Positioning for Emergency Laparoscopic Splenectomy for Traumatic Splenic Rupture

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ABSTRACT

Objective: To determine whether the right-lateral decubitus or supine position is superior for emergency laparoscopy for traumatic splenic rupture.

Study Design: Descriptive study.

Place and Duration of the Study: Department of General Surgery, Central Hospital of Shaoxing, Affiliated Hospital of China Medical University, Zhejiang, China, from January 2015 to December 2022.

Methodology: Clinical data of 96 patients who underwent laparoscopic surgery (LS) for traumatic splenic rupture were analysed. The patients were divided into two groups according to surgical position. Group A (n = 42) patients were placed in the right-lateral decubitus position and Group B (n = 54) patients were placed in the supine position. The operation time, intraoperative blood loss, conversion to laparotomy rate, postoperative length of hospital stay, and complications rates were compared between the two groups.

Results: Compared with Group B, Group A had a shorter operation time (145.5 ± 24.4 min *vs.* 169.0 ± 15.3 min, p = 0.0001), less intraoperative blood loss (75.3 ± 35.3 ml *vs.* 110.3 ± 50.6 ml, p = 0.0002), fewer conversions to laparotomy (2.4% *vs.* 16.7%, p = 0.023), fewer cases of postoperative pancreatic leakage (7.1% *vs.* 24.1%, p = 0.027), and fewer complications (23.8% *vs.* 53.7%, p = 0.003); all differences were significant. There was no statistically significant difference in the postoperative length of hospital stay, hospital cost, or rate of complications such as fever, postoperative abdominal infection, postoperative bleeding or venous thrombosis between the two groups.

Conclusion: For patients with traumatic splenic rupture, the right-lateral decubitus position is best for LS.

Key Words: *Laparoscopy, Traumatic splenic rupture, Splenectomy, Surgical position.*

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INTRODUCTION

Studies have confirmed the safety and efficacy of laparoscopic management for traumatic splenic rupture by reporting its advantages over open surgery, which include less intraoperative blood loss, earlier postoperative gas discharge, shorter hospital stay, and fewer postoperative complications.[1-3] However, compared to patients with atraumatic splenic rupture, patients with traumatic splenic rupture frequently experience an accumulation of blood within the abdominal cavity and around the spleen as well as partial rupture or active bleeding, which therefore hinders proper visualisation of the surgical site and greatly increases the difficulty of laparoscopic surgery. Some studies have demonstrated that the lateral position is superior for laparoscopic procedures.[4,5] However, there are currently no relevant comparative studies on the surgical positions for emergency laparoscopic splenectomy (LS) for traumatic splenic rupture. It is not clear whether the surgical outcomes for patients with traumatic splenic rupture are the same as those for atraumatic splenic rupture. The aim of this study was to determine the best position for LS for traumatic splenic rupture by comparing surgical outcomes between the right-lateral decubitus and supine positions to provide evidence for clinical selection.

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METHODOLOGY

The study protocol was approved by the Human Research Ethics Committees of the Shaoxing Hospital of China Medical University Hospitals (Decision No: 24, Dated: 30.08.2023). Two hundred and twenty-one patients with ruptured spleens were admitted to Shaoxing Central Hospital between January 2015 and December 2022. A total of 96 patients who underwent LS, either in the supine or right-lateral decubitus positions, included in this study. The inclusion criteria were those who underwent LS; had no history of cirrhosis or splenomegaly or upper abdominal surgery; had Grade II-IV splenic rupture (American Association for the Surgery of Trauma (AAST) splenic injury Grade I-V);[6] and were in a generally acceptable condition with no severe cardiac, pulmonary, renal or coagulation dysfunc-

tion, and were able to tolerate surgery. A total of 125 patients were excluded who underwent open splenectomy; or underwent conservative treatment; and had a history of cirrhosis or splenomegaly and upper abdominal surgery; or severe injury to other organs and therefore required emergency surgery. Informed consent was obtained from each patient. The patients were divided into two Groups: Group A (n = 42; patients were placed in the right-lateral decubitus position during LS) and Group B (n = 54; patients were placed in the supine position during LS). Group A underwent the operation between January 2020 and December 2022 and Group B underwent the operation between January 2015 and December 2019. In both groups, the operative time, intraoperative blood loss volume, laparotomy conversion rate, postoperative hospital stay, hospital costs, and incidence of complications, including postoperative incisional infection, bleeding, fever, pancreatic leakage, abdominal infection, venous thrombosis, and overwhelming post-splenectomy infection (OPSI), were monitored. Pancreatic leakage was defined as an amylase level in the drainage fluid greater than three times the upper limit of normal.[7]

Before surgery, an abdominal enhanced computed tomography (CT) scan and preoperative tests, including routine blood and coagulation function tests, were conducted to assess the severity of splenic rupture in both groups. All operations were performed by the same team of attending surgeons who were at least associate chief physicians and had successfully performed 20 LSs.

The patients in both groups underwent standard laparoscopic surgery with five ports. Routine blood preparation and autologous blood transfusion were performed.

Five trocar ports were used in the right-lateral decubitus position. A 1cm longitudinal incision was made around the umbilicus to facilitate insertion of the laparoscope. The remaining four ports were placed in a V-shaped arrangement (Figure 1A). First, the safety of LS was re-evaluated. Then, the surgeon examined the abdominal cavity and ruled out the presence of any other visceral injuries; exposed the spleen (Figure 2A); and removed any perisplenic haematoma or blood clots; and fully assessed the extent of splenic injury. If there was obvious bleeding, such as from Grade IV and V ruptures, 4cm × 4cm gauzes were used for compression. Second, the assistant raised the inferior pole of the spleen (Figure 2B). The surgeon then used an ultrasonic scalpel to gradually dissect the splenic colic ligament, splenorenal ligament, and peripheral splenic diaphragmatic ligament to expose the splenic hilum (Figure 2C). In addition, the splenic vessels, such as the inferior, middle, and superior poles, were gradually dissected at the splenic hilum (Figure 2D). The short gastric vessels were completely transected along the greater curvature of the stomach. The surgery was performed carefully and in accordance with the "easy-first" principle. In cases where there was heavy bleeding in the splenic hilum that became difficult to manage, the splenic hilum could be clamped with forceps and then resected using the Endo-GIA cutting and closing device. Third, the specimen was placed in a bag and removed from the body by extending the incision around the umbilicus by 3-5 cm. Finally, the abdominal cavity, including the hepatorenal and pelvic cavities, was lavaged through the umbilical incision using an open suction device. Once the lavage fluid was clear and completely drained, the incision was closed with a 2-0 VICRYL Plus suture (Johnson & Johnson, USA). The splenic fossa underwent laparoscopic re-examination to confirm that there was no bleeding or oozing. In all patients, a drainage tube was inserted in the splenic fossa. The pneumoperitoneum was released, and all incisions were routinely closed.

Five trocar ports (Figure 1B) were used in the supine position. The procedure was identical to that described previously.

All patients were routinely assessed for 12 months after discharge. B-ultrasonic examination and blood tests were carried out for every patient.

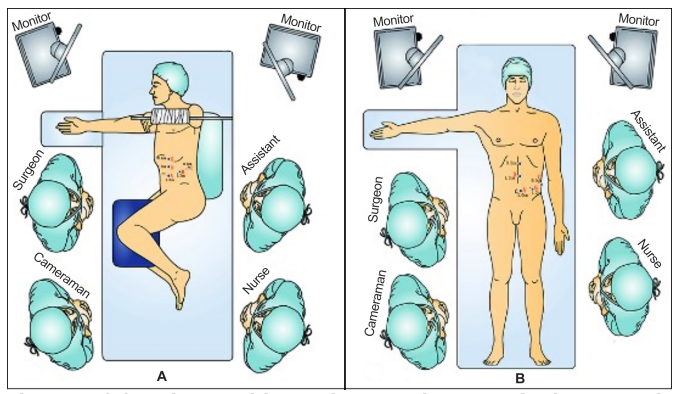

Figure 1: (A) Patient position and trocar placement for laparoscopic splenectomy in the lateral decubitus position. Port A, a 1 cm longitudinal incision around the umbilicus and a 10-mm trocar for the telescope. Port B, an auxiliary port at the intersection of the umbilicus horizontally to the midline of the right clavicle and a 12-mm trocar for the assistant's right hand. Port C, an auxiliary port at the line of the axillary, 5-mm trocar for the assistant's left hand. Port D, as the main port at the junction of the umbilicus and xiphoid line, a 12-mm trocar was used for the surgeon's right hand. Port E, an auxiliary port below the xiphoid. A 5-mm trocar was used for the surgeon's left hand. The B, C, D, and E ports could be properly adjusted during surgery. (B). Patient position and trocar placement for laparoscopic splenectomy in the supine position. The A, B, C, D, and E ports were nearly the same as those in the lateral-decubitus position and could be properly adjusted during surgery.

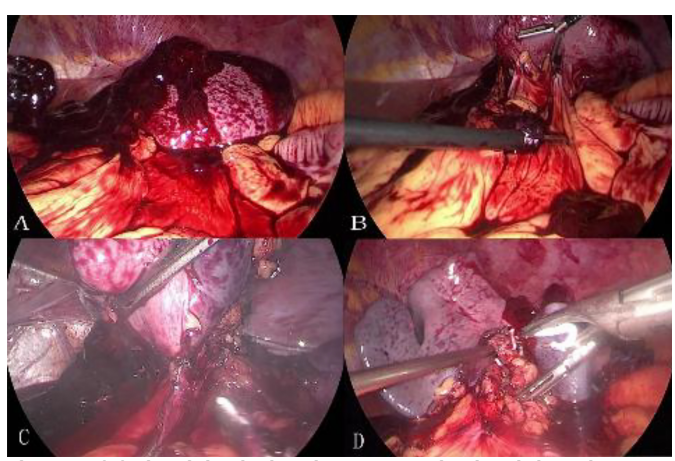

Figure 2: (A) The abdominal cavity was examined and the spleen was exposed. (B) An assistant raised the inferior pole of the spleen. (C) Fully exposure of the splenic hilum. (D) The splenic vessels, including the inferior, middle, and superior poles, were gradually dissected at the splenic hilum.

Table I: The clinical demographics of patients who underwent laparoscopic splenectomy in the right-lateral decubitus position and the supine position.

	Group A n = 42	Group B n = 54	p-value
Age (years)	51.0 ± 12.8	53.0 ± 10.7	0.403
Gender (F/M)	24/18	28/26	0.606
BMI (kg/m^2)	21.5 ± 2.6	22.0 ± 2.9	0.353
ASA (Grade I: Grade II)	32:10	40:14	0.812
Comorbidity rate (%)	27 (64.3)	29 (53.7)	0.297
AAST grade[8] (%)			0.955
Grade II	12 (33.3)	15 (33.3)	
Grade III	24 (57.1)	29 (53.7)	
Grade IV	4 (9.5)	7 (13.0)	
Grade V	2 (9.5)	3 (9.5)	
Preoperative blood loss (ml)	1900.0 ± 707.1	1850 ± 875.3	0.767

Group A: Patients who underwent laparoscopic splenectomy in the right-lateral decubitus position; Group B: Patients who underwent laparoscopic splenectomy in the supine position. AAST: American Association for the Surgery of Trauma; ASA: American Society of Anaesthesiologists (ASA) score; BMI: Body Mass Index

Table II: Surgical outcomes and postoperative complications in patients who underwent LS in the right-lateral decubitus position and the supine position.

	Group A n = 42	Group B n = 54	p-value
Conversion rate (%)	1 (2.4)	9 (16.7)	0.053
Frequency of changes in surgical position (Times)	4.3 ± 1.5	3.5 ± 1.4	0.009
Operative time (min)	145.5 ± 24.4	169.0 ± 15.3	<0.0001
Intraoperative blood loss (mL)	75.3 ± 35.3	110.3 ± 50.6	0.0002
Postoperative length of hospital stay (d)	7.7 ± 3.2	9.1 ± 4.7	0.095
Hospital costs (¥)	17168.2 ± 8231.7	19446.3 ± 8543.6	0.191
Complications			
Fever (%)	3 (7.1)	6 (11.1)	0.757
Abdominal infection (%)	1 (2.4)	3 (5.5)	0.629
Postoperative bleeding (%)	1 (2.4)	2 (3.7)	1.000
Pancreatic fistula (%)	3 (7.1)	13 (24.1)	0.027
Venous thrombosis (%)	2 (4.8)	5 (9.3)	0.462
Gross of complication (%)	10 (23.8)	29 (53.70)	0.003

Group A: Patients who underwent LS in the right-lateral decubitus position; Group B: Patients who underwent LS in the supine position.

All the statistical analyses were performed using SPSS version 22.0 (SPSS Inc., Chicago, IL). Continuous data were presented as the means ± SDs and categorical data were presented as proportions (%). Descriptive analysis was performed for the qualitative variables. Mean comparisons were made using a t-test. The χ^2 or Fisher's exact test or continuity correction was used to compare the proportions between the groups. A p-value <0.05 was considered to indicate statistical significance.

RESULTS

Of the 96 patients who were included in this study, 40 were injured in road traffic accidents, 31 due to falls, 19 due to blunt trauma to the left flank, and 6 due to stab wounds. Among these patients, 56 suffered rib fractures and 2 underwent rib-fixation surgery. Another 2 patients had pubic bone fractures, 1 of whom underwent external fixation of the pelvis. Additionally, 3 patients experienced concussion, and 1 had pneumothorax. The remaining patients did not require any special treatments. The clinical demographics of both groups are shown in Table I. Age, gender, body mass index, American Society of Anaesthesiologists (ASA) classification, comorbidity rate, American Association for the Surgery of Trauma (AAST) grade, and preoperative blood loss volume were similar in both groups. There were no significant differences (p >0.05 each).

No injuries were missed in any of the patients. Compared to Group B, Group A had a shorter operation time (p <0.0001), less intraoperative bleeding (p = 0.0002), and a lower rate of conversion to laparotomy (p = 0.024). Additionally, Group A experienced more frequent changes in surgical position (p = 0.008), However, there was no statistically significant difference in the postoperative length of hospital stay or posthospitalisation expenses (p >0.05). The incidence of pancreatic leakage was lower in Group A (p = 0.027), as was the overall rate of complications observed (p = 0.003), there was no statistically significant difference in the other complications (p >0.05), No cases of incision infection, serious infection or other severe complications occurred in either group of patients (Table II).

DISCUSSION

During the laparoscopic surgery, the surgeon has three assistants; the assistant, the cameraman, and gravity. In laparoscopic surgery, superior exposure of the surgical field is primarily achieved through changes in patient positioning and the use of gravity to expose target organs. There are three main approaches to LS; right-lateral decubitus, supine, and right oblique. The right oblique position was not included in this study because it can be achieved by changing the position of the operating table while the patient remains in one of the first two positions.

Intraoperative comparisons between the two groups revealed that patients who underwent LS in the right-lateral decubitus position had shorter operative time, lower open conversion rate, and less intraoperative blood loss than those who underwent the procedure in the supine position. This may be attributed to the good exposure of the spleen in the right-lateral decubitus position, which makes it easier to handle the splenic hilum and ligaments, thus reducing the operative time. The spleen is suspended from the diaphragm by gravity, while other organs such as the stomach, colon, and small intestine naturally fall away from the surgical field. This allows excellent exposure of the spleen without requiring any additional traction. The assistant can easily raise the spleen in steps to expose the splenic colonic ligament, splenorenal ligament, splenic hilum vessels, and spleen-gastric ligament, ensuring that they remain taut, which is more conducive to ligament dissection. For the dissection of the splenic hilum, the assistant raises inferior pole of the spleen to fully expose the splenic hilum.[2] The hilum can then be meticulously dissected using a two-step technique that involves isolating and ligating each branch. If dissection proves to be challenging or if there is vascular injury, haemostasis can be achieved using clips,[9] after which the spleen can be excised using a cutting stapler.[10,11] Previous studies have shown that vascular stapling can effectively reduce the operative time and intraoperative blood loss.[1,12]

The spleen is not well-exposed in the supine position. First, the assistant exposes the splenic ligaments and hilum using surgical instruments, however, maintaining a fixed position does not fully expose the operative field. This approach is also unstable, especially in obese patients.[13] Second, it is challenging to expose the ligaments at the posterior and superior poles of the spleen. This can frequently cause damage to the splenic capsule or bleeding from the splenic hilum, impacting the procedure and possibly requiring conversion to open surgery.[14] In this study, nine patients in the supine group had to be converted to open surgery due to bleeding from the splenic hilum dissection, while only one patient in the right-lateral position required open surgery due to rapid bleeding from the splenic hilum.[15] Although the supine position can be adjusted to the right-oblique position by changing the position of the operating table,[10] it is still limited in terms of full exposure of the spleen compared to the right-lateral decubitus position. The findings of this study suggest that the lateral decubitus position is more suitable, especially for severe splenic ruptures, as it provides good exposure of the surgical field and better access to the splenic hilum, and shortens the time to haemostasis. The results are the same as those of atraumatic LS. These outcomes are consistent with those observed after atraumatic LS.[5]

In terms of postoperative complications, pancreatic leakage is a common complication of LS. This is due to potential injury to the pancreatic tail during the manipulation of the splenic hilum.[16] In this study, patients who underwent LS in the right-lateral decubitus position had a lower incidence of pancreatic leakage than those who underwent LS in the supine position. The excellent exposure of the splenic hilum and the precise two-stage technique used for dissection may have contributed to this result.

In the surgical management of traumatic splenic rupture, initial abdominal exploration and final abdominal irrigation are the standard procedures. However, there is limited literature reporting on these two steps. Performing the two steps in the right-lateral decubitus position is difficult. Therefore, based on the authors' experience with laparoscopic exploration, it is necessary to adjust the position to the right tilt, as close to the supine position as feasible. During the exploration of the upper and lower abdomen, the position of the head was adjusted as required to allow optimal exposure of the liver, pancreas, omentum, mesentery, small intestine, colon, and pelvic region. This achieves the objectives of the exploration. It is also important to predict the blood loss volume: If the blood loss volume is greater than approximately 3000 ml, and there is active bleeding or even splenic hilar rupture, the authors recommend conversion to open surgery. If the patient is in a supine position, only the position of the head requires adjustment. No injuries were overlooked in either group. The surgeon undertaking this step must exercise caution, gentleness, and comprehensiveness.

As with open surgery, a thorough preoperative evaluation, careful review of imaging studies, and accurate assessment are crucial. Laparoscopy should be avoided if there is evidence of concomitant organ injury.[17] Extra precautions are advised when moving and positioning the patient to prevent further injury, particularly in cases involving rib fractures. Abdominal irrigation can be challenging and often inadequate. Surgeons are advised to expand the incision around the umbilical port, both above and below, to a range of approximately 3-5 cm. Through this incision, warm saline can be introduced to irrigate the pelvic region, the hepatorenal recess and the inter-intestinal spaces. The irrigation fluid can be repeatedly aspirated using a laparotomy aspirator to make the procedure more comfortable and thorough. Nevertheless, it is still advisable to laparoscopically irrigate the splenic recess, especially when performing the procedure with the patient in the right-lateral decubitus position. This study showed that patients who were positioned in the right-lateral decubitus position required more frequent changes during surgery. Although, it is important to note that the surgeons' technique may have influenced the results of the study, the authors ensured that the same surgeons performed the surgery.

CONCLUSION

The data provided in this study show that the right-lateral decubitus position is more feasible than the supine position for LS due to better access, faster haemostasis, lower risk of conversion to open surgery, less intraoperative blood loss, fewer postoperative complications, and more frequent changes in surgical positions. Importantly, although the

procedures were performed by the same surgeons, their technique may have been influenced by the experimental results. Therefore, it is necessary to conduct well-designed RCTs with sufficient power to establish a stronger foundation for making conclusive conclusions.

ETHICAL APPROVAL:
This study was approved by the Human Research Ethics Committee of the Shaoxing Hospital of China Medical University Hospitals (Decision No: 24, Dated: 30/8/23).

PATIENTS' CONSENT:
Informed consent was obtained from all the patients to publish the data in this study.

COMPETING INTEREST:
All the authors declare that the work is original and has not been submitted or published elsewhere. None of the authors have any financial disclosures or conflicts of interest.

AUTHORS' CONTRIBUTION:
HH: Study design and data collection, draft, and final editing of the manuscript.
JZ: Clinical management of the patients.
ZH and XM: Clinical management of the patients and clinical data collection.
RX: Analysis and organisation of the data.
All authors approved the final version of the manuscript to be published.

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