Injury, Int. J. Care Injured 45 (2014) 850–854

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Gasless laparoscopic assisted surgery for abdominal trauma

Chien-Hung Liao [a,1], I-Ming Kuo [a,1], Chih-Yuan Fu [a], Chih-Chi Chen [b], Shang-Ju Yang [a], Chun-Hsiang Ouyang [a], Shang-Yu Wang [a], Shao-Wei Chen [c], Yu-Pao Hsu [a], Shih-Ching Kang [a,*]

[a] *Department of Traumatology and Emergency Surgery, Chang Gung Memorial Hospital, Chang Gung University, Taoyuan, Taiwan*
[b] *Department of Physical Medicine and Rehabilitation, Chang Gung Memorial Hospital, Chang Gung University, Taoyuan, Taiwan*
[c] *Department of Cardiac Surgery, Chang Gung Memorial Hospital, Chang Gung University, Taoyuan, Taiwan*

ARTICLE INFO

Article history:
Accepted 25 October 2013

Keywords:
Gasless laparoscopy
Abdominal trauma
Isobaric laparoscopy
Abdominal lift laparoscopy
Gasless assisted laparoscopy

ABSTRACT

Background: Numerous studies have described the effectiveness of laparoscopy for trauma patients. In gas-filling laparoscopic surgery, most of the disadvantages are related to a positive pressure pneumoperitoneum that compromises the cardiopulmonary function. The main advantage of gasless laparoscopic assisted surgery (GLA) is that it does not affect the haemodynamic status, which is particularly critical for trauma patients. The purpose of this study was to investigate the feasibility and safety of GLA for abdominal trauma.
Materials and methods: This was a retrospective, 1:2 matched case–control study of all trauma gasless assisted laparoscopies performed from January 2010 until January 2013 in a Level I trauma centre. In total, 965 patients with abdominal trauma were admitted. According to the abdominal trauma protocol, a total of 93 hemodynamically stable patients required the operation; we selected fifteen patients to undergo GLA and matched 30 other patients to undergo laparotomy. Demographic information, perioperative findings, injury severity score, and postoperative recovery were recorded and analyzed.
Results: A total of fifteen patients (ten men, five women) with a mean age of 44.4, standard deviation (SD) 13.2 years underwent GLA for abdominal trauma. Eight patients had penetrating injuries, while seven had blunt injuries. Overall, 73% patients had multiple injuries. The mean time to the identified lesion was 23.1, SD 10.9 min, and the mean operative time was 109.7, SD 33.5 min. Most of the lesions were repaired concurrently by GLA. One conversion to laparotomy was done. The mean length of hospital stay (HLOS) was 9.1, SD 4.5 days. No mortality occurred in this series. The mean follow-up was 22.0, SD 7.9 months, and there were no significant events during this period. The mean operative times were comparable in the GLA and open surgery group (109.7, SD 33.5 vs. 131.2, SD 43.6 min; $p = 0.076$). Compared with the open surgery group, the HLOS was significantly shorter in the GLA group (9.1, SD 4.5 vs.16.3, SD 6.4 days; $p = 0.030$).
Conclusion: GLA offers both therapeutic and diagnostic advantages for patients with abdominal trauma. GLA shares the advantages of laparoscopy and prevents the cardiopulmonary function from being compromised due to pneumoperitoneum, which is especially critical for trauma patients.

Introduction

In the past two decades, an increasing number of surgeons have been performing laparoscopic surgery to substitute for open surgery. With increasing levels of experience in laparoscopic surgery and the advent of improved equipment and devices, the use of laparoscopic surgery has become more and more widespread. Laparoscopic surgery is commonly used in various elective and emergent operations. Numerous studies have shown that laparoscopy is effective for diagnosing penetrating and blunt abdominal traumas and can successfully avoid a negative laparotomy [1–3]. Additionally, several studies have demonstrated the feasibility and effectiveness of the therapeutic role of laparoscopy in trauma patients [4–7].

In conventional gas-filling laparoscopic surgery, most of the disadvantages are related to the creation of a positive pressure pneumoperitoneum that induces hypercapnia, acidosis, gas embolism, pneumothorax, deep venous thrombosis, and haemodynamic instability [8–11]. Because of these problems,

* Corresponding author at: Department of Traumatology and Emergency Surgery, Chang Gung Memorial Hospital, 5 Fu-Hsing Street, Kwei-Shan Shiang, Taoyuan, Taiwan. Tel.: +886 3281200x3651; fax: +886 3 3285818.
E-mail address: Acsurgymet@gmail.com (S.-C. Kang).
[1] These authors contributed equally to this article.

0020–1383/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.injury.2013.10.041

laparoscopy still carries perioperative risks for trauma patients, who are often in relative haemodynamic instability; this is why the use of laparoscopy in trauma cases is relatively limited.

Gasless laparoscopic assisted surgery (GLA) using an abdominal wall-lifting device has been performed since 1993 [12]. Several studies have been published to assess the feasibility of GLA in general and in gynecologic surgery for various operations, such as hepatectomy, gastrectomy, myomectomy and hysterectomy [13–16]. These authors reported that GLA showed comparable efficacy to gas-filling laparoscopic surgery and was able to prevent the side effect of pneumoperitoneum. The primary advantage of GLA is does not compromise cardiopulmonary function, which is particularly critical for trauma patients [17,18]. However, there has been limited research on the use of GLA in trauma patients [12]. The purpose of this study was to investigate the diagnostic and therapeutic potential of GLA. Moreover, we tried to evaluate the feasibility and effectiveness of GLA for abdominal trauma.

Materials and methods

We conducted a retrospective matched case–control review study of all trauma gasless assisted laparoscopies performed from January 2010 until January 2013 in a Level I trauma centre, Chang Gung Memorial hospital, Linkou. The Chang Gung Memorial Hospital Internal Review Board approved the study. All of the data were collected prospectively into the trauma registry. In our institute, we define systolic pressure exceeding 90 mm Hg and heart rate lower than 120 ppm without using any inotrope as haemodynamic stability. According to the abdominal trauma protocol in our institute, for patients with abdominal trauma and haemodynamic stability, we performed surgical explorations under the following situations: (1) Herniation of the viscera or omentum; (2) Foreign bodies penetrating into the peritoneal cavity; or (3) Suspicion of a significantly hollow organ, mesentery or urinary bladder injury, as indicated by computed tomography or diagnostic lavage. During this period, 965 patients with abdominal traumas were admitted by the trauma service. We excluded patients with haemodynamic changes while they were waiting for the operation, those with obvious abdominal compartment syndrome and those with serious head injuries. We included 93 hemodynamically stable patients requiring surgery in this study. Fifteen patients were selected to undergo gasless assisted laparoscopic surgery, while the other 78 patients underwent laparotomy. Informed consent for the operative procedure was obtained from all patients before surgery. Demographic information and the results of physiological and biochemical analyses were collected. In addition, perioperative findings, operative time, non-therapeutic exploration and conversion to laparotomy were recorded. Postoperative data included the length of hospital stay, postoperative complications and final prognosis. The complication grade was the based on the Clavien–Dindo classification, and the occurrence of complications was defined positive if they were more severe than grade II. Afterward, we performed a 1:2 case–control matching and analysis. The 15 patients who underwent GLA were individually matched to 30 patients, who underwent an open surgery (OS) on the basis of age and injury severity score (ISS). We compared their perioperative courses and lengths of hospital stay (HLOS).

Statistical methods

The means and standard deviations (SD) were calculated for continuous variables. The conditional logistic regression model for matched data was used to compare groups of categorical data. Groups of continuous data were compared by the repeated measures ANOVA. A $p < 0.05$ was considered statistically significant, and all calculations were performed using SPSS for Mac (Version 20.0; IBM SPSS Inc, USA).

Surgical technique

During the operation, the patient was placed in a lithotomy position under general anaesthesia, and a nasogastric tube and a Foley tube were inserted. A vertical incision of 1.5 cm was made at the umbilicus. The peritoneum was entered under direct vision, and one finger was inserted into the peritoneal cavity to ensure that no viscera or omentum was retracted. The abdominal lifting system (Abdo-Lift®, EndoSurgery Ltd., Germany) was used for gasless-assisted laparoscopy. The lifting arm was applied at the transumbilical wound, and the abdominal wall was lifted until an adequate surgical field was achieved (Fig. 1). The 30-degree rigid videoscope was inserted into this incision. Two other ports were created bilateral to the pararectus line at the proper heights. If necessary, accessory ports were established, depending on the site of the lesion (Fig. 2). At first, the patient was placed in the reverse Trendelenburg position, which allows most of the small bowel to move into the lower abdomen in order to assess whether any damage occurred at the liver, pancreas, spleen, either diaphragm, transverse colon or stomach. Then, the patient was placed in the supine position and examined at the mid abdomen, the ascending and descending colon and the small bowel. The "handed off" manoeuvre was used to examine the small bowel from the ileocecal valve to the ligament of Treitz [17]. The small bowel and colon were evaluated inch by inch to prevent missing any lesions. If

Fig. 1. The gasless laparoscopic assisted surgery setting.

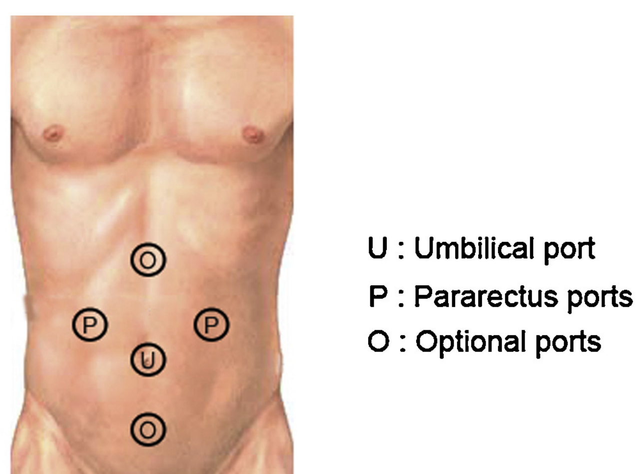

Fig. 2. Trocar position: umbilical port for abdominal lift system and laparoscope; two pararectus ports for instruments; optional port at epigastric or suprapubic area if necessary.