Int J Clin Exp Med 2017;10(8):11991-11997
www.ijcem.com /ISSN:1940-5901/IJCEM0057281

Original Article

Laparoscopy versus laparotomy for upper gastrointestinal perforation in elderly patients

Jianguo Li, Xianhui Shang, Xingbin Zheng

Department of Gastrointestinal Surgery, Affiliated Hospital of Zunyi Medical College, Zunyi, Guizhou, P. R. China

Received May 12, 2017; Accepted June 15, 2017; Epub August 15, 2017; Published August 30, 2017

Abstract: Objective: To compare the efficacy of laparoscopy versus laparotomy in the treatment of upper gastrointestinal (GI) ulcer perforations in elderly patients. Methods: A total of 100 patients with upper GI ulcer perforation treated in our hospital from January 2014 to December 2016 were enrolled in this study. All the eligible patients were older than 60 years and received emergency surgeries. They were randomly divided into two groups: the laparoscopy group (n=50) and the laparotomy group (n=50). The intraoperative factors, postoperative recovery, complication rate, postoperative pain, QOL (quality of life) scores and serum inflammatory cytokine (hs-CRP, TNF-α and IL-6) levels were compared between the two groups. Results: As compared with the laparotomy group, the laparoscopy group significantly reduced operation time, intraoperative bleeding, and length of hospital stay (P<0.05). Significantly shorter time for gastrointestinal function recovery, anal exhaustion and postoperative ambulation was also observed in the laparoscopy group (P<0.05). In addition, the laparoscopy group had significantly lower incidence of overall complications (P<0.05). As for the magnitude of postoperative pain, the VAS scores at 1 day and 3 days after surgery were significantly lower (P<0.05) and the postoperative QOL at 1 month and 3 months significantly improved in the laparoscopy group (P<0.05). The postoperative inflammatory cytokineshs-CRP, TNF-α and IL-6 levels at 1 week were also significant lower in the laparoscopy group (P<0.05). Conclusion: For treatment of upper GI perforation in elderly patients, laparoscopy is significantly superior to laparotomy in reducing the presence of complications and inflammatory reactions, alleviating postoperative pain and improving therapeutic effects. Therefore, it is beneficial to elderly patients.

Keywords: Upper gastrointestinal perforation, repair of perforation, laparotomy, laparoscopy, elderly population

Introduction

Upper gastrointestinal (GI) perforation, which started urgently and intractably, is a common acute abdomen disease encountered in the Department of General Surgery. It may develop into diffuse peritonitis without timely and effective treatment, leading to shock and even death [1, 2]. Recently, with the increasingly aging population, the incidence of upper GI perforation is on the rise among the elderly population. Various chronic comorbidities and degradation of organ functions, as well as atypical clinical manifestations in elderly patients frequently result in rapid progression, high misdiagnosis rate and mortality of the disease. Surgery is mainly adopted for the management of perforation in the upper GI tract [3]. Although the conventional laparotomy can cure the lesions, it has the disadvantages of large trauma and high rate of complications [4, 5]. With the further advance in the laparoscopic techniques, the minimally invasive advantage of laparoscopic repair of perforation is becoming increasingly popular with clinicians [6]. For elderly patients, however, the increase in abdominal pressure attributed to pneumoperitoneum during laparoscopy, the elevated diaphragm and other factors may, to some extent, affect the circulatory and respiratory functions of elderly patients and thereby increase the risk of laparoscopy. Whether elderly patients with upper GI perforation associated with visible cardiopulmonary dysfunctions can benefit from laparoscopic repair remains unclear. Therefore, it is still uncertain about how to choose optimal surgeries for elderly patients with GI perforation in clinical practice. In the present study, we compared the clinical efficacy of laparoscopy and laparotomy in the treatment of elderly patients

with GI perforation, in the hope of providing guidance for making proper choice in clinical practice.

Materials and methods

General data

The subjects enrolled in the present study were 100 elderly patients with confirmed upper GI perforation, who were admitted to our hospital between January 2014 and December 2016. The eligible patients were randomly assigned to receive either conventional perforation repair by laparotomy (the laparotomy group, n=50) or perforation repair by laparoscopy (the laparoscopy group, n=50). Patients were included in the present study if they were older than 60 years, and they and their families approved the surgery. Patients were excluded if they had severe hepatic and renal dysfunction, severe cardiopulmonary dysfunction, malignant ulcer perforation, gastrointestinal malignancy, severe abdominal infection, a history of abdominal surgery, or conversion to laparotomy. The present study was approved by the Hospital Ethics Committee and all patients provided written informed consents.

Laparoscopy

After induction of general anesthesia in the patient, a 1 cm arc incision was made below the umbilicus to establish pneumoperitoneum where a laparoscope was inserted through the umbilicus, followed by puncture and insertion of the trocars into the sites apart below the left costal margin at the midclavicular line and below the right costal margin at the anterior axillary line, to drain food residue and effusions as many as possible under the direct vison through the laparoscope while probing the upper GI perforations and identifying the sites of duodenal and gastric perforations. The duodenal perforations were treated using repair of perforation while the gastric perforation was repaired with the use of interrupted sutures; then the sites of perforations were covered by the greater omentum. The peritoneal and the pelvic cavities were flushed by normal saline, followed by placement of a plastic drain tube.

Laparotomy

Under general anesthesia, an incision was cut through the right upper abdominal of the patient, to gain access into the peritoneal cavity by separating layers of skin and muscle tissues. The effusions below the diaphragm and in the pelvic cavity were drained away to fully expose stomach or duodenum for identification of the lesion sites. The perforations were sutured using interrupted sutures and finally covered by the greater omentum. The peritoneal cavity and the pelvic cavity were flushed by normal saline, followed by placement of a plastic drain tube.

Outcome measures

Records with regard to all the patients' surgical conditions (operative time and intraoperative bleeding), postoperative recovery (length of hospital stay, duration of gastrointestinal function recovery, anal exhaust time and postoperative ambulation time) and the incidence of postoperative complications were pooled and filed. The differences between the two groups were compared using the statistical analysis. The postoperative pains were assessed using visual analog scale (VAS). The VAS scale is a scale ranging from 0 to 10, namely, a scale of 10 grades ranging from 0 (painless) to 10 scores (severe pain), with higher scores indicating more severe pain. The VAS scores were compared between the two groups before surgery as well as at 1 d and 3 d after surgery. The quality of life (QOL) questionnaires were used to assess the postoperative quality of survival of the patients in the two groups. The QOL questionnaires covers 45 scores (1-5 scores for each category) of eight categories (spirit, fatigue, appetite, pain, sleep, attitude towards treatment, side effects of treatment and daily life), with higher scores indicating more survival and better efficacy. The serum inflammatory cytokines hs-CRP, IL-6 and TNF-α levels before surgery and at 1 week after surgery were measured using the enzyme-linked immunosorbent assay (ELISA) kit according to the manufacture's instructions and then comparison of the three inflammatory cytokines was carried out between the two groups.

Statistical analysis

All data in the study were analyzed using SPSS software, version 19.0. Categorical data were expressed as percentages and the comparison between groups was performed with the use of the chi-square test. Measurement data were expressed as $\bar{x} \pm s$ and a student's t test was

Table 1. Comparison of basic data between the two groups

Variable	Laparotomy (n=50)	Laparoscopy (n=50)	P
Age (year)	65.3±1.6	67.1±1.8	0.752
Gender (n) Male/Female	27/23	26/24	0.321
MDP	12.7±1.5	13.2±1.6	0.548
Diseases-DP	20 (40%)	23 (46%)	0.632
Duodenal perforation	30 (60%)	27 (54%)	0.489
TFOO (h)	14.1±7.1	14.6±7.5	0.813

Notes: MDP denotes Mean diameter of perforation; GP Gastric perforation; TFOO Time from onset to operation.

employed to assess the differences between groups, VAS scores, QOL scores and serum inflammatory cytokines hs-CRP, IL-6 and TNF-α levels were compared using repeated measures analysis of variance (ANOVA). *P* values <0.05 were considered to represent statistically significant differences.

Results

Comparison of general clinical data among the patients in the two groups

The laparotomy group had 50 patients (27 male, 23 female), with the mean age of 65.3± 1.6 years and mean diameter of perforation 12.7±1.5 mm. Gastric perforation occurred in 20 patients and duodenal perforation occurred in 30 patients, with the time from onset to operation 14.1±7.1 h. The laparoscopy group had 50 patients (26 male, 24 female), with the mean age of 67.1±1.8 years and the mean diameter of perforation 13.2±1.6 mm. Gastric perforation occurred in 23 patients and duodenal perforation occurred in 27 patients, with the time from onset to operation 14.6±7.5 h. There were no significant differences between the laparotomy group and laparoscopy group in clinical data including age, gender, the types of diseases and the mean diameter of perforation, so both groups were comparable (P>0.05, **Table 1**).

Comparison of intraoperative outcomes and postoperative recovery among the patients in both groups

Compared with the laparotomy group, the patients in the laparoscopy group showed significantly better intraoperative outcomes (operative time and intraoperative bleeding; P<0.05). For postoperative recovery, length of hospital stay, duration of gastrointestinal function recovery, anal exhaust time and postoperative ambulation time were significantly shorter in the laparoscopy group than in the laparotomy group (P<0.05, **Table 2**).

Comparison of the incidence of complications between the two groups

The intraoperative bleeding occurred in one patient, intraperitoneal abscess in one patient, infection in one patient and intestinal adhesion in one patient in the laparoscopy group, with an overall complication rate of 8%. By contrast, the overall complication rate was 26% in the laparotomy group, including 4 cases of intraoperative bleeding, 3 cases of intraperitoneal abscess, 4 cases of infection and 2 cases of intestinal adhesion. The incidence of complications between the two groups was statistically significant (P<0.05, **Figure 1**).

Comparison of the VAS cores between the two groups

The postoperative VAS pain scores before surgery, at 1 day and 3 days after surgery in the laparotomy group were 7.98±3.21, 3.39±0.76 and 1.35±0.28, respectively. The pain VAS scores at 1 d and 3 d after surgery in the laparoscopy group were significantly lower than those of the laparotomy group (P<0.05); but the preoperative pain VAS scores were insignificantly different between the two groups (P>0.05, **Figure 2**).

Comparison of the QOL scores between the two groups

No statistically significant difference was found in the QOL scores before surgery between the two group (P>0.05); but the postoperative QOL scores were significantly better than preoperative ones among the patients of both groups. In addition, the QOL scores at 1 month and 3 months after surgery respectively were significantly better in the laparoscopy group than in the laparotomy group (P<0.05, **Figure 3**).

Comparison of postoperative inflammatory cytokines between the two groups

The differences in preoperative inflammatory cytokine hs-CRP, TNF-α and IL-6 levels were insignificant different between the two groups (P>0.05); however, the serum hs-CRP, TNF-α

Table 2. Comparison of intraoperative outcomes and postoperative recovery between the two groups

Group	Case	Intraoperative outcome		Postoperative recovery			
		OD (min)	IB (ml)	LOS (d)	AET (h)	DOGFR (h)	PAT (h)
Laparotomy	50	85.74±10.86	55.93±10.66	13.92±4.75	47.92±6.97	4.25±1.42	26.12±5.42
Laparoscopy	50	67.53±9.23*	35.58±6.82*	8.87±4.59*	19.89±5.51*	3.11±1.12*	14.71±2.41*
P		0.005	0.006	0.003	0.007	0.012	0.009

Note: *Comparison with the laparotomy group, *P<0.05. OD denotes operation duration; IB Intraoperative bleeding, LOS Length of stay; DOGFR denotes, Duration of gastrointestinal function recovery, AET Anal exhaust time, PAT postoperative ambulation time.

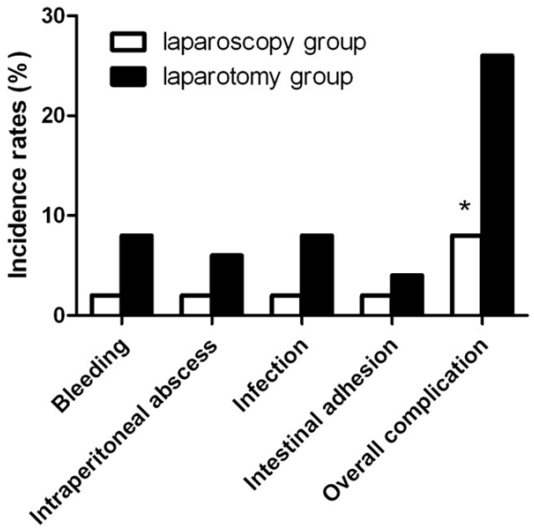

Figure 1. Comparison of the incidence of complications between the two groups; *comparison with the laparotomy group, *P<0.05.

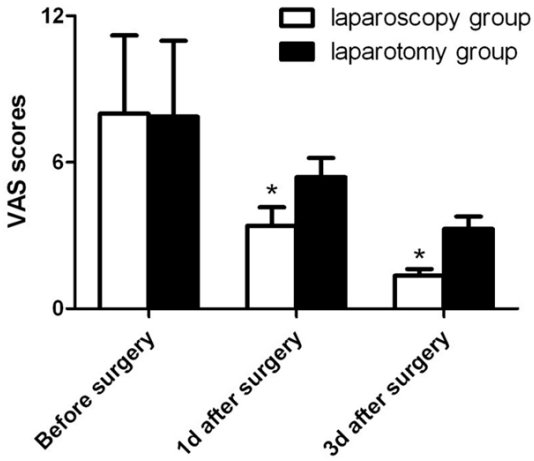

Figure 2. Comparison of postoperative pain among the patients of the two groups; *comparison with the laparotomy group, *P<0.05.

and IL-6 levels at 1 week after surgery in the laparoscopy group were significantly lower than

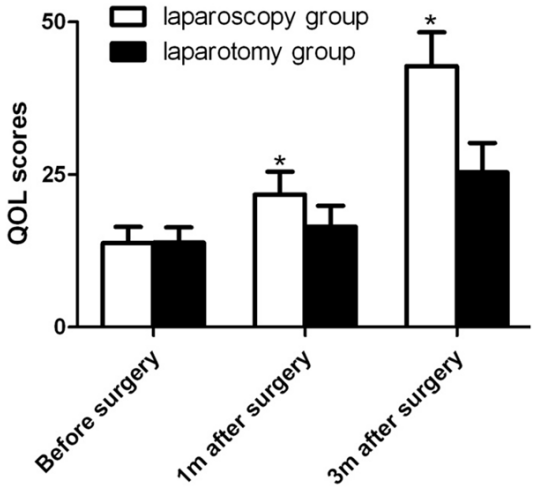

Figure 3. Comparison of postoperative QOL among the patients of the two groups; *comparison with the laparotomy group, *P<0.05.

those in the laparotomy group (P<0.05, **Figure 4**).

Discussion

Duodenal ulcer perforation and gastric ulcer perforation are common types of perforation occurred in the upper GI tract. Once the diseases are identified, it is advisable to perform emergency surgery [7]. What surgical alternatives are chosen is directly related to the prognosis of elderly patients. Currently, two surgical methods, laparoscopy and conventional laparotomy are used in the treatment of perforations present in the upper GI tract [8]. Many studies have shown that laparoscopy is superior to conventional laparotomy in repair of perforation in the upper GI tract [9-12]. However, in these studies, the special factors of elderly patients have not been taken into consideration. Laparoscopy has advantages of less severe trauma, faster postoperative recovery, but elderly patients have worse constitution

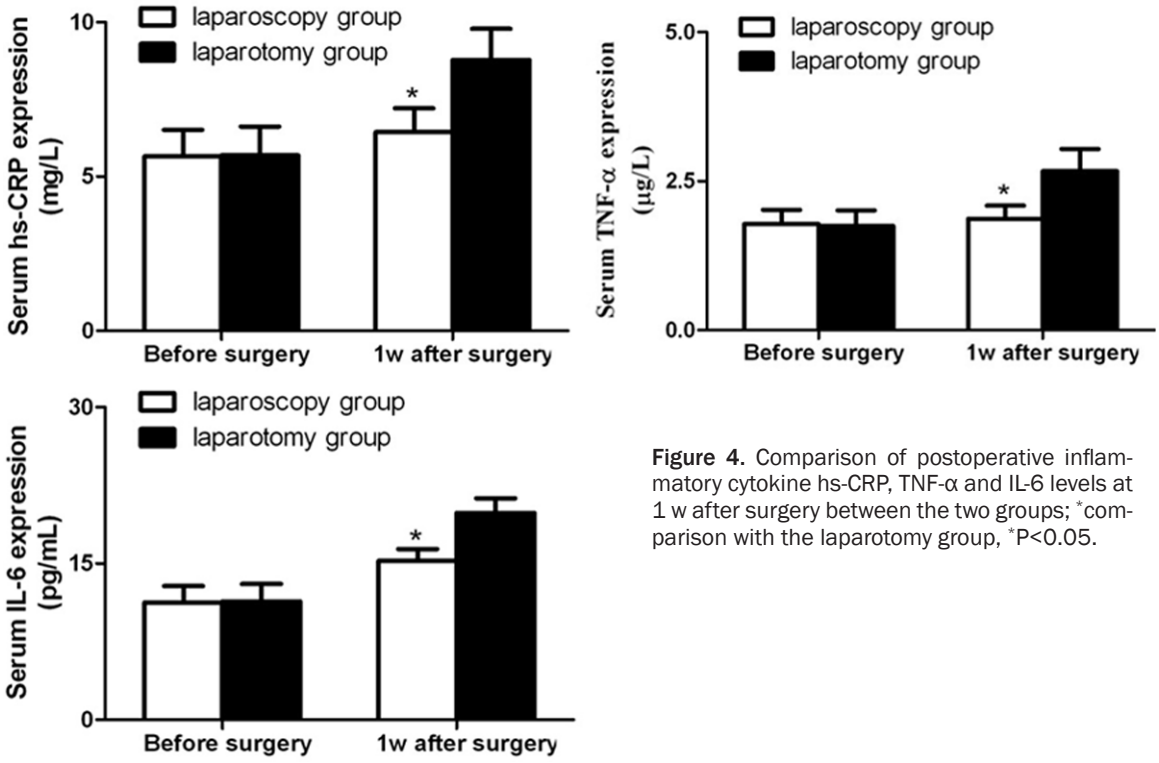

Figure 4. Comparison of postoperative inflammatory cytokine hs-CRP, TNF-α and IL-6 levels at 1 w after surgery between the two groups; *comparison with the laparotomy group, *P<0.05.

and self-repair ability. Most of them are associated with cardiopulmonary diseases. Besides, changes in ventilation function and hemodynamics during laparoscopic procedures are detrimental to elderly patients. Therefore, the purpose of this study was to investigate whether the elderly patients with upper GI perforation could benefit from minimally invasive surgeries.

Given the characteristics of elderly patients, they should undergo simple and effective surgical procedures with shorter operation time and good prognosis. Laparoscopy has proven an array of unique advantages over conventional laparotomy in repair of upper GI perforations. As for efficacy, laparoscopy for repair of upper GI perforations can extensively check the abdominal cavity, thoroughly suck up the effusions in the cavity and clean the cavity up, reducing the incidence of infection attributed to peritoneal effusions. In this way, it brings less tissue bleeding, but much clearer vision field and fewer impacts on the vision field, resulting in lower incidence of misdiagnosis and missed diagnosis [13, 14]. As far as complications are concerned, laparoscopy causes less severe trauma, thereby more effective in enhancing immune protection of the patient [15]. It is of value for the elderly patients with low immunity as it can directly affect the incidence of postoperative complications. Nevertheless, in one study, laparoscopy was found to be insignificantly different from laparotomy in complications [16]. By contrast, the results of our study showed that the overall complication rate was significantly lower in the laparoscopy group than in the laparotomy group. Complications include bleeding, postoperative infection, abdominal or pelvic infection, and intestinal adhesions. Among them, intestinal adhesion is a common complication after repair of perforations in the upper GI tract. Compared with laparotomy, laparoscopy with the help of instruments is easier to remove the effusions in the intestines, the pelvic cavity and other occult regions, reducing the incidence of intraabdominal infection or intraperitoneal abscess [17]. During the procedures, laparoscopy avoids the stimulation of gauze and gloves to the tissues, and reduces exposure to the internal organs in the abdominal cavity and interference to the gastrointestinal tract, leading to less inflammation and fewer complications such as intestinal adhesion [18]. As to surgical trauma, the results of our study demonstrates that the operation time, intraoperative bleeding, length of hospital stay, anal exhaust time,

gastrointestinal function recovery time and postoperative ambulation time in the laparoscopy group were significantly shorter or early than those in the laparotomy group. This is due to a smaller incision of laparoscopic surgery, without big incision or sutures, so the surgery becomes less difficult and needs less time. Relatively closed surgical setting reduces the interference and stimulation to the abdominal cavity, allowing quicker recovery the patients' of gastrointestinal functions and early ambulation [19]. In addition, it is generally not necessary to remove stitches in a laparoscopic surgery, so the length of hospital stay is shorter. As for postoperative pains, although the preoperative VAS scores did not differ significantly between the laparoscopy group and the laparotomy group, the findings at 1 day and 3 days after surgery showed that the patients in the laparoscopy group suffered less postoperative pain than those in the laparotomy group. This may be attributed to the facts that postoperative pain is reduced because of smaller incision and less traction of the muscles in the abdominal walls during the laparoscopic surgery.

When it comes to postoperative inflammation, laparoscopy can reduce inflammatory response. The results of our study showed that 1 week after surgery, the serum hs-CRP, TNF-α and IL-6 levels in the laparoscopy group were significantly lower than those in the laparotomy group. The cytokines Hs-CRP, TNF-α and IL-6 are frequently used as inflammatory stress predictors. After trauma, mastocytes or eosinophils in the body secrete a sea of hs-CRP, TNF-α and IL-6. The changes in their expression levels can reveal severity of inflammation in the body. Ma Z and other researchers have also reported that laparoscopy is more effective in reducing the inflammatory cytokines CRP, TNF-α and IL-6 levels than open radical gastrectomy [20]. As far as postoperative recovery is concerned, the postoperative overall QOL scores at 1 month and 3 months in the laparoscopy group were significantly better than those in the laparotomy group. This may be the reasons that laparoscopy is associated with much less damage to the body. In contrast, the conventional laparotomy makes more damage to the body [21]. The evaluation of postoperative QOL can quantitatively measure the patients, and comprehensively reflect the patient's psychological, physical and social conditions. Thus, it can provide evidence for the assessment of clinical effects. A study on QOL of laparoscopic colorectal cancer done by a foreign scholar showed that, compared with the laparotomy group, the laparoscopy group gained short-term benefits with regard to the overall QOL scores, which is consistent with the results of this study [22].

In conclusion, the elderly patients should undergo laparoscopy for repair of perforation after confirmed with upper GI perforations. As compared with the conventional laparotomy, laparoscopy brings more accurate operational effects, less severe trauma, less intraoperative bleeding and inflammatory response, lower incidence of postoperative complications, quicker postoperative recovery, as well as less severe pain. However, this study has some limitations, such as a small sample size and single-centered nature. Large, high-quality prospective, randomized, controlled studies are required to future validate the findings.

Disclosure of conflict of interest

None.

Address correspondence to: Xingbin Zheng, Department of Gastrointestinal Surgery, Affiliated Hospital of Zunyi Medical College, No. 149 Dalian Road, Zunyi 563000, Guizhou, P. R. China. Tel: +86-0851-28608915; Fax: +86-0851-28608915; E-mail: xingbinzheng68@163.com

References

[1] Lui FY and Davis KA. Gastroduodenal perforation: maximal or minimal intervention? Scand J Surg 2010; 99: 73-77.

[2] Nirula R. Gastroduodenal perforation. Surg Clin North Am 2014; 94: 31-34.

[3] Byrge N, Barton RG, Enniss TM and Nirula R. Laparoscopic versus open repair of perforated gastroduodenal ulcer: a national surgical quality improvement program analysis. Am J Surg 2013; 206: 957-962; discussion 962-953.

[4] Bhogal RH, Athwal R, Durkin D, Deakin M and Cheruvu CN. Comparison between open and laparoscopic repair of perforated peptic ulcer disease. World J Surg 2008; 32: 2371-2374.

[5] Wilhelmsen M, Moller MH and Rosenstock S. Surgical complications after open and laparoscopic surgery for perforated peptic ulcer in a nationwide cohort. Br J Surg 2015; 102: 382-387.

[6] Guadagni S, Cengeli I, Galatioto C, Furbetta N, Piero VL, Zocco G and Seccia M. Laparoscopic repair of perforated peptic ulcer: single-center results. Surg Endosc 2014; 28: 2302-2308.

[7] Soreide K, Thorsen K, Harrison EM, Bingener J, Moller MH, Ohene-Yeboah M and Soreide JA. Perforated peptic ulcer. Lancet 2015; 386: 1288-1298.
[8] Agaba EA, Klair T, Ikedilo O and Vemulapalli P. A 10-Year review of surgical management of complicated peptic ulcer disease from a single center: Is laparoscopic approach the future? Surg Laparosc Endosc Percutan Tech 2016; 26: 385-390.
[9] Tan S, Wu G, Zhuang Q, Xi Q, Meng Q, Jiang Y, Han Y, Yu C, Yu Z and Li N. Laparoscopic versus open repair for perforated peptic ulcer: a meta analysis of randomized controlled trials. Int J Surg 2016; 33 Pt A: 124-132.
[10] Wong CW, Chung PH, Tam PK and Wong KK. Laparoscopic versus open operation for perforated peptic ulcer in pediatric patients: a 10-year experience. J Pediatr Surg 2015; 50: 2038-2040.
[11] Zhou C, Wang W, Wang J, Zhang X, Zhang Q, Li B and Xu Z. An updated meta-analysis of laparoscopic versus open repair for perforated peptic ulcer. Sci Rep 2015; 5: 13976.
[12] Ge B, Wu M, Chen Q, Chen Q, Lin R, Liu L and Huang Q. A prospective randomized controlled trial of laparoscopic repair versus open repair for perforated peptic ulcers. Surgery 2016; 159: 451-458.
[13] Lee DJ, Ye M, Sun KH, Shelat VG and Koura A. Laparoscopic versus open omental patch repair for early presentation of perforated peptic ulcer: matched retrospective cohort study. Surg Res Pract 2016; 2016: 8605039.
[14] Antoniou SA, Antoniou GA, Koch OO, Pointner R and Granderath FA. Meta-analysis of laparoscopic versus open repair of perforated peptic ulcer. JSLS 2013; 17: 15-22.
[15] Boo YJ, Kim WB, Kim J, Song TJ, Choi SY, Kim YC and Suh SO. Systemic immune response after open versus laparoscopic cholecystectomy in acute cholecystitis: a prospective randomized study. Scand J Clin Lab Invest 2007; 67: 207-214.
[16] Noel JK, Fahrbach K, Estok R, Cella C, Frame D, Linz H, Cima RR, Dozois EJ and Senagore AJ. Minimally invasive colorectal resection outcomes: short-term comparison with open procedures. J Am Coll Surg 2007; 204: 291-307.
[17] Sanabria A, Villegas MI and Morales Uribe CH. Laparoscopic repair for perforated peptic ulcer disease. Cochrane Database Syst Rev 2013; CD004778.
[18] Bertleff MJ, Halm JA, Bemelman WA, van der Ham AC, van der Harst E, Oei HI, Smulders JF, Steyerberg EW and Lange JF. Randomized clinical trial of laparoscopic versus open repair of the perforated peptic ulcer: the LAMA trial. World J Surg 2009; 33: 1368-1373.
[19] Golash V. Ten-year retrospective comparative analysis of laparoscopic repair versus open closure of perforated. Oman Med J 2008; 23: 241-246.
[20] Ma Z, Bao X and Gu J. Effects of laparoscopic radical gastrectomy and the influence on immune function and inflammatory factors. Exp Ther Med 2016; 12: 983-986.
[21] Ates M, Sevil S, Bakircioglu E and Colak C. Laparoscopic repair of peptic ulcer perforation without omental patch versus conventional open repair. J Laparoendosc Adv Surg Tech A 2007; 17: 615-619.
[22] Weeks JC, Nelson H, Gelber S, Sargent D and Schroeder G. Short-term quality-of-life outcomes following laparoscopic-assisted colectomy vs open colectomy for colon cancer: a randomized trial. JAMA 2002; 287: 321-328.