Straight Tenckhoff catheter with coiled tip and two Dacron cuffs.

Figure 2. Segments of the PD catheter.

Figure 3. The upper border of the curved catheter tip is aligned with the upper border of the pubic symphysis and the positions of the deep cuff, subcutaneous cuff, and skin exit site are marked with a sterile pencil.

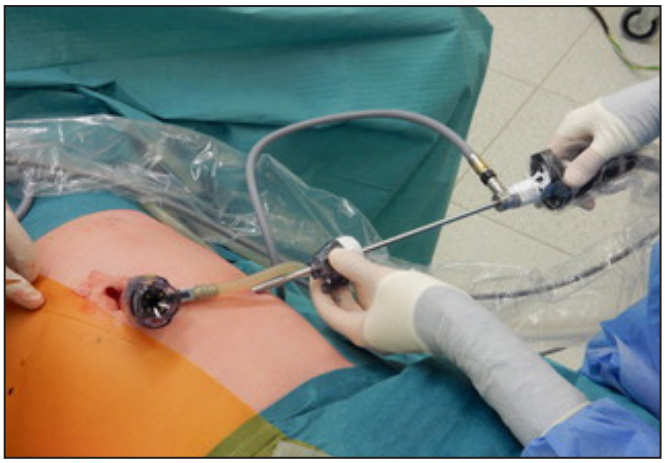

Figure 4. Laparoscopy with two 5 mm ports and a 5 mm scope.

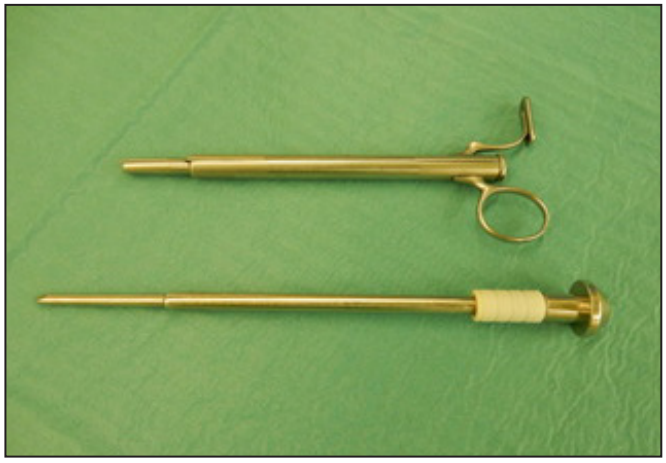

Figure 5. The special trocar that we use for rectus sheath tunneling.

Figure 6. Rectus sheath tunneling and inserting the PD catheter.

Figure 7. Endoscopic view of PD catheter insertion.

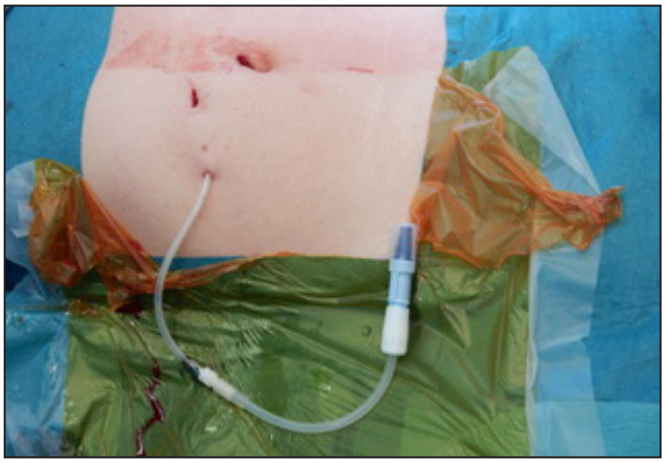

Figure 8. Inserted PD catheter directed downward with skin exit site placed laterally.

abdominal wall and the coiled tip sits in the retrovesical space, the remaining catheter is tunneled subcutaneously using a stylet to the planned exit site. The skin exit site is placed laterally, and the catheter should be oriented downward (Figure 8).

The PD catheter is flushed with saline and the patency of the catheter is evaluated immediately after the implantation procedure. Peritoneal lavage with a small volume of dialysate fluid is performed; the inflow and outflow of the dialysate fluid are evaluated. If the inflow or outflow is insufficient, the PD catheter can still be corrected.

Discussion

In recent years, there has been considerable interest in the use of laparoscopy for creating peritoneal access. As with any new application modality, laparoscopy for peritoneal access is still undergoing procedure-specific adaptations. It has become apparent that simply using laparoscopy to verify catheter location is not enough. The advantage of laparoscopy is that it allows an opportunity to actively address problems that adversely affect catheter outcome, such as catheter tip migration, omental entrapment, and peritoneal adhesions. The advantages of laparoscopy over other catheter insertion techniques are the identification and attendance to these problems at the time of the catheter insertion procedure [6]. Laparoscopic insertion is a minimally invasive procedure. It is suitable in obese patients, and complications can be managed laparoscopically [7]. Prior reports described several insertion techniques and port placements. Some authors reported a combination of 5 mm and 10 mm ports, and others described a minilaparoscopic technique, using 2 mm and 3 mm ports, to avoid herniation and fluid leak [8]. If additional procedures are performed, such as omentectomy or omentopexy, then a third port is needed [9].

We use two 5 mm ports and a 5 mm 30-degree laparoscope, unless there is simultaneous cholecystectomy because of gallstones. In that case, we use standard ports for laparoscopic cholecystectomy (10 mm umbilical port, 11 mm epigastric port, and two 5 mm right subcostal ports) and a 10 mm 30-degree laparoscope. We do not perform routine omentectomy or omentopexy. Some authors recommend fixation of the catheter tip to the pelvic structures to prevent catheter tip migration [10]. We do not perform routine catheter tip fixation because based on our experience the proper rectus sheath tunneling and positioning of the catheter tip in the Douglas pouch is sufficient to prevent catheter tip migration.

Conclusion

Laparoscopic insertion of a PD catheter has become the standard method for providing PD access at our institution in adult patients that need chronic PD because of ESRD. Based on our experience, the method is safe, is reliable, and has minimal complications.

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Surgical management of ulcerative colitis: a short review and a retrospective analysis of our experience at the University Medical Center Ljubljana

David Badovinac, Jan Grosek, Aleš Tomažič
Department for Abdominal Surgery, University Medical Centre Ljubljana

Correspondence

Jan Grosek
jan.grosek@kclj.si

Key words

ulcerative colitis, surgical management, postoperative results

Short review

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Abstract

Background. Ulcerative colitis requires surgical therapy in about a third of patients. A staged colectomy with end ileostomy should be performed in the acute setting, whereas a total proctocolectomy with ileal pouch–anal anastomosis is the current gold standard in the elective setting. Overall morbidity after surgery of ulcerative colitis is high. Surgical treatment in acute setting results in a higher incidence of postoperative complications as well as higher mortality rates. The laparoscopic approach tends to lower the incidence of septic complications and shortens the hospital stay.

Methods. The aim of our study was to learn how many patients with ulcerative colitis were surgically treated at the Ljubljana University Medical Center during a 5-year period and what the results were of the different approaches we chose. We performed a retrospective analysis of patient data from 2010 to 2015. Thirty-nine patients operated on for the first time were identified over a period of 5 years. Thirty-four operations were performed in an elective setting and five operations were acute (urgent) due to failure of medical salvage therapy.

Results. There were 27 non-restorative resections with terminal ileostomy (17 proctocolectomies and 10 total colectomies) and 12 restorative resections (four total colectomies with ileo-rectal anastomosis and eight proctocolectomies with ileal pouch–anal anastomosis). In 25 cases open surgery was performed, and in 12 cases resections were performed laparoscopically, with two cases converted to open surgery. The overall morbidity rate was 41%, with four major postoperative complications requiring surgical reintervention. One patient died as a result of serious septic complications.

Conclusions. Morbidity after surgery for ulcerative colitis remains significant and affects 25 to 50% of patients. The most important postoperative complication is pelvic sepsis as a result of anastomotic dehiscence or less frequently an infected

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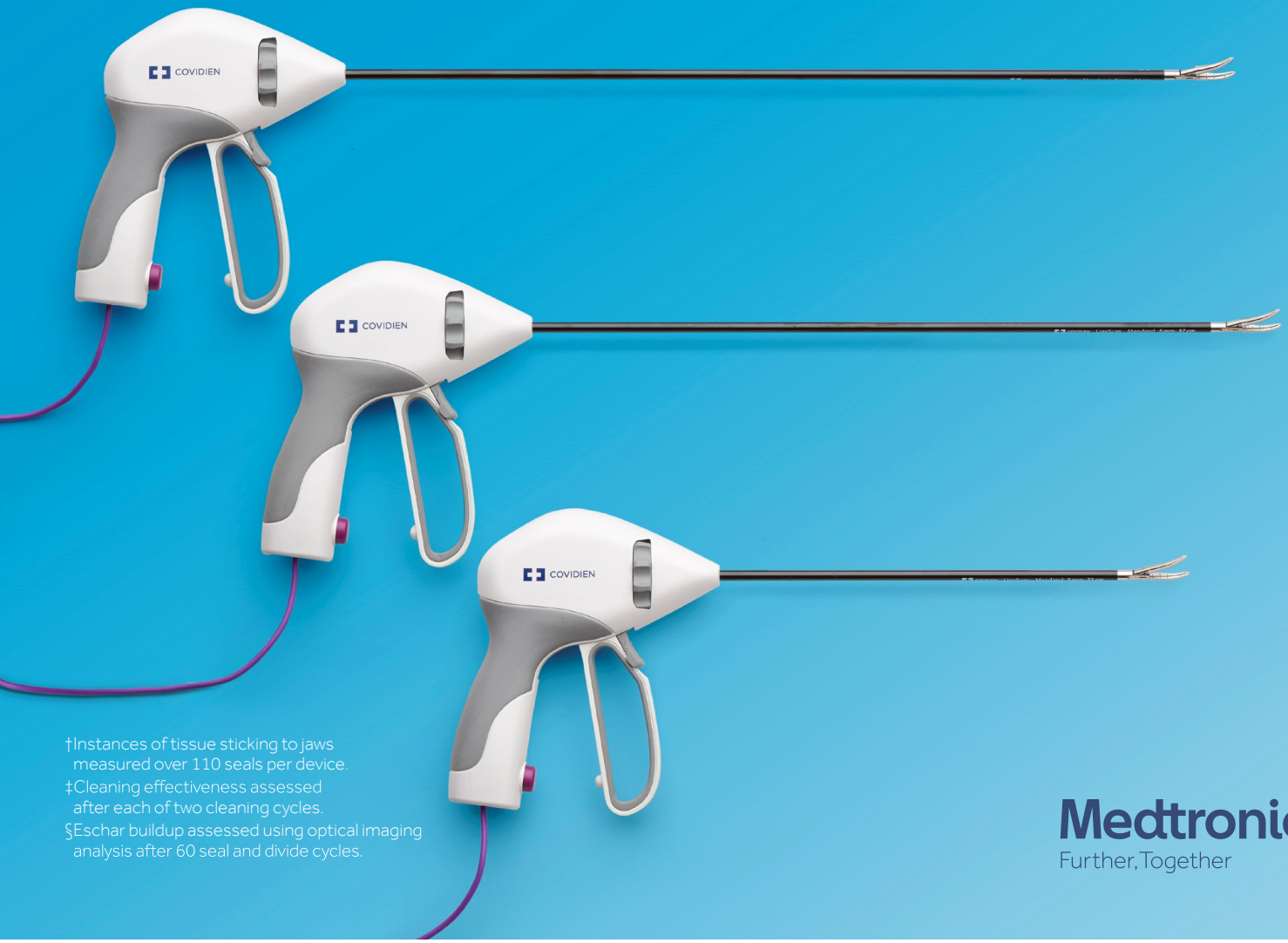

†Instances of tissue sticking to jaws measured over 110 seals per device.
‡Cleaning effectiveness assessed after each of two cleaning cycles.
§Eschar buildup assessed using optical imaging analysis after 60 seal and divide cycles.

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hematoma. Mortality rates are low, not exceeding 1% for operations performed in an elective setting. Higher rates are seen for urgent resections in acute colitis, especially in malnourished, steroid-dependent patients.

Introduction

Disease characteristics

Ulcerative colitis (UC) is a chronic inflammatory bowel disease characterized by a continuous inflammation that is limited to the mucosa of the colon and rectum. However, some patients with proctitis or left-sided colitis might have a cecal patch of inflammation. The symptoms are local with or without systemic disturbances. Increased stool frequency with passage of bloody diarrhea and mucus associated with abdominal pain are the most characteristic complaints. Diagnosis of UC is based on these clinical symptoms and confirmed by findings from endoscopic and histological examinations. Both infectious and noninfectious causes of diarrhea should be ruled out before a definitive diagnosis of UC is made [1].

About 50% of patients have the disease confined to the rectum at the time of diagnosis. In 20% UC extends to the left colon and in the remainder beyond the splenic flexure. Disease is therefore classified as proctitis, left-sided colitis, or pancolitis. The disease severity, based on the number of daily stools and presence or absence of systemic signs of inflammation, such as fever and tachycardia, should be assessed as well [2]. The treatment strategy for UC should consider the extent, severity, and pattern of the disease. The pattern includes relapse frequency, the course of the disease, response to previous medications, possible side-effects of medical treatment, and extra-intestinal manifestations. Medical treatment controls the disease most of the time and mainly consists of mesalazine, corticosteroids, immunosuppressive drugs, and monoclonal antibodies to tumor necrosis factor ⊠ (TNF-⊠). Around 30% of UC patients eventually require surgical therapy, either in an acute or elective setting [3].

Acute colitis

Surgery in an acute setting is performed for life-threatening complications of fulminant colitis that are unresponsive to medical treatment (toxic megacolon, colonic perforation, and rarely hemorrhage) as well as for patients with severe UC admitted to the hospital that do not respond to intensive medical treatment [4].

Acute UC occurs in about 10% of all UC patients and is the initial presentation in 30%. According to the guidelines of the European Crohn's and Colitis Organisation (ECCO), patients with bloody diarrhea ≥ 6/day and any signs of systemic toxicity (tachycardia > 90 bpm, fever > 37.8 °C, Hb < 10.5 g/dl, or an erythrocyte sedimentation rate > 30 mm/h) have severe colitis and should be hospitalized for intensive treatment. This treatment is based on intravenous corticosteroids, and concomitant infection with Clostridium difficile and cytomegalovirus must be ruled out [5]. More than two-thirds of these patients respond to such treatment [6]. However, steroid treatment should not be extended beyond 7 to 10 days because such extended therapy does not benefit the patients. Moreover, the duration of medical therapy before colectomy seems to be the only factor associated with major surgical complication rates [7]. Hence, the response to steroid therapy should be thoroughly evaluated, preferably with the gastroenterologist and the attending surgeon discussing the patient's progress at least once daily. Steroid refractory disease must be recognized early (preferably no later than day 3) and a decision must be made whether to start medical salvage therapy or proceed to colectomy, which must be regarded as a life-saving procedure [8]. A staged colectomy with end ileostomy should be performed in the acute setting, which is a relatively straightforward and safe procedure even in very ill UC patients. Patients are cured from the burden of toxic colitis and, while they are regaining their general health, they are able to consider the option of either an ileal pouch–anal anastomosis (IPAA) or permanent ileostomy. Leaving the rectal stump avoids the complications of pelvic dissection and a possible bowel anastomosis in critically ill patients. Moreover, in many patients with severe acute colitis unresponsive to medical therapy the distinction between the UC and Crohn's disease is made only after the final pathology report is finished. One of the major disadvantages of leaving the diseased rectum behind is the continuation of active

disease, which may require a subsequent urgent proctectomy. However, this problem is very uncommon.

Elective surgery

ndications for surgery in an elective setting include cancer, risk for cancer (dysplasia), strictures, medical intractability, and unresponsive extra-intestinal manifestations. In children, growth retardation is equally an indication for surgery.

Intractability is a clinically defined condition that can occur in either the acute or chronic state of UC. In the latter, it refers to refractory colitis, chronically active despite maximal medical therapy, as well as to inability to taper steroids to a reasonable maintenance dose or the development of severe drug-related side effects.

Table 1. Patient demographics.

Demographic	Value
Total patients	39
Sex (male:female)	17:22
Average age (years)	44 (32–80)
Average hospital stay (days)	22 (9–75)
Average ASA	2.4 (1–4)
Mortality, n (%)	1 (2.6%)
Morbidity, n (%)	16 (41.0%)

The risk of colon cancer in a UC patient becomes obvious after 10 years and rises to 50% and 75% after 30 and 40 years of disease, respectively. The most important risk factors are the extent of the disease and longer duration. Most cases are believed to arise from dysplasia, and surveillance colonoscopy is therefore recommended. Multiple (at least 32) random biopsy specimens from all segments of the colon should be obtained (approximately three to four biopsies every 10 cm). Recently, with the advent of video endoscopy and new endoscopic technologies, many investigators are reporting that most dysplasia discovered in patients with inflammatory bowel disease are visible. This paradigm shift could have important implications for the surveillance and management of dysplasia [9]. However, despite the evolving evidence regarding newer endoscopic methods to detect dysplasia, current European evidence-based consensus on surgery for UC recommends colectomy not only for carcinoma but also for patients with the following [11]:

- Flat high-grade dysplasia (HGD) due to the immediate and subsequent risk of carcinoma;
- Non-adenoma-like dysplastic raised lesions due to the high association with metachronous or synchronous carcinoma;
- Adenoma-like lesions if they cannot be completely resected or there is dysplasia present in the surrounding mucosa.

Indications for the management of flat low-grade dysplasia (LGD) are less clear than for HGD. The current evidence is insufficient to assess the balance of risks and benefits of colectomy for flat

Table 2. Operative details and postoperative data.

	Open surgery	Laparoscopic	Conversion
Patients, n	25	12	2
Scheduled procedures, n (%)	20 (80.0%)	12 (100%)	2 (100%)
Urgent procedures, n (%)	5 (20.0%)	0 (0%)	0 (0%)
Average operation time (minutes)	162 (65–350)	233 (95–410)	236 (215–257)
Postoperative complications, n (%)	10 (40.0%)	4 (33.0%)	2 (100%)
Need for transfusion, n (%)	8 (32.0%)	3 (25.0%)	0 (0%)
Average hospital stay (days)	21.3 (10–60)	17.9 (9–59)	45.0 (15–75)
Reoperation within 30 days, n (%)	2 (8.0%)	2 (16.7%)	0 (0%)

LGD. Hence, the decision should be individualized and discussed with the patient. Polyps in colonic segments proximal to the UC involvement should be treated as sporadic adenomas. The same is true for adenoma-like raised lesions if they can be completely endoscopically resected, provided there is absence of dysplasia at the margins and there is no evidence of flat dysplasia elsewhere in the colon.

In the elective setting, total proctocolectomy with IPAA is the current gold standard. In patients with a preoperative diagnosis of dysplasia or cancer, the proctocolectomy should include oncologic lymphadenectomy with ligation of the vessels at their origins. Anastomosis should be covered with protective ileostomy most of the time. In rare cases, a colectomy with ileorectal anastomosis can be offered to patients with relative rectal mucosal sparing on endoscopy, absence of dysplasia with a distensible rectum on air insufflation, and a competent anal sphincter. Only a few patients fulfil the aforementioned criteria. Nevertheless, this type of resection should be sometimes considered, especially in fertile female patients because it is now clear that the risk of infertility after IPAA is increased threefold. If restorative surgery is not an option based on general and mental health, sphincter function, and motivation, then conventional total proctocolectomy with a Brooke ileostomy is performed.

The aim of our study was to learn how many patients with UC were surgically treated at the Ljubljana University Medical Center during a 5-year period and what the results were of the different approaches we chose.

Methods

We performed a retrospective analysis of UC cases hospitalized and surgically treated at our institution over a period of 5 years, from 2010 to 2015. A database search revealed 39 patients. Basic demographic information of the patients was extrapolated, along with the setting and the mode of the operation performed. Potential postoperative complications, need for transfusion, and the length of hospital stay were also noted. Statistical analysis was mostly based on simple calculations of the average values of certain numeric variables.

Results

Among 39 patients operated on for the first time, 34 operations were performed in an elective setting and five were acute (urgent) due to failure of medical salvage therapy.

There were 27 non-restorative resections with terminal ileostomy. In 17 of these cases, proctocolectomy was performed and 10 underwent total colectomy. Twelve resections out of 39 were restorative; four total colectomies with ileorectal anastomosis and eight proctocolectomies with IPAA. In 25 cases open surgery was performed, and in 12 cases resections were carried out laparoscopically. Two of the laparoscopically initiated cases were converted to open surgery.

In the emergency group, all five patients underwent open surgery. Four of these patients had some kind of postoperative complications (80.0%), yet none needed a reoperation within 30 days. The elective group of patients included all of the laparoscopically initiated procedures. Among 34 patients operated on in the elective setting, four underwent reoperation within 30 days (11.8%). The rate of postoperative complications in this group was 35.3% (12 patients).

The overall morbidity rate was 41.0%. The most common postoperative complication was surgical wound infection (four cases; 10.2%), followed by postoperative ileus (two cases) and fistula formation (two cases). Four cases required surgical reintervention due to major postoperative complications. One patient in the emergency group died after serious septic complications (2.6% mortality rate). The patient demographics and operative/postoperative data are summarized in Table 1 and Table 2, respectively.

Discussion

Despite the fact that surgery for UC is technically demanding and is often performed in very ill patients, the mortality rates are low. In patients undergoing elective procedures postoperative mortality does not exceed 1.0%, and in patients undergoing emergency surgery the rates go up to 6.9% [12]. The results of our small series show a similar conclusion because only one patient was lost due to septic complications (mortality rate

of 2.6%). However, the morbidity rates are high, even in elective cases. Early postoperative complications (≤ 30 days postoperatively) occur overall in 9 to 65% of patients and late complications (> 30 days postoperatively) in 17 to 55% [13]. Wound infection, small bowel obstruction, and pelvic sepsis are the most common early complications. Less commonly, one can expect ileostomy-related complications and hemorrhage. Our own results are in accordance with such reports in the literature because 41.0% of patients had some kind of early postoperative complications. Apart from surgical complications, pneumonia and thromboembolic complications with pulmonary embolism are also an important contributor to postoperative morbidity [14]. Morbidity is higher in patients undergoing surgery in an acute setting [12]. Such results were also seen in our series, with elective cases presenting with postoperative complications in 35.3% and emergency cases in 80.0%.

Patients should be preoperatively optimized, especially if they are malnourished. An enhanced surgical recovery is to be applied because it appears to yield an outcome advantage in terms of hospital stay and postoperative morbidity. Preoperative steroids, hypoalbuminemia, and malnutrition are associated with an increased rate of surgical complications, as are probably anti-TNF-☒ agents. On the other hand, preoperative thiopurines and calcineurin inhibitors do not increase the risk of postoperative complications [15].

A laparoscopic approach, even in an emergency setting as long as the patient is not critically ill or unstable, results in a shorter hospital stay and in reduction of postoperative infectious complications [11]. Hence, it is our strong goal to perform more laparoscopic procedures, even in patients needing emergency surgical treatment. This has not been the case so far (Table 2) because none of the patients in the emergency group were operated on laparoscopically. Moreover, we would like to offer every UC patient scheduled for elective surgery a laparoscopic coloproctectomy.

Finally, it is a well-established fact that the most important parameter in the long run for IPAA patients is bowel function. Incontinence affects around 5% of patients, who are usually satisfied with the functional results because there is no urgency, which is the most incapacitating symptom of UC. However, functional results must be objectively measured, preferably through reliable, validated, and sensitive instruments (i.e., questionnaires). Such quality-of-life assessment was not systematically carried out for our patients; hence this important endpoint of our surgery could not be properly investigated in this study.

Conclusions

Morbidity after surgery for UC remains significant and affects 25 to 50% of patients. The most important postoperative complication is pelvic sepsis as a result of anastomotic dehiscence or less frequently an infected hematoma. Mortality rates are low, not exceeding 1% for operations performed in an elective setting. Higher rates are seen for urgent resections in acute colitis, especially in malnourished, steroid-dependent patients. Morbidity rates are higher in an acute setting surgery. Laparoscopic resections should provide a lower risk of septic complications and shorter hospital stay when compared to open surgery. The results of our series correlate well with reports from the literature. However, the relatively small number of patients operated on during the 5-year period analyzed failed to provide statistically significant results. Restorative proctocolectomy with IPAA should be offered to all suitable patients, regardless of their chronological age. Colectomy with ileorectal anastomosis is rarely justified. However, it can be proposed to young female patients as a possible interim procedure, based on concerns about infertility.

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Is laparoscopic resection of hepatocellular carcinoma feasible?

Mihajlo Djokić, Monika Alič, Miha Petrič, Dragoje Stanisavljević, Blaž Trotovšek
Department for Abdominal Surgery, University Medical Centre Ljubljana

Correspondence

Mihajlo Djokić
mihajlo.djokic@kclj.si

Key words

hepatocellular carcinoma, liver disease, laparoscopic resection, hepatectomy

Short review

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Abstract

Background. Hepatocellular carcinoma is the most common carcinoma of the liver. Its treatment depends on the number of lesions, state of liver parenchyma, systemic liver function, presence of portal hypertension, and esophageal varices as well as the patient's other concurrent diseases. Mortality and co-morbidity are associated with the state of liver parenchyma and the liver function, which is assessed by the Child–Pugh score, and further treatment is decided based on the Barcelona Clinic Liver Cancer classification.

Methods. The advantages and disadvantages of laparoscopic resection of hepatocellular carcinoma are discussed in the article, and the results of these procedures at the Ljubljana University Medical Center are reviewed.

Results. Between 2012 and 2017, 21 laparoscopic resections of hepatocellular carcinoma were performed at the Ljubljana University Medical Center. All patients were stage 0 or A carcinoma according to the Barcelona Clinic Liver Cancer classification (T1 or T2 on TNM score). In five patients a conversion to open resection was required due to hemorrhage, insufficient visibility, extensive adhesions, and previously undiagnosed satellite hepatocellular carcinoma lesion. The laparoscopic resection compared to classic resection resulted in shorter hospitalization time (in average 7.3 days), lower incidence of complications (6.25%), or less progress of the disease (18.75%). All resections were R0 and all patients survived.

Conclusion. The laparoscopic resection of hepatocellular carcinoma is feasible in appropriately selected patients in the hands of an experienced surgeon.

Introduction

Hepatocellular carcinoma (HCC) is the fifth most common carcinoma worldwide and it accounts for 5.6% of all cancers. It is responsible for 800,000 to 1,000,000 deaths annually, which is the third-highest cancer-associated death risk [1, 2]. In 2013,

213 new patients with this type of cancer were diagnosed in Slovenia, 69 women and 144 men [3, 4].

Etiology

The main etiological factor for HCC development is the state of the liver parenchyma. In more than 80% of HCC cases, there is preexisting liver damage (liver cirrhosis). The main factors for cirrhosis are chronic hepatitis (B or C), high alcohol consumption, hemochromatosis, non-alcoholic fatty liver disease, afla-toxin toxicity, steroids, and vein obstruction [5]. The most common factor for liver cirrhosis in Slovenia is high alcohol consumption.

Statistically, more men than women are affected; the ratio is 3:1. In western countries, patients are usually diagnosed with HCC between ages 40 and 50, whereas in Asia and Africa HCC develops faster: patients are between 30 and 40 years old [5, 6].

Clinics and diagnostics

Symptoms of HCC are usually nonspecific: pain or discomfort under the right costal arch, appetite and weight loss, nausea, ascites, and jaundice. At examination an enlarged, palpable painful liver can be found. Laboratory results show increased values of serum cholesterol levels, serum calcium levels, and hypoglycemia. Moreover, the alpha-fetoprotein is a specific serum tumor marker associated with HCC.

In addition, CT and MRI scan can provide useful information about HCC by detecting possible hypervascular lesions in the liver. In some cases, the diagnosis of HCC is made by ultrasound- or CT-guided liver biopsy [5, 6].

Classification

Because the decision for treating HCC is primarily based on systemic liver function and the general condition of the patient, there was a need for specific classification for HCC instead of TNM classification. There are many different classifications: the Cancer of the Liver Italian Program (CLIP) score, the Chinese University Prognostic Index (CUPI), and the Okuda and Barcelona Clinic Liver Cancer classification (BCLC), which is the most commonly used in the western world, including Slovenia [7].

The Child–Pugh classification assesses the prognosis of chronic liver disease and includes the presence of encephalopathy and ascites, serum values of albumins, bilirubin, and prothrombin time. According to the sum of these parameters, three classes are formed: A, B, and C. The Child–Pugh score as well as the patient`s general health condition, concurrent diseases, and number and size of tumor lesions are taken into account in BCLC classification [8]. The treatment of HCC is based on BCLC staging.

Laparoscopic resection of HCC

The first laparoscopic hepatectomy was performed by Gagner in 1992, and interest in this kind of technique has grown ever since. At first it was used for biopsy and treatment of small liver lesions, but it later spread and has become an important treatment option for liver metastasis as well as HCC [1]. Lately it has become the gold standard for the treatment of HCC with one subcapsular lesion with a radius smaller than 5 cm located in the left liver lobe or anterior segments of the right liver lobe [9]. With the development and improvement of surgical instruments (scalpels, dissectors, staplers, intraoperative ultrasound, etc.), operations became safer and the outcome improved. This goes hand in hand with the improvement of surgical skills and growing experience [9].

Laparoscopic resection (LR) is the method of choice in stage O and A of BCLC classification; however, due to strict criteria only approximately 27% of all HCC lesions can be operated on laparoscopically [10]. The main criteria for LR is the location of the HCC lesion, and LR is therefore indicated when the lesion is in anterolateral liver segments, but unfortunately not when the lesion is in posterosuperior segments.

The advantages of LR when compared to classical hepatectomy are numerous: shorter operating time, shorter hospitalization time, reduced blood loss, less need for transfusion and analgesics, and lower morbidity and mortality. Moreover, when there is a need for reoperation there are fewer postoperative abdominal adhesions. Reduced blood loss and less need for transfusion were recognized as the consequence of pneumoperitoneum and laparoscopic camera enlargement effect, which both resulted in better postoperative hemostasis [10]. In laparoscopic redo operations, independently of the primary open or laparoscopic

approach, there was less blood loss, a lower need for transfusion, lower mortality, and lower ascites incidence when compared to open redo operations. Meta-analysis, which included 244 patients with open hepatectomy and 165 patients with LR of HCC, showed no statistically important differences in HCC recurrence or patient survival [1, 11]. Contraindications for LR are a large tumor lesion, an unfavorable location (posterosuperior liver segments), vascular invasion, rupture or inflammation of the lesion, decompensated liver cirrhosis, portal hypertension, esophageal varices (more than grade 1), and thrombocytopenia [1, 2].

In some cases, complications connected to LR can occur, such as technical difficulty of parenchyma resection, insufficient hemostasis, and air embolism. Due to the need for suitable technical support and surgical skills, LR is currently limited to larger medical centers [10].

Methods

At the Department of Abdominal Surgery at the Ljubljana University Medical Center, 21 laparoscopic resections of HCC were performed between January 1st, 2012 and December 31st, 2017. There were 15 male and six female patients, between 41 and 85 years old. All the patients were stage 0 or A carcinoma according to the BCLC classification (T1 or T2 on the TNM score).

Results

In five procedures (23.5%), a conversion to open operation was required due to hemorrhage and insufficient hemostasis, insufficient visibility, large adhesions, and a previously undiagnosed satellite lesion near the targeted HCC lesion.

The hospitalization time of patients operated on laparoscopically (16 patients) was between 4 and 21 days, on average 7.3 days. Most of the patients (12/16; 75%) were hospitalized between 4 and 6 days. Patients with conversion to open procedure were hospitalized longer: between 7 and 18 days, on average 13 days.

All resections were R0 and all patients survived. All patients were still alive during this review and most of them have continued their gastro-oncological treatment.

In three patients there was progression of the disease on average 4 years after the procedure. One patient had a local recurrence and was later treated with a liver transplantation. In one patient, there was a need for an additional operation in which extirpation of lymph nodes in the hepatoduodenal ligament was performed.

Conclusion

Laparoscopic resection of HCC is a gold standard for treatment of early stages of this disease. Based on our analysis, laparoscopic surgery for HCC treatment proved to be safe when performed by an experienced surgeon on appropriately selected patients with favorable outcomes. These include successful treatment with a low incidence of complications, a low rate of progression and recurrence of the disease, and shorter hospitalization when compared to the open procedure.

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SHORT REVIEWS