

Original Article

Diagnostic Value of Mini-laparoscopy in Patients with Abdominal Neoplasm

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ABSTRACT

Objective: Blood biochemistry, ascites tests, and imaging examinations have low sensitivities in abdominal neoplasm diagnoses. In addition, exploratory laparotomy is not suitable for final stage patients. Mini-laparoscopy has recently emerged as a new diagnostic technology for abdominal disease. The aim of this research was to evaluate the value of mini-laparoscopy in diagnosing abdominal neoplasms.

Methods: Clinical and operational data were retrospectively analyzed in 20 cases with pathologically confirmed abdominal malignancies. Of these, 10 cases were each diagnosed by mini-laparoscopy and exploratory laparotomy. The surgical and anesthesia expenses, perioperative nursing, monitoring and treating charges, postoperative hospital stay and complications were compared between groups.

Results: The surgical and anesthesia costs were statistically lower in patients who received a mini-laparoscopy ($P < 0.01$). Perioperative drug expenses and nursing and monitoring charges were also significantly decreased ($P < 0.05$ and $P < 0.01$, respectively). Further, the gastrointestinal function recovery time and postoperative hospital stay were significantly reduced in the mini-laparoscopy group. There was no significant difference between the two groups regarding the preoperative hospital stay and postoperative complications.

Conclusion: Mini-laparoscopy effectively reduces surgical injury and treatment costs, and is capable of safely diagnosing abdominal tumors. Moreover, the procedure is also easy to perform.

Key words: Laparoscopy; Abdominal neoplasms; Diagnosis

INTRODUCTION

On September 21, 1901, which is considered the birth date of the laparoscopy technique, Georg Kelling, a surgeon from Dresden, Germany, described his new technique as "coelioscopy" and used pneumoperitoneum to create visual intra-abdominal space in dogs^[1]. Years later, Jacobaeus^[2] named the procedure "laparoscopy" and initiated its clinical use. Kalk, who was an internist in Frankfurt, Germany, "reinvented" laparoscopy for the fourth time in the 1920s, ushering in the modern era of laparoscopy, which was dominated by gastroenterologists for more than six decades^[3]. Kalk developed the modern instrumentation, specifically for oblique optics (135-degree side-viewing), which facilitated a panoramic view of the abdominal cavity and its organs through rotation. Laparoscopy became an important diagnostic tool, especially in the differential diagnosis of liver disease with guided biopsy and the staging of intra-abdominal malignancies. Over the years, laparoscopy has undergone multiple rediscoveries, coming full circle with its current use predominantly by surgeons for minimally invasive surgery; however, in comparison to therapeutic laparoscopic techniques, laparoscopic

exploration has been relatively ignored. The traditional laparoscopic technique that is applied by surgeons is often not easily mastered by physicians. With the emergence of non-invasive imaging techniques, such as ultrasound (US), computer tomography (CT), and magnetic resonance imaging (MRI), physicians have come to believe that comparable laparoscopic exploration results could be obtained with these methods; thus, the use of laparoscopy by gastroenterologists has dramatically declined since the 1980s^[4, 5].

Clinically, small metastatic foci in the peritoneum or liver, or primary retinal and peritoneal malignancy cannot be accurately diagnosed using traditional US, CT or MRI in some cases. The accuracy rates of routine blood biochemistry, ascites testing and imaging examinations have been reported to be no more than 40% to 41.2%, whereas the accuracy rate of peritoneal biopsy and percutaneous liver biopsy was merely 5% to 57%^[6-8]. Meanwhile, patients with rapidly growing disease might miss the opportunity for an open abdominal exploration. Finally, the open abdominal diagnosis rates of difficult and complicated cases were only 10% to 40%, whereas diagnostic laparotomy or a combination of diagnostic laparotomy with laparoscopic ultrasound correctly diagnosed 43% to 65% of patients using the open abdominal exploration^[9].

For decades, diagnostic laparoscopy in internal medicine has been performed using laparoscopes that are

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similar to those used in surgery, with diameters of approximately 10 mm. In late 2007, OLYMPUS small-caliber laparoscopic instrumentation was introduced for application in mini-laparoscopy, and this instrumentation has been used by physicians in the Zhong-Shan Hospital Endoscopy Center of Fudan University. Using this instrumentation, fifty patients underwent laparoscopic exploration, of whom ten patients were diagnosed with an abdominal malignancy. These patients were compared to ten other patients who had been confirmed with an abdominal malignancy by open exploration to explore the clinical value and safety of mini-laparoscopy in diagnosing abdominal malignancy.

MATERIALS AND METHODS

General Information

From Jan 2007 to Jun 2008, 20 consecutive inpatients were pathologically diagnosed with primary or metastatic abdominal malignancy. Of these, ten patients were diagnosed with a mini-laparoscopy (LAP group), whereas the rest were diagnosed with an open abdominal exploration (OPEN group). All 20 patients had complete clinical and laboratory tests (physical examination, blood biochemistry, ascites test and endoscopy) and imaging results (US, CT and MRI), and all the results were negative.

Equipment and Methods

The OLYMPUS high-definition mini-laparoscopy instrumentation, high-flow automatic pneumoperitoneum machine (UHI-3, Olympus Surgical & Industrial America Inc., Center Valley, PA, USA) and high-brightness xenon lamps (CLV-S40, Olympus Surgical & Industrial America Inc.) were used for the mini-laparoscopy in the present study. The selection of anesthetic techniques (regional anesthesia with or without intravenous anesthesia and general anesthesia) followed the patients' conditions. The supine position was also used. The skin was incised in the left upper quadrant of the abdomen at 3-5 cm away from the ventral line, and two fingers' width above the navel. The

artificial pneumoperitoneum was made, and an intra-abdominal pressure of 8-12 mmHg was maintained. The entire abdominal cavity was explored using mini-laparoscopy. At least 6 points of biopsy tissue at the most suspicious site for pathological examination were taken, and the total exploration time lasted at least 15-45 minutes. For patients with moderate or greater volumes of ascites, a layer-by-layer suture was performed, whereas no suturing was needed for patients with low volumes of or without ascites. If needed, an open abdominal exploration was performed.

Statistical Analysis

The demographic data, laboratory data, and clinical and economic parameters for each patient were recorded. For the statistical analyses, *t*-tests and Fisher's exact tests were performed with a cut-off point of $P < 0.05$ using the SPSS statistical analysis program, version 13.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

The sex ratio was the same in LAP group and OPEN group (3:2). The mean age in the LAP group and the OPEN group was 53.60 ± 11.59 years and 59.90 ± 13.35 years, respectively, and no statistical difference was found between the two groups. No statistical differences were found in the laboratory data, including hemoglobin (Hb), alanine aminotransferase (ALT), creatinine (Cr), carcinoembryonic antigen (CEA), CA199, CA125, endoscopy results, ascites tests or CT and MRI imaging (Table 1). In the LAP group, there were two cases of malignant mesothelioma, five cases of metastatic adenocarcinoma, two cases of mucinous cystadenocarcinoma and one case of epithelial malignancy, whereas in the OPEN group, there were five cases of metastatic adenocarcinoma, one case of malignant mesothelioma, two cases of mucinous cystadenocarcinoma, one case of metastatic neuroendocrine tumors, and one case of rhabdomyosarcoma.

Table 1. Comparison of demographic and laboratory data between the LAP and OPEN groups

Indices	LAP (n=10)	OPEN (n=10)	P
Sex (Male:Female)	3:2	3:2	1.000 ^a
Age	53.60±11.59	59.90±13.36	0.275 ^b
Hb <110 g	30%	10%	0.264 ^a
ALT >70 U/L	0	10%	0.305 ^a
Cr >110 μmol/L	0	0	-
Positive exfoliated cells in ascites	0	0	-
Positive endoscopy results	0	0	-
Abnormal CEA	30%	50%	0.361 ^a
Abnormal CA199	10%	30%	0.264 ^a
Abnormal CA125	30%	20%	0.606 ^a
Abnormality in CT or MRI results			
Ascites	100%	80%	0.136 ^a
Omentum thickening	60%	40%	0.371 ^a
Retropertoneum lymph node enlargement	30%	50%	0.361 ^a

^aChi square test, ^b*t*-test.

Table 2. Comparison of clinical data between the LAP and OPEN groups

Indices	LAP (n=10)	OPEN (n=10)	P
Preoperative Hospital time (days)	7.30±4.35	9.60±3.20	0.195 ^a
Surgical expense (RMB)	1160.01±95.98	2403.86±602.58	<0.001 ^b
Anesthesia and monitoring cost (RMB)	1164.22±123.00	3284.17±425.24	<0.001 ^b
Perioperative drug expense (RMB)	723.31±362.33	1949.09±1080.74	0.016 ^b
Perioperative nursing expense (RMB)	70.80±15.30	495.94±558.47	0.001 ^b
Gastrointestinal function recovery time (days)	0.10±0.13	3.35±1.25	<0.001 ^b
Complication rate	0	20%	0.474 ^c
Postoperative hospital time (days)	4.50±2.22	12.30±7.92	0.060 ^b

^at-test, ^bWilcoxon rank sum test, ^cChi square test.

In-hospital days from admission to operation were 7.30±4.35 days in the LAP group and 9.60±3.20 days in the OPEN group ($P=0.195$). In terms of Chinese Yuan, significant differences were found in the surgical expenses (LAP group: 1160.01±95.98; OPEN group: 2403.86±602.58) and anesthesia and monitoring costs (LAP group: 1164.22±123.00; OPEN group: 3284.17±425.24) ($P<0.01$). Moreover, the perioperative drug expenses (723.31±362.33) and perioperative nursing expenses (70.80±15.30) of the LAP group were also significantly less than the OPEN group (1949.09±1080.74 and 495.94±558.47, respectively). The gastrointestinal recovery time in the LAP group (0.15±0.13 days) was significantly shorter than that in the OPEN group (3.35±1.25 days) ($P<0.01$). The postoperative hospital stay in the LAP group (4.50±2.22 days) was still significantly shorter than that in the OPEN group (12.30±7.92 days) ($P<0.01$). No significant difference was found in the incidence of complications between the two groups ($P=0.474$) (Table 2).

DISCUSSION

Safety of mini-laparoscopy

The diagnostic process is usually relatively lengthy for patients with abdominal tumors, as they might undergo imaging examination or endoscopy several times with negative results; however, such malignancies usually rapidly progress and quickly present the end-stage clinical manifestation of cachexia. Routine open abdominal exploration is an invasive operation that requires anesthesia. Patients in poor condition cannot tolerate open exploration and the associated as well, which may result in their not receiving treatment in a timely manner. The anesthesia requirements were relatively low in the LAP group: 6 patients underwent regional anesthesia (local anesthetic infiltration) after propofol vein-induced anesthesia, two patients received epidural anesthesia, and the other two patients with chronic obstructive pulmonary disease received general anesthesia. Meanwhile, all of the patients in the OPEN group received general anesthesia. Regional anesthesia has several advantages: quicker recovery, decreased postoperative nausea and vomiting, less postoperative pain, shorter postoperative stay, cost effectiveness, improved patient satisfaction, overall safety, early diagnosis of complications, and fewer hemodynamic changes^[10, 11]. The sequelae of general anesthesia, such as

sore throat, muscle pain, and airway trauma, can be avoided.

Carbon dioxide approaches the ideal insufflation gas and maintains its role as the primary insufflation gas in laparoscopy. Residual carbon dioxide in pneumoperitoneum is cleared more rapidly than other gases, minimizing the duration of postoperative discomfort^[12]; however, the chief drawback of carbon dioxide is its significant vascular absorption across the peritoneum, leading to hypercapnia and intravascular embolization^[13]. The mini-laparoscopy technique also exhibited a low demand on the associated artificial pneumoperitoneum. The intra-abdominal pressure of the mini-laparoscopy should generally maintain at 8-12 mmHg, which is much lower than routine surgical laparoscopy. The OLYMPUS high-volume automatic pneumoperitoneum machine (UHI-3) that is used in our center can automatically control and set pressure and has the ability to automatically decompress, minimizing the influence of breathing and reducing the incidence of gas embolism and subcutaneous emphysema.

In comparison to open abdominal exploration, the incidence of complications for the laparoscopy technique was extremely low^[14]. Considering the high diagnostic efficacy of laparoscopy, the complication rate of this micro-invasive method seems to be acceptable. According to a review covering 46,364 cases of laparoscopy, severe complications occur in 0.149% of cases, with a mortality rate of 0.054%. In this review, bleeding from the abdominal wall and umbilical veins caused by the trocar (8 deaths) and complications following liver biopsy, with bleeding, bile leakage and bile peritonitis (17 deaths), posed the highest risk^[15]. Catastrophic bleeding from large caliber vessels in the abdominal wall may be avoided by pre-laparoscopic US with high-frequency and high-resolution linear scanners and with the aid of duplex sonography; laparoscopists can use these methods to reduce potential injury to these vessels by selecting the trocar as the point of entry^[16]. A 5 mm caliber mini-laparoscope is used in our clinical practice. Therefore, the laparoscope could be inserted into the abdomen just after the skin incision, minimizing organ injury^[17]. Further, suturing was not routinely required. The operation could also be safely conducted outside of the operation room in the endoscopy center because the laparoscopy technique requires a relatively simplified

operation environment^[18].

Economic Value of Mini-laparoscopy

The surgical, monitoring and nursing expenses were significantly lower in the LAP group in comparison to the OPEN group as a result of the mini-laparoscopy's operability and safety. Open exploration should be conducted in the operating room and demands both high levels of anesthesia and monitoring, even though the operation may not be complicated from the surgeon's perspective. Conversely, the mini-laparoscopy procedure can be conducted in the endoscopy center after the administration of local anesthesia. General anesthesia was reserved for patients with high-volume ascites or cardiopulmonary diseases. Owing to the minimally invasive procedure and relatively simplified anesthesia, the perioperative drug, nursing and monitoring expenses were significantly lower in the LAP group in comparison to the OPEN group. Patients undergoing the mini-laparoscopy procedure rarely required special nursing and monitoring, and the operation had less effect on the gastrointestinal functions. In the present control study, the patient recovery time in the LAP group was significantly shorter than that in the OPEN group.

In comparison to open abdominal exploration, mini-laparoscopy has a clear cost-benefit advantage in diagnosing abdominal malignancy. Because the ultra-fine method of minimally invasive laparoscopy and anesthesia is simplified relative to open exploration, drug use after surgery, care and custody costs were lower; hence, surgery had little effect on the gastrointestinal functioning of patients (only a few patients required general anesthesia and 6 hours of fasting). Wounds did not require dressing, so post-surgical nursing care costs and drug costs were also lower than those of the laparotomy. In this controlled study, the postoperative recovery time of patients who received mini-laparoscopy was significantly shorter than that of the control group. In comparison to the laparotomy procedure, the laparoscopic diagnosis of malignant tumors has clear cost-benefit advantages.

In conclusion, for the diagnosis of abdominal tumors, mini-laparoscopy has reduced surgical injuries and costs, while being safe and easily mastered. The procedure might

be recommended as the routine approach in diagnosing abdominal disease, especially in abdominal malignancies.

REFERENCES

1. Kelling G. Uber Oesophagoskopie, Gastroskopie und Koloskopie. Münch Med Wochenschr 1902; 49:21-4.
2. Jacobaeus HC. Kurze Übersicht über meine Erfahrungen mit der Laparo-thoraskopie. Münch Med Wochenschr 1911; 58:2017-9.
3. Kalk H. Erfahrungen mit der Laparoskopie. Zeitschr Klin Med 1929; 111:303-48.
4. Gutt CN, Müller-Stich BP, Reiter MA. Success and complication parameters for laparoscopic surgery: a benchmark for natural orifice transluminal endoscopic surgery. Endoscopy 2009; 41:36-41.
5. Nord HJ. Laparoscopy—A historical perspective: are gastroenterologists going to reclaim it? Gastrointest Endosc 2008; 68:67-8.
6. Weickert U, Jackobs R, Riemann JF. Diagnostic laparoscopy. Endoscopy 2005; 37:33-7.
7. Parra JL, Reddy KR. Diagnostic laparoscopy. Endoscopy 2004; 36: 289-93.
8. Sporea I, Popescu A, Sirli R. Why, who and how should perform liver biopsy in chronic liver diseases? World J Gastroenterol 2008; 14: 3396-402.
9. Schneider AR, Eickhoff A, Arnold JC, et al. Diagnostic laparoscopy. Endoscopy 2001; 33:55-9.
10. Mazdisnian F, Palmieri A, Hakakha B, et al. Office microlaparoscopy for female sterilization under local anesthesia. A cost and clinical analysis. J Reprod Med 2002; 47:97-100.
11. Collins LM, Vaghadia H. Regional anesthesia for laparoscopy. Anesthesiol Clin North America 2001; 19:43-55.
12. Menes T, Spivak H. Laparoscopy: searching for the proper insufflation gas. Surg Endosc 2000; 14:1050-6.
13. Gutt CN, Oniu T, Mehrabi A, et al. Circulatory and respiratory complications of carbon dioxide insufflation. Dig Surg 2004; 21:95-105.
14. Yoon YJ, Ahn SH, Park JY, et al. What is the role of laparoscopy in a gastroenterology unit? J Gastroenterol 2007; 42:881-6.
15. Karnam US, Reddy KR. Diagnostic laparoscopy: an update. Endoscopy 2002; 34:146-53.
16. Friedrich K, Vogel HM, Henning H. The importance of variant insertions of the ligamentum teres hepatis in the Cruveilhier Baumgarten syndrome. Endoscopy 1988; 20:254-9.
17. Classen M, Zillinger C, Frimberger E. Diagnostic laparoscopy: let's do it again. Gastrointest Endosc 1999; 50:297-9.
18. Gerges FJ, Kanazi GE, Jabbour-Khoury SI. Anesthesia for laparoscopy: a review. J Clin Anesth 2006; 18:67-78.