

Effect of bilateral paravertebral nerve block on cognitive function in elderly patients undergoing radical gastrectomy for gastric cancer

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Abstract

Objective To investigate the effect of bilateral paravertebral nerve block on cognitive function in elderly patients undergoing radical gastrectomy for gastric cancer(GC).

Methods One sixty elderly patients, which were 40 males and 20 females, aged 65-80 years old, undergoing radical GC surgery under general anesthesia in The First People's Hospital of Taicang from January 2019 to December 2021 were included and randomly divided into control group (group C) and paravertebral nerve block group (group PVB).Group PVB received ultrasound-guided bilateral paravertebral nerve blocks in T8 with 0.375% ropivacaine 20 ml, and group C did not receive special treatment. Patients in both groups received total intravenous anesthesia. propofol and remifentanil dosages and intraoperative information were recorded.

Results There were no statistically significant differences in general information and basic intraoperative conditions between the two groups ($P > 0.05$). The awareness time in group PVB was shorter than that in the C group, and the propofol and remifentanil dosage was less than that in the C group ($P < 0.05$). At T1 and T2, the MMSE score in group PVB was higher than that in group C, and the NSE concentration was lower than that in the C group($P < 0.05$).

Conclusion Preoperative application of ultrasound-guided bilateral paravertebral nerve blocks can reduce intraoperative propofol and remifentanil dosage, postoperative awareness time, and have a protective effect on postoperative cognitive function in elderly GC surgery patients.

1 Introduction

Gastric cancer(GC) is the most common malignant tumor in the digestive tract in China, which brings a huge disease burden to society. Elderly patients are the high-risk group for the development of GC [1], and surgery is an important means to treat early GC. The incidence of perioperative cognitive dysfunction in elderly patients undergoing abdominal surgery is as high as 60%, resulting in increased hospital stay, medical expenses, and medical resource consumption. Postoperative cognitive dysfunction may be related to the surgical site, anesthesia method, and postoperative pain [2]. Paravertebral block(PVB)has been widely used in thoracic and abdominal surgery [3] and has similar effects as epidural anesthesia and analgesia. However, the effect of PVB on the postoperative cognitive function of patients with GC is still unclear. This study was designed to explore the effects of bilateral paravertebral nerve block combined with general anesthesia on postoperative cognitive function of elderly patients with radical gastrectomy.

2 Data And Methods

2.1 General information

This study was approved by the Ethics Committee of the First People's Hospital of Taicang and the informed consent forms were signed for all enrolled patients. All methods were carried out in accordance with relevant guidelines and regulations or Declaration of Helsinki. A total of 60 patients who underwent elective gastrointestinal tumor surgery in our hospital from January 2019 to December 2021 were included in the study. Inclusion criteria: Patients of any gender, 65–80 years old, ASA grades II-III, and retrograde elective gastrointestinal surgery. Exclusion criteria: operation duration < 2 hours; History of chemotherapy or radiotherapy before surgery; another previous history of abdominal surgery; Long-term history of opioid or neuropsychiatric drug use; Combined history of neurological diseases such as Alzheimer's disease and Parkinson's disease or cognitive dysfunction; Postoperative transfer to ICU or secondary surgery; Hearing or language expression disorders; Patients with coagulation disorders; The puncture point has skin infection; Allergic to any drug used in this study; The patient refused to continue participating in the study.

2.2 grouping and processing

In this study, the enrolled patients were randomly divided into two groups according to the random number table: the control group (Group C, 30 cases) and the paravertebral nerve block group (PVB group, 30 cases). The anesthesiologists who performed anesthesia management and the researchers who followed up after the operation were blinded. Anesthesia management and nerve block procedures in this study were performed by experienced anesthesiologists.

All patients included in the study did not receive preoperative medication, and monitoring was established after the patient entered the room: percutaneous oxygen saturation (SpO₂), non-invasive blood pressure monitoring, electrocardiogram, and Bispectral Index(BIS). After the peripheral venous access was opened, lidocaine local anesthesia was applied for radial artery puncture catheterization and invasive arterial blood pressure was monitored. After intravenous injection of 1mg midazolam and 5 µg sufentanil citrate in the PVB group, the patient was asked to lie on his/her side. After routine disinfection and drape laying, he/she was scanned and positioned along the spine by Sonite ultrasound apparatus so that the direction of the convex array probe was parallel to the ribs and positioned to the T8 vertebral body. The thoracic para-space was identified in the ultrasound image, and the needle was inserted in the plane. After the puncture needle broke through the costal transverse process ligament and drew back the airless, blood, and cerebrospinal fluid, 20ml of 0.375% ropivacaine was injected, and the sliding pleural downforce was visible. Complete the other side of the T8 paravertebral block in the same way. The rats were observed for 20 min after the block and the block plane was tested by acupuncture. If there was no obvious block plane, the block was considered a failure. Group C has no special treatment.

2.3 Anesthesia methods and postoperative analgesia

All patients were under intravenous anesthesia during the operation. midazolam 0.04 mg/kg, etomidate 0.3 mg/kg, sufentanil citrate 0.5 µg/kg and atracurium cis-benzenesulfonate 0.2 mg/kg were used for anesthesia induction. After induction, intubation was performed orally under the guidance of a visual laryngoscope and connected to the anesthesia machine for mechanical ventilation. The catheter was

fixed. The lower part of the head was taken, deep venipuncture was performed through the right internal jugular vein of the patient, and catheterization was performed. During the operation, the pulmonary protective ventilation strategy was adopted: tidal volume of 6–8 mL/kg, the inhaled oxygen concentration of FIO₂ 50–80%, PEEP 4–8 mmH₂O, and suction to shout ratio of 1: 2. The respiratory frequency was adjusted to 12–15 times/min to maintain the end-tidal carbon dioxide (PetCO₂) 35 ~ 40 mmHg during the operation. The anesthetics were maintained by continuous intravenous infusion of propofol 0.08–10 ~ 15 µg kg⁻¹ min⁻¹, atracurium besylate 0.05–0.1 mg kg⁻¹ h⁻¹, and remifentanil 0.15–0.3 µg kg⁻¹ min⁻¹, with intermittent addition of sufentanil citrate 10–15 µg. During the operation, medication dosage was adjusted according to the monitored values of patients' BIS values to maintain the fluctuation of BIS values within the range of 40–60. The intraoperative blood pressure management goal of the patient was to give appropriate fluid replacement and vasoactive drugs such as phenylephrine and ephedrine within the range of 20% above and below the preoperative basic blood pressure to achieve the target value.

Atracurium besylate was stopped 20min before the end of the operation. Propofol was stopped when the surgeon sewed the skin. Remifentanil and Tenet 40mg were added after the operation. The patient was transferred to PACU with a catheter. Patient-controlled intravenous analgesia (PCIA) pump was used in all postoperative analgesia programs, and the prescription was as follows: 100 µg of sufentanil citrate + 10 mg of tropisetron hydrochloride; normal saline was added for dilution to 100 ml; no background dose was given; bolus dose was 2 ml, and the locking time was 15 min. Antagonists were not used in all patients during the awakening period after the operation until the patients were fully awake and able to respond to calls, the throat reflex, swallowing reflex and cough reflex had fully recovered, and the tidal volume and minute ventilation volume had returned to normal. All patients were observed in the PACU for 1h after extubation, and no special cases could be transferred to the ward.

2.4 Observation indicators

The patients in the two groups received a mini-mental state examination (MMSE) one day before surgery (T₀), one day after surgery (T₁), and three days after surgery (T₂), which included five aspects: memory, computational power, memory, language power, and directional power. The total score was 30 points. The higher the score was, the stronger the cognitive function would be [4]. The peripheral venous blood was collected from the patients at time points T₀, T₁, and T₂, and the enzyme-linked immunosorbent assay (ELISA) was used to determine NSE and detect the concentration of neuron-specific enolase, NSE). Record the operation and anesthesia-related information: operation duration, anesthesia duration, extubation duration, type and the total amount of infusion liquid during the operation, intraoperative bleeding and urine volume, and the total dosage of propofol and opioids during the operation.

2.5 Statistical methods

All data were statistically analyzed by SPSS 15.0. Measurement data of normal distribution were expressed as mean standard deviation, t-test was used for inter-group comparison, and one-way analysis of variance was used for comparison within the group at different time points. Enumeration data were

expressed as a rate (%) and inter-group comparisons were performed by Chi-square test or Fisher's exact probability method. $P < 0.05$ indicated that the difference was statistically significant.

3 Results

3.1 General information

There was no significant difference in age, gender, BMI, ASA stage, educational year, basic disease, and preoperative MMSE score between the two groups ($P > 0.05$). (Table 1).

Table 1
General data and operation-related information of patients in the two groups ($\bar{x} \pm s$ or n/%)

project	C group(n = 30)	PVB group(n = 30)
Age (years)	68.7 ± 5.9	70.1 ± 6.3
Gender (male/%)	22/73.3	18/60.0
BMI(kg/m ²)	24.23 ± 2.11	23.95 ± 2.33
ASA staging (Ⅱ/Ⅲ)	20/10	18/12
Hypertension (case/%)	21/70.0	19/63.3
Diabetes (Cases/%)	18/60.0	15/50.0
Years of Education (years)	5.23 ± 1.93	5.62 ± 1.77

3.2 Patients in two groups: operation and anesthesia related information

Nerve block procedures in the PVB group were successful and there were no complications. The differences in operation time and total anesthesia time were not significant among groups ($P > 0.05$). The time from the end of surgery to tracheal extubation in PVB group was shorter than that in group C ($P < 0.05$). The doses of propofol and remifentanyl in PVB group were lower than those in group C ($P < 0.05$). (Table 2).

Table 2

Intraoperative situation of two groups of patients ($\bar{x} \pm s$)

project	C group(n = 30)	PVB group(n = 30)
Operation duration (min)	195.39 ± 38.43	189.54 ± 35.86
Extubation time (min)	9.48 ± 1.21	6.93 ± 1.43*
Propofol (mg)	1184.6 ± 190.7	981.9 ± 184.1*
Remifentanil (mg)	2.5 ± 0.9	1.9 ± 0.8*

Note: Compared with group C, * p < 0.05

3.3 Comparison of MMSE and NSE levels during the perioperative period between the two groups

There was no significant difference in the MMSE scores of patients between the two groups at T0, while on T1 and T2, the MMSE scores and NSE indexes of patients in the two groups, and the MMSE score of patients in PVB group was higher than that in group C (P < 0.05).(Table 3).

Table 3

Comparison of MMSE and NSE levels between the two groups during the perioperative period ($\bar{x} \pm s$ or n/%)

project		T0	T1	T2
MMSE score (score)	C group(n = 50)	27.09 ± 1.32	23.48 ± 2.31	25.07 ± 1.67
	PVB group(n = 50)	27.16 ± 1.21	25.26 ± 2.08*	26.37 ± 1.80*
NSE(μg/L)	C group(n = 50)	5.69 ± 1.98	12.73 ± 3.31	7.45 ± 1.71
	PVB group(n = 50)	5.77 ± 1.83	9.48 ± 2.99*	6.64 ± 1.48*

Note: Compared with group C, * p < 0.05

4 Discussion

Paravertebral nerve block refers to the simultaneous block of somatosensory and motor nerves and analgesic effect achieved by injecting local anesthetics into the T1-T12 paravertebral space so that the lateral peripheral nerves of the spinal cord are surrounded by the local anesthetics. It is proposed in the guidelines for rapid rehabilitation of elderly patients that multimodal analgesia can reduce the perioperative use of opioids and accelerate the rehabilitation of patients [5]. Studies have confirmed that local anesthetics penetrate into other spaces through the vertebral body or epidural space connected with the injection points, so as to achieve the effect of blocking multiple segments [3]. The failure rate of PVB

technology under ultrasound guidance is only 2.9%, which can bring about comparable analgesic effects of epidural anesthesia. At the same time, the failure rate and complications of PVB technology are much lower than those of thoracic epidural block, thus improving the success rate of operation and reducing the complications [6]. Due to the special anatomical location of the paravertebral nerve block, it is mainly used in chest surgery and upper abdominal surgery, and the application of paravertebral nerve block in radical surgery for GC has certain feasibility. In this study, PVB procedures were successful and uncomplicated in all patients. In this study, the anesthetics used in the PVB group were all less than those in the C group ($P < 0.05$), which was similar to the study result of paravertebral nerve block in video-assisted thoracoscopic lobectomy [7]. The application of paravertebral nerve block before the start of surgery can reduce the use of anesthesia drugs during the operation for patients undergoing radical gastrectomy, and accelerate the patient's postoperative recovery.

At present, the specific mechanism of POCD is still unclear, but it may be related to factors such as the age of the patient, the use of anesthesia drugs, the surgical site, and postoperative pain [2]. In noncardiac surgery, the incidence of postoperative cognitive dysfunction in elderly patients is as high as 26%. Some study has shown that nerve block during surgery can improve the postoperative cognitive function of elderly patients [8], which is similar to the conclusion of this study. NSE is an important serological indicator reflecting postoperative cognitive dysfunction, and its activity is highest in brain cells. The change of activity of NSE is closely related to many neurological diseases caused by nerve injury. The increase of serum NSE concentration can sensitively reflect neuronal injury. In this study, the MMSE scores of the patients in the PVB group were higher than those in group C and the serum NSE was lower than that in the group C on day 1 and day 3 after surgery, suggesting that preoperative implementation of PVB could reduce the use of anesthetics in the surgery of patients and reduce the degree of postoperative nervous system damage.

5 Conclusion

In summary, an ultrasound-guided paravertebral nerve block is simple and feasible, and it can reduce the dosage of propofol and remifentanyl during the operation and the postoperative awakening time, thus protecting the postoperative cognitive function of elderly patients undergoing GC surgery.

Abbreviations

ASA

American Society of Anesthesiologists

BMI

Body mass index

PACU

postanesthesia care unit.

Declarations

Ethics approval and consent to participate

The study has been approved by the Ethics Committee of Department of anesthesiology, the First People's Hospital of Taicang. Written informed consent was obtained from each participant prior to data collection or study intervention.

Consent for publication

Not applicable.

Availability of data and materials

Due to concealment involving participants, privately anonymous datasets will be sent to by reasonable request corresponding author.

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Author contribution

YHZ,FWQ AND ZZ designed the trial. GYY collected the data. FF and QG analyzed the data.YHZ and KLZ wrote the manuscript. All authors have read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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Not applicable

References

1. Cao Maomao, Li He, Sun Dianqin, et al. Epidemiological trend analysis of gastric cancer in China from 2000 to 2019 [J]. Chinese Journal of Digestive Surgery, 2021,20 (1): 102–109. DOI: 10.3760/CMA.j.cn115610-200
2. Chen Xiaohui, Ren Xiaoqiang, Ma Yabing, et al. Research progress of related mechanism of postoperative cognitive dysfunction in elderly patients caused by postoperative pain [J]. Journal of Southern Medical University, 2019, 39(09): 1122–1126
3. Richardson J, Lonnqvist P A, Naja Z. Bilateral thoracic paravertebral block: potential and practice[J]. BrJAnaesth, 2011, 106(2): 164–171.DOI:10.1093/bja/aeq378
4. Yang L, Yan J, Jin X, et al. Estimation of diagnostic performance of dementia screening tests: Mini-Mental State Examination, Mini-Cog, Clock Drawing test and Ascertain Dementia 8 questionnaire[J].

Aging & Mental Health, 2018, 22(8): 948–952.DOI:10.1080/13607863.2017.1320701

5. Anesthesia and Perioperative Management Group for the Elderly of Anesthesiology Branch of Chinese Medical Association, Pain Group of Anesthesiology Branch of Chinese Medical Association, National Clinical Medical Research Center for Geriatric Diseases, National Union of Anesthesia for the Elderly. Consensus of Chinese experts on multi-mode analgesia and low opioid program for elderly patients during perioperative period (2021 edition) [J]. Chinese Journal of Medicine, 2021,101(3): 170–184. DOI: 10.30
6. Luyet C, Eichenberger U, Greif R, et al. Ultrasound-guided paravertebral puncture and placement of catheters in human cadavers: an imaging study[J]. Br J Anaesth, 2009, 102(4): 534–539.DOI:10.1093/bja/aep015
7. Zhang Ran, Huo Fei, Tian Long, et al. Comparison of analgesic effects of paravertebral nerve block and intercostal nerve block under ultrasound guidance after thoracoscopic pulmonary surgery [J]. Journal of Clinical Anesthesiology, 2020, 36(09): 886–889
8. Wang Y, Cheng J, Yang L, et al. Ropivacaine for Intercostal Nerve Block Improves Early Postoperative Cognitive Dysfunction in Patients Following Thoracotomy for Esophageal Cancer[J]. Med Sci Monit, 2019, 25: 460–465.DOI:10.12659/MSM.912328