

Original Research Article

Effect of a combination of general anesthesia and superficial cervical plexus block with ropivacaine on patients undergoing thyroidectomy

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Abstract

Purpose: To investigate the effect of a combination of general anesthesia and superficial cervical plexus block (SCPB) with ropivacaine on patients undergoing thyroidectomy.

Methods: Ninety-six (96) patients undergoing thyroidectomy were randomly divided into control and study group. Both groups were subjected to SCPB in combination with general anesthesia. Ropivacaine was used for SCPB in the study group. Vital signs, visual analogue scale (VAS) scores, and serum interleukin 1 β (IL-1 β) levels were determined at various time points (T) after tracheal intubation. Occurrence of adverse reactions was recorded.

Results: Compared with the control group, mean arterial pressure (MAP), heart rate (HR), diastolic blood pressure (DBP), and systolic blood pressure (SBP) levels from T1 to T5 were declined in study group ($p < 0.01$). VAS scores of study group were significantly lower at 12, 24, and 48 h after thyroidectomy than in control group ($p < 0.05$). At 5, 10 and 15 h after surgery, serum IL-1 β level in study group was down-regulated ($p < 0.05$). Moreover, a marked decrease in the incidence of adverse reactions was also found in the study group post-surgery ($p < 0.05$).

Conclusion: Ropivacaine is effective for SCPB in combination with general anesthesia in patients undergoing thyroidectomy. It is safer and more feasible in SCPB when combined with general anesthesia. However, further clinical trials are required to validate this technique.

Keywords: Thyroidectomy, General anesthesia, Cervical plexus block, Ropivacaine, Adverse reactions

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INTRODUCTION

The thyroid gland is an endocrine organ, and its main function is to synthesize thyroid hormones and regulate body metabolism [1]. Thyroid cancer and other diseases pose severe threat to the physical and mental health of the affected individuals. However, timely treatment effectively

restores good health [2]. Previous studies have shown that surgical resection is ideal for thyroid diseases. Local anesthesia is frequently used in thyroidectomy due to its ease of operation and high safety [3,4]. However, local anesthesia easily leads to stress-induced adverse reactions such as respiratory depression and surgical traction [5]. Therefore, the combination of

superficial cervical plexus block (SCPB) with general anesthesia is gradually being used for thyroidectomy.

The use of general anesthesia improves the comfort of patients during operations [6]. Usually, SCPB is implemented under ultrasound guidance, and it is highly target-specific [7]. The combination of general anesthesia and SCPB maximizes the effect of anesthesia. Cervical plexus block is a frequently-used anesthesia for thyroid surgery [8]. Ropivacaine, a new amide local anesthetic, has the advantages of fast onset and long blocking time [9]. At the same time, the feasibility and effect of ropivacaine in cervical plexus block anesthesia have gradually attracted the attention of surgeons.

Ropivacaine has the characteristic of separating sensory and motor blocks. It blocks sensory nerve fibers with higher sensitivity, while it weakly blocks larger motor nerve fibers [10]. The sensorimotor separation effect of ropivacaine is conducive to the stability of intraoperative respiration and postoperative rehabilitation of patients [11]. The present research was focused on determination of the safety and efficacy of ropivacaine in thyroidectomy under SCPB in combination with general anesthesia.

METHODS

Patients

Ninety-six patients who underwent thyroidectomy from January 2018 to January 2020 were involved in this research. Signed informed consent was obtained from all participants. All participants were randomly divided into control and study groups (each $n = 48$). The clinical features had no significant difference between the two groups ($p > 0.05$, Table 1). The present research was approved by the ethics committee of Xingtai People's Hospital (approval no. 2018:012). The research was conducted based on the guidelines of Declaration of Helsinki [12].

Inclusion and exclusion criteria

All included patients were diagnosed through clinical symptoms, B-ultrasound and thyroid

function tests, and the patients were in grades I and II, based on the rating of American Association of Anesthesiologists (ASA). All patients had indications for surgical anesthesia, and they had complete medical records. However, patients with abnormal liver and kidney functions, malignant tumor, and severe cardiovascular and cerebrovascular diseases were excluded. Moreover, patients in special physiological periods such as pregnancy and lactation, were excluded.

Treatments

The two groups of patients were taken into the operating theatre after routine fasting for 8 h. The patients were given oxygen. Venous access was established, and ECG and vital signs were monitored. All patients were given penehyclidine hydrochloride (1 mg) intravenously. General anesthesia was induced using fentanyl (2.5 $\mu\text{g}/\text{kg}$), intravenous infusion of propofol (2 mg/kg) and cis-atracurium (0.3 mg/kg). At last, all patients received assisted ventilation through endotracheal intubation.

Patients in the observation group received ropivacaine bilateral SCPB after general anesthesia. In this procedure, 2 mL of 0.375 % ropivacaine (in 0.9 % sodium chloride solution) was first injected through the myofascial membrane. Then, it was injected behind the occiput, behind the ears, in front of the neck, and above the clavicle. After completing the above operations, anesthesia was maintained in the patients with a micropump of propofol at doses of remifentanyl (1 - 3 $\mu\text{g}/\text{kg}/\text{h}$), and 4 - 8 mg/kg/h. At the same time, the patients were intermittently given intravenous injection of 5 - 10 mg cis-atracurium.

Evaluation of parameters/indices

At various time points (T), mean arterial pressure (MAP) values were measured and compared: before induction of anesthesia (T_0), 1 min before tracheal intubation (T_1), 1 min after tracheal intubation (T_2), 1 min after skin incision (T_3), at the time of lesion resection (T_4), and at the end of the operation (T_5).

Table 1: Comparison of general information on the two groups of patients ($n = 48$)

Parameter	Study group	Control group
Gender (male/female)	23/25	22/26
Age (years)	43.2 \pm 9.6	42.3 \pm 10.9
Weight (kg)	64.3 \pm 11.4	67.2 \pm 8.9
Height (cm)	162.3 \pm 5.1	163.5 \pm 4.8
Duration of surgery (min)	57.3 \pm 10.8	56.6 \pm 11.6

Mindray BereView T8 monitor was used to monitor circulation and respiration during the perioperative period. Changes in patient's diastolic blood pressure (DBP), heart rate (HR), and systolic blood pressure (SBP) were recorded.

Visual analogue scale scores (VAS, 10 points) at 4, 8, 12, 24, and 48 h after thyroidectomy were assessed. The higher the score, the more severe the pain in the patient. The levels of IL-1 β at 5, 10 and 15 h after operation in the two groups were examined by enzyme-linked immunosorbent assay (ELISA). The occurrence of adverse reactions was recorded. Adverse reactions comprised nausea and vomiting, pain, itching and respiratory depression.

The operation time, spontaneous breathing recovery time, eye-opening time, and the time lapse before removal of tracheal tube were recorded. The operation time was the duration from the start of skin incision to the completion of neck skin suture. Spontaneous breathing recovery time referred to the time from the stoppage of infusion of atracurium cis sulfonate to recovery of spontaneous breathing. Eye opening time referred to the time from when the neck skin was sutured to when the eyes were opened in response to calls. The time lapse before removal of the tracheal tube was the duration from the completion of neck skin suture to removal of the tracheal tube.

Statistical analysis

Data were analyzed with the SPSS 21.0 statistical software and presented as mean \pm standard deviation (SD). Differences between groups were analyzed by Chi-square test or Student's *t*-test. The $p < 0.05$ indicated statistically significant differences.

RESULTS

Mean arterial pressure (MAP)

At T₀, MAP level was slightly changed between the two groups ($p > 0.05$, Table 2). MAP levels from T₁ to T₅ were lowered in study group compared to control group ($p < 0.01$, Table 2). The results showed that ropivacaine improved

the MAP level of the patients during thyroidectomy.

SBP, DBP and HR

At T₀, HR, SBP and DBP levels had little change between the two groups ($p > 0.05$; Figures 1 A - C). In comparison of the control group, HR, SBP and DBP levels from T₁ to T₅ were dropped in the study group ($p < 0.01$; Figures 1 A - C). The results indicate that ropivacaine effectively stabilized the blood pressure and heart rate of patients during thyroidectomy.

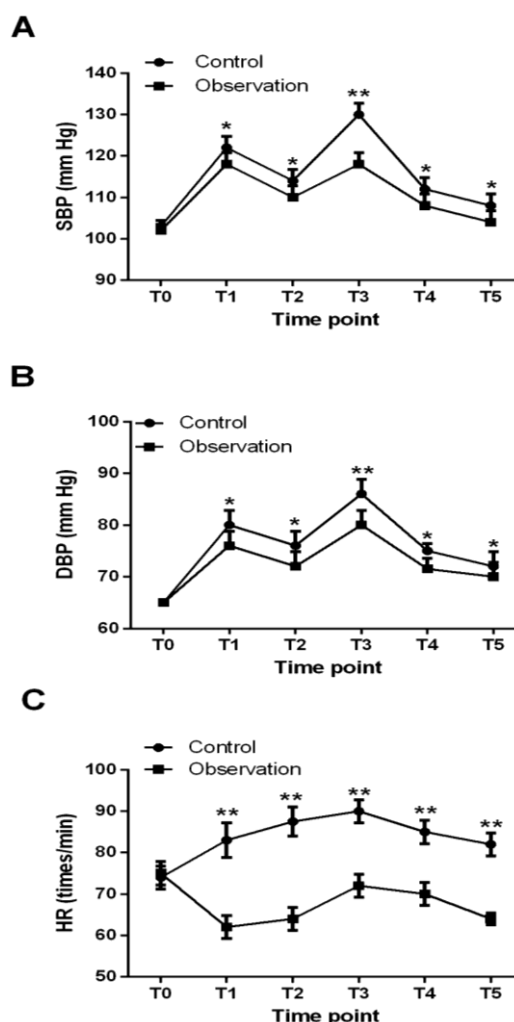


Figure 1: Comparison of the levels of (A) SBP, (B) DBP and (C) HR at different time points between the study and control groups. * $P < 0.05$, ** $p < 0.01$, study vs control group

Table 2: Comparison of MAP levels at different time points (mmHg)

Group	T ₀	T ₁	T ₂	T ₃	T ₄	T ₅
Control	76.48 \pm 5.81	87.62 \pm 8.16	81.01 \pm 7.01	88.28 \pm 8.04	85.58 \pm 7.24	84.48 \pm 6.21
Observation	76.12 \pm 5.57	69.48 \pm 7.05	68.21 \pm 7.15	68.14 \pm 7.01	72.03 \pm 6.54	71.75 \pm 7.21
<i>t</i>	0.032	30.154	25.423	35.147	27.657	24.846
<i>P</i> -value	1.054	<0.01	<0.01	<0.01	<0.01	<0.01

VAS scores after operation

At 4 and 8 h after surgery, VAS scores had no significant difference between the two groups ($p > 0.05$; Table 3). The VAS scores in the study group at 12, 24, and 48 h post-surgery were lessened compared to control group ($p < 0.05$, Table 3). It indicated that ropivacaine exerted good analgesic effect at 12 h postoperatively.

Times taken prior to recovery

The times taken for recovery of spontaneous breathing, eye-opening, and removal of tracheal tube were only slightly changed between the two groups ($p > 0.05$; Figure 2). Moreover, patients in the two groups recovered well after the tracheal tube was removed, and there was no obvious discomfort. Thus, ropivacaine did not negatively affect recovery of the patients, and it had good safety profile.

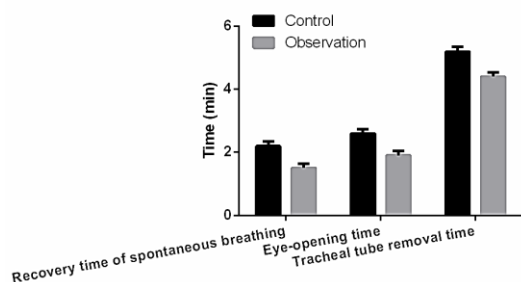


Figure 2: Comparison of the times taken for recovery of spontaneous breathing, eye opening and tracheal tube removal

Postoperative IL-1 β serum level

In comparison with the control group, serum IL-1 β levels at 5, 10 and 15 h after operation were downregulated in the study group ($p < 0.05$;

Figure 3). Thus, ropivacaine inhibited increases in serum level of inflammatory factors, and enhanced the recovery of patients after surgery.

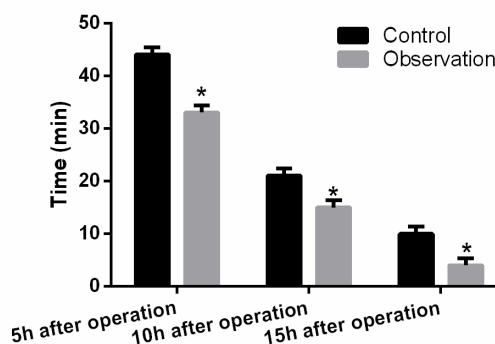


Figure 3: Comparison of postoperative serum IL-1 β level. * $P < 0.05$

Postoperative adverse reactions

All patients with SCPB had smooth thyroidectomy without block-related complications such as hemorrhage and hematoma, local anesthesia toxicity, epidural and subarachnoid anesthesia, and general spinal anesthesia. Intraoperative body temperature, breathing and other vital signs of all patients were within the normal ranges. Adverse reactions incidence in the study group after surgery (8.33 %) was significantly lower than 22.92 % incidence of adverse reactions in the control group ($p < 0.05$; Table 4). These results indicated that ropivacaine reduced the occurrence of adverse reactions.

Table 3: Comparison of VAS scores at different time points

Group	4h	8h	12h	24h	48h
Control	2.88 \pm 0.23	5.02 \pm 0.24	6.52 \pm 0.33	7.26 \pm 0.94	2.63 \pm 0.54
Study	2.92 \pm 0.11	4.98 \pm 0.21	5.06 \pm 0.15	6.08 \pm 0.44	1.12 \pm 0.21
<i>t</i>	0.468	0.431	5.642	6.024	9.126
<i>P</i> -value	0.62	0.69	<0.01	<0.01	<0.01

Table 4: Comparison of postoperative adverse reactions (n = 48)

Group	Itchy skin	Respiratory depression	Nausea and vomiting	Pain	Total
Control	2 (4.17)	5 (10.42)	1 (2.08)	3 (6.25)	11 (22.92)
Study	1 (2.08)	0 (0)	2 (4.17)	1 (2.08)	4 (8.33)
χ^2					4.652
<i>P</i> -value					<0.05

DISCUSSION

Thyroidectomy is the most common treatment for thyroid tumors. Anesthesia which comprises general and local anesthesia, is essential in thyroidectomy [13]. Currently, SCPB is widely used in local anesthesia. Although local anesthesia is not associated with intraoperative stress reactions, it results in surgical risks [14]. Under the influences of dense blood vessels and nerve tissues around the thyroid gland, surgical operations are prone to traction [15].

In order to circumvent these problems, general anesthesia is advocated in clinical thyroidectomy. However, with general anesthesia alone, it is difficult to ensure stability of hemorheology [16]. In view of this, clinical thyroid surgery adopts combination of general anesthesia and SCPB.

Ropivacaine, a local anesthetic, is a long-acting amide drug of L-body. When ropivacaine is injected into a vein, sodium ion influx is inhibited [17]. Thus, the normal conduction of nerve impulses by nerve fibers is blocked, resulting in loss of pain transmission. In addition, ropivacaine not only exerts an analgesic effect, it also produces a sedative effect [18]. The sedative effect of ropivacaine increases with increase in drug concentration [19].

This study revealed that MAP values at T₁, T₂, T₃, T₄, and T₅ were lowered in the observation group. At the same time points, SBP, DBP and HR levels were also declined in the observation group. These results indicate that the use of ropivacaine in SCPB in combination with general anesthesia was better for maintenance of the stability of vital signs of patients than the use of general anesthesia only.

Here, the VAS scores at 12, 24, and 48 h after surgery was also found to drop in the observation group. Overall, ropivacaine prolonged the time of postoperative analgesia and mitigated unbearable pain during the recovery period in postoperative patients [20]. However, some researchers have reported that combined use of general anesthesia and SCPB did not reduce postoperative VAS score [21,22]. This may be due to the fact that early SCPB was performed without ultrasound, or that the doctors were inexperienced. In addition, ropivacaine for superficial cervical plexus nerve block significantly reduced the application of opioids during surgery, thereby reducing opioid-associated adverse reactions [23].

In this study, the call response time and complete wake-up time of patients were

shortened in the observation group. A decrease in adverse reactions incidence was also found in observation group. These results further confirm the feasibility and safety of ropivacaine for SCPB in combination with general anesthesia during thyroidectomy in patients.

CONCLUSION

Ropivacaine is effective for SCPB in combination with general anesthesia. It stabilizes blood pressure and reduce pain and the levels of inflammatory factors in patients. In addition, ropivacaine is safer and more feasible in SCPB I combination with general anesthesia, when compared with general anesthesia only.

Therefore, the combination treatment should be investigated further for application in clinical practice.

DECLARATIONS

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Ethical approval

None provided.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

We declare that this work was done by the authors named in this article, and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. Xiao Chen and Zhenhua Qu conceived and designed the study, and drafted the manuscript. Yan Qin, Xing Zhao, and Zhihu Liu collected, analyzed and interpreted the experimental data. Xiao Chen and Zhenhua Qu revised the manuscript for important intellectual contents. All authors read and approved the final manuscript.

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