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ABOUT COVER

Editorial Board Member of *World Journal of Gastrointestinal Surgery*, Georgios Tsoulfas, AGAF, FACS, FICS, MD, PhD, Professor, Transplant Surgery, Aristotle University of Thessaloniki School of Medicine, Thessaloniki 54124, Greece. tsoulfasg@gmail.com

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WJGS mainly publishes articles reporting research results and findings obtained in the field of gastrointestinal surgery and covering a wide range of topics including biliary tract surgical procedures, biliopancreatic diversion, colectomy, esophagectomy, esophagostomy, pancreas transplantation, and pancreatectomy, etc.

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Retrospective Study

Utilization of deep neuromuscular blockade combined with reduced abdominal pressure in laparoscopic radical gastrectomy for gastric cancer: An academic perspective

Yi-Wei Zhang, Yong Li, Wan-Bo Huang, Jue Wang, Xing-Er Qian, Yu Yang, Chang-Shun Huang

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Yi-Wei Zhang, Yong Li, Wan-Bo Huang, Jue Wang, Xing-Er Qian, Yu Yang, Chang-Shun Huang, Department of Anesthesiology, Ningbo First Hospital, Ningbo 315016, Zhejiang Province, China

Corresponding author: Chang-Shun Huang, MBChB, Chief Doctor, Department of Anesthesiology, Ningbo First Hospital, No. 59 Liuting Street, Haishu District, Ningbo 315016, Zhejiang Province, China. nbhcs1967@163.com

Abstract

BACKGROUND

Few studies have examined the specific efficacy of deep neuromuscular blockade (NMB) combined with pneumoperitoneal pressure reduction in laparoscopic radical gastrectomy (LRG) in the elderly.

AIM

To investigate the application effect of deep neuromuscular blockade (NMB) combined with reduced pneumoperitoneum pressure in LRG for gastric cancer (GC) in elderly patients and its influence on inflammation.

METHODS

Totally 103 elderly patients with GC treated in our hospital between January 2020 and January 2022 were retrospectively analyzed. Among them, 45 patients treated with surgery based on deep NMB and conventional pneumoperitoneum pressure were assigned to the control group, while the rest of the 58 patients who underwent surgery based on deep NMB and reduced pneumoperitoneum pressure were assigned to the observation group. The two groups were compared in the changes of the Leiden-surgical rating scale score, serum tumor necrosis factor- α (TNF- α) and interleukin 6 (IL-6) before and after therapy. The visual analogue scale (VAS) was adopted for evaluating the shoulder pain of patients at 8 h, 24 h and 48 h after the operation. The driving pressure of the two groups at different time points was also compared. Additionally, the operation time, pneumoperitoneum time, infusion volume, blood loss, extubation time after surgery, residence time in the resuscitation room, TOF% = 90% time and post-anesthetic recovery room (PACU) stay time were all recorded, and adverse PACU-associated respiratory events were also recorded. The postoperative hospitalization time and

postoperative expenses of the two groups were counted and compared.

RESULTS

No significant difference was found between the two groups at the time of skin incision, 60 minutes since the operation and abdominal closure after surgery ($P > 0.05$). The observation group exhibited significantly lower VAS scores than the control group at 24 and 48h after surgery ($P < 0.05$). Additionally, the observation group had significantly lower driving pressure than the control group at 5 min and 60 min after the establishment of pneumoperitoneum ($P < 0.05$). Additionally, the two groups were similar in terms of the operation time, pneumoperitoneum time, infusion volume, blood loss, extubation time after surgery, residence time in the resuscitation room and TOF% = 90% time ($P > 0.05$), and the observation group showed significantly lower TNF- α and IL-6 Levels than the control group at 24 h after therapy ($P < 0.05$). Moreover, the incidence of adverse events was not significantly different between the two groups ($P > 0.05$), and the observation group experienced significantly less hospitalization time and postoperative expenses than the control group ($P < 0.05$).

CONCLUSION

Deep NMB combined with reduced pneumoperitoneum pressure can decrease the VAS score of shoulder pain and inflammatory reaction, without hindering the surgical vision and increasing adverse PACU-associated respiratory events, and can thus shorten the hospitalization time and treatment cost for patient.

Key Words: Deep neuromuscular blockade; Low pneumoperitoneum pressure; Elderly; Laparoscopy; Gastric cancer; Radical gastrectomy; Inflammation

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Core Tip: Laparoscopic radical gastrectomy is a common operation for the treatment of gastric cancer (GC) with minimally invasive and rapid recovery. However, high pneumoperitoneum pressure during laparoscopic surgery has an adverse effect on the perioperative outcome of patients, especially in elderly patients. Deep muscle relaxation has been proved to improve the conditions of abdominal surgery and reduce postoperative pain, but it is still unclear whether deep muscle relaxation combined with low pneumoperitoneum pressure is effective in laparoscopic radical resection of GC in the elderly. In this study, we analyzed the role of deep muscle relaxation combined with low pneumoperitoneum pressure in elderly patients undergoing laparoscopic radical gastrectomy for GC and its effect on inflammation, in order to provide a reference for clinicians to choose treatment options.

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INTRODUCTION

With the annual increase in the elderly population worldwide, ageing has become a crucial challenge for many countries, and these countries are making active efforts to prolong their citizens' lives[1]. With the improvement of living standards and the changes in dietary habits, the incidence of digestive system diseases is increasing gradually[2]. Gastric cancer (GC) is one of the malignant tumors with the highest incidence in China, which poses a serious threat to the life safety of patients and is more common among middle-aged and elderly people[3]. According to global oncology statistics in 2018, over 700000 people died of GC each year worldwide, and the disease is increasingly common among the young population[4].

Laparoscopic radical gastrectomy (LRG) is a primary method for GC, with the vantages of minimal invasion, clear surgical vision and rapid postoperative recovery[5]. The establishment of pneumoperitoneum is a key step in laparoscopic surgery, and the commonly used medium is carbon dioxide (CO₂). Intra-abdominal pressure (IAP) is primarily triggered by the hydrostatic pressure of abdominal organs. IAP in a normal physiological state is between 0-5 mmHg, while IAP in laparoscopic surgery is mostly 12-15 mmHg[6]. Clinically, excessive pneumoperitoneum pressure during laparoscopic surgery has been found to affect many organs of the body[7]. Moreover, the increase of IAP results in compression of the inferior vena cava and aorta, a decrease of visceral blood flow and renal blood flow and diaphragm displacement, and also greatly increases the risk of lower limb deep venous thrombosis, arrhythmia and cardiac events[8, 9]. These risks directly impact the perioperative outcome and long-term prognosis of patients, especially elderly patients with declining organ function and/or dysfunction[10].

In recent years, the technique of deep neuromuscular blockade (NMB) under muscle relaxation monitoring has been extensively adopted in clinical anesthesia, especially in laparoscopic surgery which requires more muscle relaxation, and it is highly popular among surgeons[11]. The improvement of surgical conditions during deep NMB is of great clinical significance for surgeons and deep NMB has become a crucial technique in some clinical laparoscopic operations[12]. Deep NMB has been shown to improve the surgical conditions of laparoscopic cholecystectomy, urology and gynaecological surgery. Compared with moderate NMB, deep NMB mainly provides the benefits of increasing the amount of CO₂ perfusion in the abdominal cavity and the distance between skin and sacrum and headland during pneumoperitoneum to greatly increase the abdominal space during pneumoperitoneum establishment, which is convenient for the operator to perform the procedure, relieve postoperative pain and promote intestinal function recovery[13]. Similarly, a study has revealed significant advantages of deep NMB over moderate NMB for patients undergoing elective laparoscopic colorectal surgery after recording the incidence of IAP alarm, surgical satisfaction, and the need for additional muscle relaxants to measure surgical conditions[14].

However, whether deep NMB combined with reduced pneumoperitoneum pressure is effective in LRG for GC in the elderly is rarely studied. Accordingly, this study analyzed the effect of deep NMB combined with reduced pneumoperitoneum pressure in elderly patients undergoing LRG for GC and its influence on inflammation, with the purpose of providing a reference for clinicians for the selection of therapeutic regimens.

MATERIALS AND METHODS

Clinical data

Totally 103 elderly patients with GC treated in our hospital between January 2020 and January 2022 were retrospectively analyzed. Among them, 45 patients treated with surgery based on deep NMB and conventional pneumoperitoneum pressure were assigned to the control group, while the rest 58 given surgery based on deep NMB and reduced pneumoperitoneum pressure were assigned to the observation group.

Inclusion and exclusion criteria

Inclusion criteria: (1) Patients ≥ 65 years old but ≤ 85 years old; (2) patients whose permanent residence had an altitude lower than 2500 m; (3) patients who received elective LRG for GC; (4) patients at grade I-III in American Society of Anesthesiologists (ASA) classification; and (5) patients with detailed clinical data.

Exclusion criteria: (1) Patients who received emergency surgery; (2) patients at grade IV or V in ASA classification; (3) patients who had received preoperative radiotherapy or chemotherapy or had distant metastasis of tumor; (4) patients with renal insufficiency (glomerular filtration rate < 30 mL/min) or liver dysfunction (aspartate aminotransferase and alanine transaminase > 1.5 times the normal value); (5) patients who were unable to cooperate with the research for reasons such as language understanding, mental illness, *etc.*; (6) patients who had taken other experimental drugs or participated in other clinical trials within 3 mo before enrolment into the study; and (7) patients who were not suitable for enrolment into this study.

Therapeutic regimen for the patients

Each patient received routine examination, and also received pulmonary function test and blood gas analysis. In addition, anesthetic visit was carried out by the anesthesiologist to each patient on the day before operation. All patients were operated on the same anesthesia equipment (anesthesia machine: Drager A500; monitor: Drager Infinity C500). After the patient entered the room, the electrocardiogram, blood pressure, pulse oxygen saturation, cerebral oxygen saturation, BIS (COVIDEN) and muscle relaxation (GE NMT module) were routinely monitored. Central venous catheterization and arterial puncture catheterization were performed to the patient under conscious local anesthesia to monitor arterial blood pressure, and 5 mL blood was sampled and kept in ice water mixture. Anesthesia induction was performed with 0.02-0.05 mg/kg midazolam, 0.2-0.5 μ g/kg sufentanil, 0.2-0.4 mg/kg etomidate, and 0.6 mg/kg rocuronium in sequence, and intubation was performed when TOF ratio was 0. Parameters of mechanical ventilation during operation: FiO₂ = 60%; oxygen flow: 2 L/min; ventilation mode: AUTO flow mode; VT = 6-8 mL/kg; I:E = 1:2; PEEP = 3 mmHg. Intravenous anesthesia was maintained during the operation with 4-8 mg/kg/h propofol and 0.1-0.3 μ g/kg/min remifentanyl, and BIS was maintained at 40-60. End-tidal carbon dioxide was maintained at approximate 35 mmHg. The usage of muscle relaxants was as follows: The control group was pumped with rocuronium immediately after intubation, with initial rate of 20 μ g/kg/min. PTC was measured every 2 min. When the PTC count was 1-2, the infusion rate of rocuronium (0-10 μ g/kg/min) was adjusted, and the PTC count was maintained at 1-2. The laparoscopic pneumoperitoneum pressure was set at 14 mmHg during operation. When muscle relaxation returned to T2 after surgery according to monitoring results, 2 mg/kg britine was used for antagonism, or when muscle relaxation showed that PTC count was 1-2 according to monitoring results, 4 mg/kg britine was used for antagonism. Patients in the observation group were pumped with rocuronium immediately after intubation, with the initial rate of 20 μ g/kg/min, and PTC was measured every 2 min. When the PTC count was 1-2, the infusion rate of rocuronium (0-10 μ g/kg/min) was adjusted and the PTC count was maintained at 1-2. The laparoscopic pneumoperitoneum pressure was set at 8 mmHg during operation. When muscle relaxation returned to T2 after surgery according to monitoring results, 2 mg/kg britine was used for antagonism, or when muscle relaxation showed that PTC count was 1-2 according to monitoring, 4 mg/kg britine was used for antagonism. The infusion of muscle relaxant and propofol was stopped 15 min abdominal closure after surgery, followed by application of the analgesic pump, and the patient was given 5 μ g sufentanil intravenously. The infusion of

remifentanyl was stopped during suturing the skin. The formula of postoperative analgesia pump: 1.5-2 µg/kg sufentanil + 5 mg tropisetron that were diluted to 100 mL normal saline, with flow rate of 2 mL/h, 1.5 mL single pressing, locking time of 15min. All cases were transported to the post-anesthetic recovery room (PACU) for resuscitation after abdominal closure at the end of the operation, and the extubation pointer was used for extubation according to the extubation pointer. All cases were treated by the chief surgeon and one assistant doctor in the same medical group from the department of gastrointestinal surgery, and were also given the same laparoscopic equipment and display device.

Biological index test

Before and after the therapy, 5 mL peripheral venous blood was collected from each patient, followed by 5-min centrifugation (2000 r/min) to separate serum, and the serum was kept at low temperature. Then serum tumor necrosis factor-α (TNF-α) and interleukin 6 (IL-6) were quantified *via* enzyme-linked immuno-sorbent assay with kits from Shanghai MLBIO Co., Ltd.

Outcome measures

Primary outcome measures: The changes of Leiden-surgical rating scale (L-SRS) scores before operation, 10 min after the establishment of pneumoperitoneum, 60 min after the establishment of pneumoperitoneum, and at the end of pneumoperitoneum in the two groups were recorded and compared[15]. L-SRS score ranges from 1 to 5, with 1 for extremely poor conditions, 2 for poor conditions, 3 for acceptable conditions, 4 for good conditions, and 5 for the best conditions. The changes of serum TNF-α and IL-6 were compared between the two groups before and after surgery.

Secondary outcome measures: The visual analogue scale (VAS) was adopted for evaluation of shoulder pain at 8, 24 and 48 h after operation[16]. The driving pressure of the two groups was compared at 5 min after intubation, 5 min and 60 min after establishment of pneumoperitoneum, and after recovery of pneumoperitoneum deflation returns to the horizontal level. Additionally, the operation time, pneumoperitoneum time, infusion volume, blood loss, extubation time after surgery, residence time in resuscitation room, TOF% = 90% time and PACU stay time were recorded. The adverse PACU-associated respiratory events were also recorded. The postoperative hospitalization time and postoperative expenses were counted and compared. Moreover, the clinical data were also compared between the two groups.

Statistical analyses

This study adopted SPSS 20.0 (SPSS Inc., Chicago, IL, the States) for analysis of collected data, and GraphPad Prism 8 for visualization of data. The Kolmogorov-Smirnov test was adopted for evaluation of the normal distribution. Data in normal distribution were described through mean ± SD, and analyzed using the *t* test. Inter-group comparison and intra-group comparison were conducted through the independent sample *t* test and paired *t* test, respectively. The classified variables were compared through chi-square test. *P* < 0.05 indicates a significantly significance.

RESULTS

Comparison of clinical data

According to comparison of clinical data between the observation and control groups, the two group were not significantly different in age, sex, body mass index, ASA classification, past medical history, clinical stage and tumor diameter (*P* > 0.05, Table 1).

L-SRS score changes

No significantly difference was found between the two groups in the changes of L-SRS score at the time of skin incision, 60 min since operation and abdominal closure after surgery (*P* > 0.05, Table 2).

VAS score changes

According to evaluation of VAS scores at 8, 24 and 48 h after operation in the two groups, the VAS score at 8 h after operation was not significantly different between the two groups (*P* > 0.05), but the VAS score of the observation group at 24 and 48 h after operation was diaphragm nerve. This problem has been effectively solved by reducing pneumoperitoneum pressure of patients. Moreover, after absorption of CO₂, microbubbles are form lower than that of the control group (*P* < 0.05, Table 3).

Comparison of driving pressure during operation

According to comparison of driving pressure during operation between the observation and control groups, the two groups were not significantly different in driving pressure at 5 min after intubation and after recovery of the pneumoperitoneum deflation to horizontal level (*P* > 0.05), but the driving pressure of the observation group was significantly lower than that of the control group at 5 min and 60 min after establishment of pneumoperitoneum (*P* < 0.05, Table 4).

Comparison of operation indexes

The operation time, pneumoperitoneum time, infusion volume, blood loss, extubation time after surgery, residence time in resuscitation room, TOF% = 90% time and PACU stay time in the two groups were recorded. According to the results, the two groups were similar in terms of operation time, pneumoperitoneum time, transfusion volume, blood loss, extubation time after surgery, residence time in resuscitation room and TOF% = 90% time (*P* > 0.05, Figure 1).

Table 1 Comparison of clinical data

Factors	Control group (n = 45)	Observation group (n = 58)	χ^2 value	P value
Age (yr)			0.287	0.591
≥ 65	21	24		
< 65	24	34		
Gender			1.059	0.303
Male	25	38		
Female	20	20		
BMI (kg/m ²)			0.069	0.791
≥ 23	19	26		
< 23	26	32		
ASA classification			0.142	0.931
Grade I	15	19		
Grade II	22	27		
Grade III	8	12		
Past medical history				
Hypertension	25	22	3.173	0.074
Diabetes mellitus	15	17	0.191	0.661
Clinical stages			0.341	0.558
Phase I	22	25		
Phase II	23	33		
Tumor diameter			0.234	0.628
≥ 5 cm	12	18		
< 5 cm	33	40		

ASA: American Society of Anesthesiologists.

Table 2 Comparison of Leiden-surgical rating scale scores between patients during and after skin incision

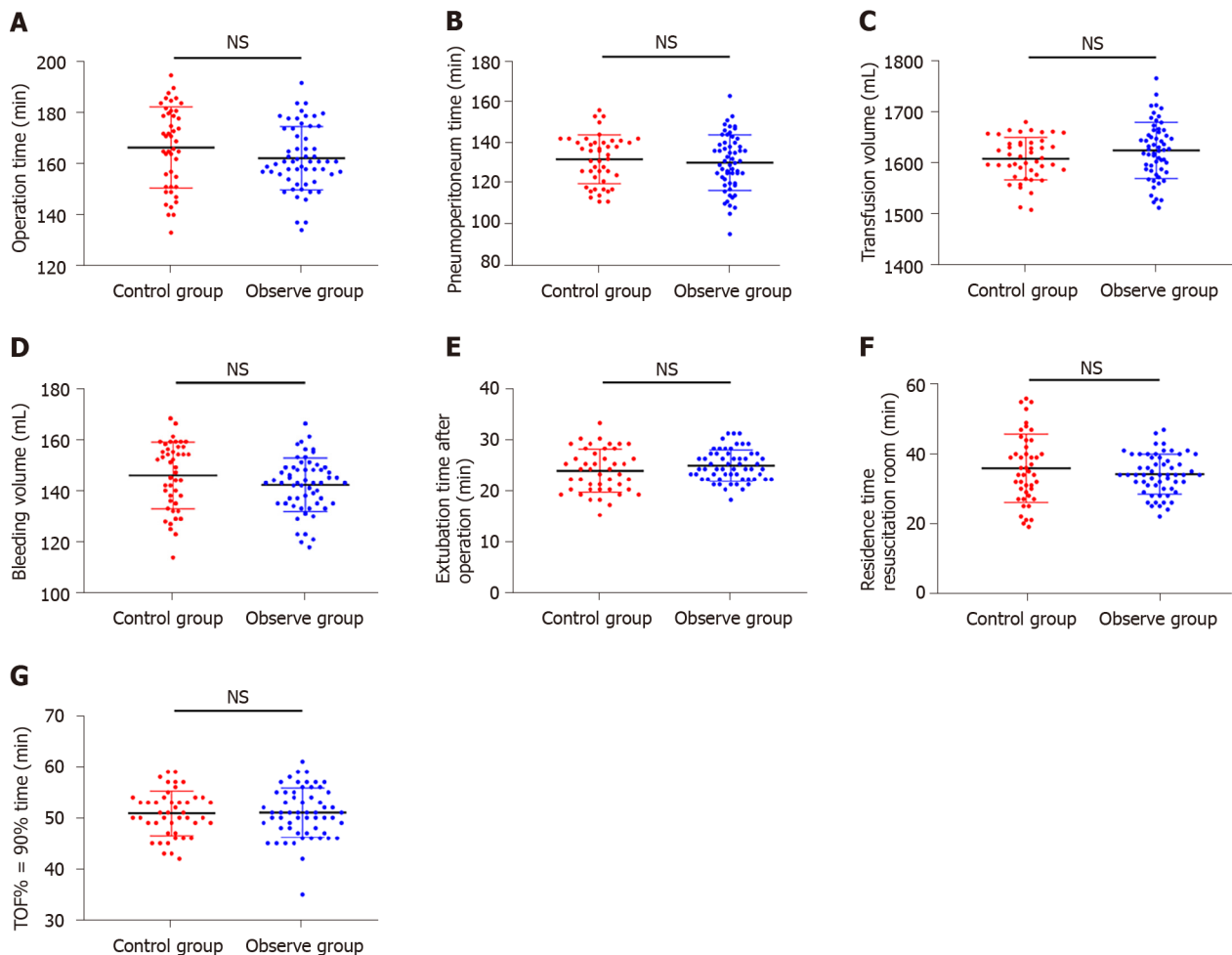
Group	Before operation	60 min	At abdominal closure after operation
Control group (n = 45)	4.55 ± 0.93	4.46 ± 0.85	4.60 ± 0.53
Observation group (n = 58)	4.34 ± 0.47	4.32 ± 0.80	4.48 ± 0.78
t value	1.878	1.244	1.422
P value	0.063	0.216	0.158

Table 3 Comparison of visual analogue scale scores between patients before and after operation

Group	8 h	24 h	48 h
Control group (n = 45)	2.88 ± 1.01	1.48 ± 0.96	1.02 ± 0.63
Observation group (n = 58)	2.91 ± 0.94	1.08 ± 0.82	0.75 ± 0.43
t value	0.133	2.280	2.538
P value	0.894	0.024	0.012

Table 4 Comparison of driving pressure between patients during operation (p/cmH₂O)

Group	5 min after intubation	5 min after establishment of pneumoperitoneum	60 min after establishment of pneumoperitoneum	After recovery of the pneumoperitoneum deflation to horizontal level
Control group (<i>n</i> = 45)	10.08 ± 2.33	18.21 ± 3.80	19.58 ± 4.51	12.11 ± 3.71
Observation group (<i>n</i> = 58)	10.50 ± 1.65	15.12 ± 3.20	16.04 ± 3.09	11.59 ± 2.81
<i>t</i> value	1.210	5.183	5.415	0.856
<i>P</i> value	0.229	< 0.001	< 0.001	0.393



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Figure 1 Comparison of surgical indexes. A: Comparison of operation time between the two groups; B: Comparison of pneumoperitoneum time between the two groups; C: Comparison of transfusion volume between the two groups; D: Comparison of blood loss between the two groups; E: Comparison of extubation time after operation between the two groups; F: Comparison of residence time in resuscitation room between the two groups; G: Comparison of TOF% = 90% time between the two groups. NS: Not significant.

Changes of inflammatory indexes in patients

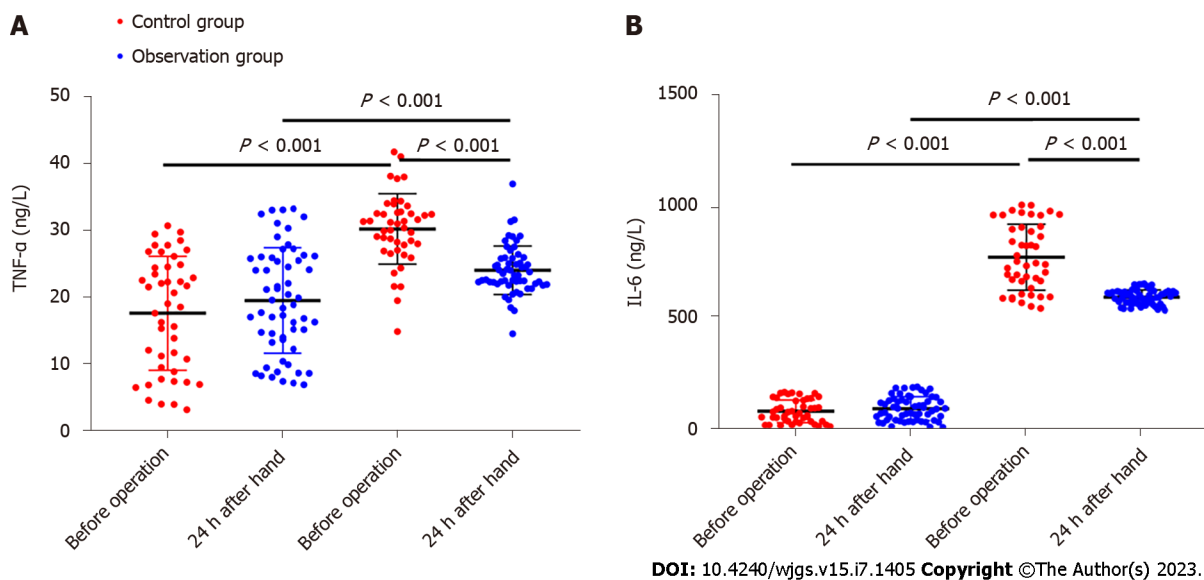
According to comparison of the changes in TNF- α and IL-6 before and after the operation between the two groups, no significantly difference was found between them in the levels of TNF- α and IL-6 before surgery ($P > 0.05$), while the levels of them in both groups increased significantly at 24 h after surgery ($P < 0.05$), and the observation group showed significantly lower levels of them than the control group at 24 h after surgery ($P < 0.05$, Figure 2).

Statistics of adverse PACU-associated respiratory events in patients

According to statistics of adverse PACU-associated respiratory events between the two groups, the two groups were not significantly different in the total incidence of adverse events ($P > 0.05$, Table 5).

Table 5 Statistics of adverse post-anesthetic recovery room-associated respiratory events

Group	Upper respiratory tract obstruction	Mild to moderate hypoxia	Severe hypoxia	Respiratory distress	Total incidence rate
Control group (<i>n</i> = 45)	3	3	3	2	11
Observation group (<i>n</i> = 58)	2	1	2	1	6
χ^2 value					3.655
<i>P</i> value					0.055



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Figure 2 Changes of inflammatory indexes in patients before and after operation. A: Comparison of TNF- α changes between the two groups before and after operation; B: Comparison of IL-6 changes between the two groups before and after operation. TNF- α : Tumor necrosis fact- α ; IL-6: Interleukin 6.

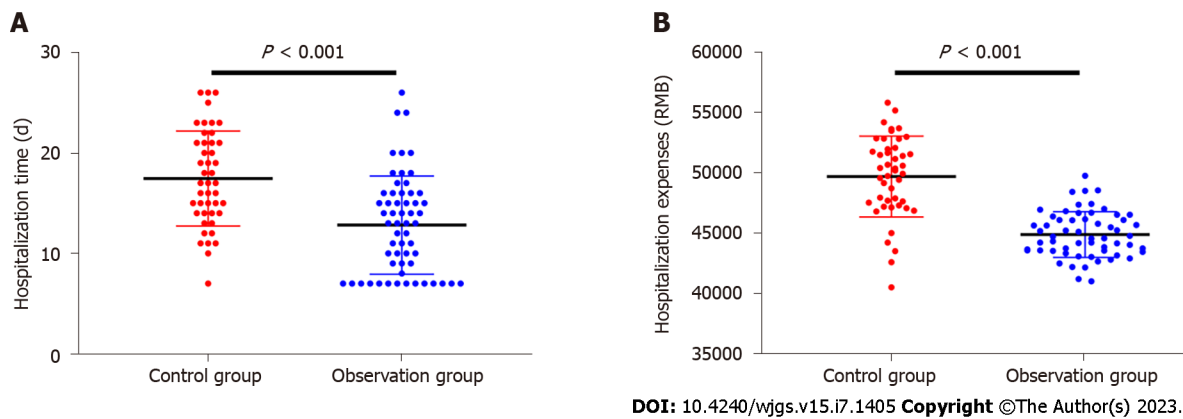
Statistics of hospitalization time and hospitalization expenses after operation

Comparison of hospitalization time and hospitalization expenses after operation between the observation and control groups revealed no significantly difference between the two groups in hospitalization time and hospitalization expenses after operation ($P < 0.05$, Figure 3).

DISCUSSION

Due to the poor tolerance and various underlying diseases of elderly patients with GC, traditional laparotomy has some limitations for them[17]. As the medical level advances continuously, laparoscopic technology has been extensively adopted in clinical practice[18], with advantages of less trauma, small incision and less intraoperative bleeding. Laparoscopic guidance during the operation can improve the clarity of the operative field, effectively reduce the damage to the surrounding soft tissue and gastrointestinal tract on the basis of ensuring the accurate resection of the focus tissue, improve the therapeutic effect, and lower inflammatory reaction and immunosuppression[19]. Clinically, the upper pneumoperitoneum pressure is generally set at 12-15 mmHg, but some people have studied the feasibility of operation under reduced pneumoperitoneum pressure[20]. According to prior research[21], deep NMB combined with reduced pneumoperitoneum pressure has achieved good results in gynecological laparoscopic surgery, but there is a lack of relevant research on whether it has the same clinical value in GC patients undergoing laparoscopic surgery.

As a commonly used scale in clinical laparoscopic surgery, the L-SRS score is primarily adopted to evaluate the exposure of the surgical field. This study first compared the changes of L-SRS scores in patients undergoing laparoscopic surgery for GC based on conventional pneumoperitoneum combined with deep NMB and those undergoing laparoscopic surgery for GC based on reduced pneumoperitoneum pressure combined with deep NMB. Similar to the research of Moro *et al*[22], the results in this study showed no significantly difference between the two groups at the time of skin incision, 60 min after operation and abdominal closure after operation ($P > 0.05$), indicating that deep NMB combined with reduced pneumoperitoneum pressure would not affect the surgical vision. The main reason is that deep NMB can make up for the lack of visual field caused by reduced pneumoperitoneum pressure by reducing abdominal muscle tension and increasing abdominal compliance.



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Figure 3 Statistics of hospitalization time and hospitalization expenses after operation of patients. A: Statistics of hospitalization time after operation in the two groups; B: Statistics of hospitalization expenses after operation in the two groups.

Minimally invasive laparoscopic technique has greatly reduced the incision pain, but the establishment of artificial pneumoperitoneum during the operation will aggravate the visceral pain and the incidence of shoulder pain after operation[23]. According to prior research[24], the increase in the incidence of shoulder pain after laparoscopic surgery is mainly due to the expansion and pull of the diaphragm caused by carbon dioxide pneumoperitoneum, which stimulates the phrenic nerve distributed in the diaphragm and causes shoulder pain after operation. This study compared the indices of the two groups during the operation. According to the results, the two groups were similar in terms of operation time, pneumoperitoneum time, transfusion volume, blood loss, extubation time after surgery, residence time in resuscitation room and TOF% = 90% time. Moro *et al*[22] have found no difference between patients given low pneumoperitoneum pressure and those given standard pressure in terms of the operation time of laparoscopic cholecystectomy, which was in agreement with our results. It indicates that reduced pneumoperitoneum pressure will not affect the operation progress. Moreover, in this study, the pain situation of patients before and after surgery and the occurrence of inflammatory reaction *in vivo* were compared between the two groups. The results revealed significantly lower VAS scores in the observation group than those in the control group at 24 and 48 h after surgery, and significantly lower levels of TNF- α and IL-6 in the observation group than those in the control group at 24 h after surgery. The results show that deep NMB combined with reduced pneumoperitoneum pressure can alleviate the inflammatory response and shoulder pain of patients. Similar to the present study, prior research by Madsen *et al*[25] has found that compared with moderate neuromuscular blocking agent and standard pressure pneumoperitoneum (12 mmHg), deep neuromuscular blocking blockade and low pressure pneumoperitoneum (8 mmHg) can reduce the incidence of shoulder pain after laparoscopic hysterectomy. We believe that this is mainly due to the fact that the excessive tension of the diaphragm caused by normal pneumoperitoneum pressure, coupled with surgical traction, leads to the lifting of the diaphragm and traction injury of the diaphragm nerve. This problem has been effectively solved by reducing pneumoperitoneum pressure of patients. Moreover, after absorption of CO₂, microbubbles are formed in the blood vessels, which interfere with the normal blood flow and become turbulent, releasing platelet activation inhibitors and a large number of cytokines, and promoting platelet aggregation, finally triggering the systemic inflammatory reaction of the body and causing the excitement of sympathetic nervous system to increase and causing pain.

The increase of pneumoperitoneum pressure can give rise to an increase in abdominal cavity volume, elevation of the diaphragm, and limitation of thoracic expansion, resulting in a decrease in lung volume and an increase in airway resistance and triggering an increase in mild adverse PACU-associated respiratory events[26]. Driving pressure, as the ratio of tidal volume to lung compliance, reflects the pressure on lung tissue of ventilated patients[27]. In this study, by comparing the driving pressure of patients at different time points, the driving pressure in the observation group was found to be significantly lower than that in the control group at 5 min and 60 min after establishment of pneumoperitoneum, and the total incidence of postoperative adverse PACU-associated respiratory events in the observation group was found to be lower than that in the control group. The results indicate that reduced pneumoperitoneum pressure can lower the driving pressure of patients during operation, without increasing the incidence of adverse PACU-associated respiratory events, so as to reduce the hospitalization time and hospitalization expenses of patients.

This study has determined the application effect of deep NMB combined with reduced pneumoperitoneum pressure in elderly patients undergoing LRG. However, it still has some limitations. First of all, in such a retrospective study, we are unable to randomly divide patients into groups like randomized controlled trials, and the results analysis may be biased. Secondly, we have not followed up the patients in this study, so whether two different pneumoperitoneum pressures have an impact on the prognosis of patients remains unclear. Finally, the indexes tested in this study are little, and whether reduced pneumoperitoneum pressure impacts patients' stress function and immune function requires further investigation. Therefore, we hope to carry out more experiments in the follow-up research to improve the research conclusions.

CONCLUSION

To sum up, deep NMB combined with reduced pneumoperitoneum pressure can reduce VAS score of shoulder pain and inflammatory reaction, without hindering the surgical vision and increasing adverse PACU-associated respiratory events, and can thus reduce the hospitalization time and treatment cost for patients.

ARTICLE HIGHLIGHTS

Research background

Gastric cancer (GC) is a major health concern with increasing incidence, particularly among middle-aged and elderly individuals. Laparoscopic radical gastrectomy (LRG) is a primary treatment method for GC, but concerns exist regarding the impact of excessive pneumoperitoneum pressure on patients, especially the elderly.

Research motivation

Although deep neuromuscular blockade (NMB) has been shown to improve surgical conditions in various laparoscopic procedures, there is limited research on the effectiveness of deep NMB combined with reduced pneumoperitoneum pressure in LRG for elderly GC patients.

Research objectives

This study aimed to investigate the application effect of deep NMB combined with reduced pneumoperitoneum pressure in LRG for elderly GC patients and its influence on inflammation.

Research methods

A retrospective analysis of 103 elderly GC patients was conducted, comparing those treated with deep NMB and conventional pneumoperitoneum pressure (control group, $n = 45$) *vs* those treated with deep NMB and reduced pneumoperitoneum pressure (observation group, $n = 58$) in various outcome measures.

Research results

The observation group experienced lower postoperative pain, reduced inflammatory markers, and lower driving pressure at specific time points compared to the control group. No significant difference was observed in adverse event incidence, but the observation group had shorter hospitalization times and lower postoperative expenses.

Research conclusions

Deep NMB combined with reduced pneumoperitoneum pressure can decrease postoperative pain and inflammation without compromising surgical vision or increasing adverse respiratory events, ultimately leading to shorter hospitalization times and reduced treatment costs.

Research perspectives

This study provides valuable insights for clinicians when selecting therapeutic regimens for elderly GC patients undergoing LRG, highlighting the potential benefits of deep NMB combined with reduced pneumoperitoneum pressure.

FOOTNOTES

Author contributions: Zhang YW and Li Y designed the study, contributed equally to this study, are considered as co-first authors; Zhang YW, Li Y, Huang WB, Wang J, and Qian XE conducted the research; Yang Y contributed to the analytical tools; Zhang YW, Li Y and Huang CS analyzed the data and wrote the manuscript; and all authors read and approved the final manuscript.

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Country/Territory of origin: China

ORCID number: Chang-Shun Huang 0000-0003-4385-042X.

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