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Research on the Effects of Dexmedetomidine on Anesthesia Complications and Postoperative Analgesia in Patients Undergoing Thyroid Cancer Surgery

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Abstract: *Objective*: To investigate the application effect of dexmedetomidine in anesthesia for thyroid cancer (TC) surgery. *Methods*: A total of 90 patients admitted to our hospital from January 2023 to December 2023 were selected as the study subjects. The patients were divided into an observation group (given continuous intravenous infusion of dexmedetomidine during surgery) and a control group (given continuous intravenous infusion of an equal volume of sodium chloride injection during surgery) by lottery method, and the anesthesia indicators of the two groups were compared. *Results*: The dosages of remifentanil and propofol in the observation group were lower than those in the control group ($p < 0.05$); the incidence of complications in the observation group was lower than that in the control group ($p < 0.05$); the Visual Analogue Scale (VAS) scores of the observation group at 4 h, 12 h, 24 h, and 48 h postoperatively, both at rest and during activity, were lower than those of the control group ($p < 0.05$). *Conclusion*: During surgery for TC patients, continuous intravenous infusion of dexmedetomidine can reduce the dosage of anesthetic drugs and the incidence of anesthesia-related complications, alleviate postoperative pain, and is worthy of promotion and application.

Keywords: Dexmedetomidine; Thyroid cancer; Complications; Analgesia

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1. Introduction

Thyroid cancer (TC) is a malignant tumor that occurs in thyroid cells and is one of the most common types of cancer in the endocrine system [1]. If left untreated promptly, it may lead to hypothyroidism, cervical lymph node metastasis, distant metastasis (such as bone metastasis), as well as local compression symptoms like dyspnea and dysphagia. Surgical treatment is the primary approach, especially for aggressive or large-diameter tumors, as it can completely remove tumor tissue, reduce the risk of recurrence, and help determine the pathological type and degree of differentiation [2]. Postoperative pain is a common issue faced by patients after surgery, which not only causes discomfort and affects recovery and quality of life but may also lead to a series of adverse reactions such as

pulmonary infection and deep vein thrombosis. Meanwhile, the surgical trauma is extensive and time-consuming, imposing high demands on intraoperative anesthetic medications. Selecting appropriate anesthetic drugs is of great significance for ensuring the smooth progress of surgery and reducing the occurrence of postoperative pain. Dexmedetomidine, an α2-adrenergic receptor agonist, has been widely used in intensive care units and operating rooms in recent years [3]. To further explore its application effect in surgery for patients with TC, this study included 90 patients as research subjects, aiming to investigate the anesthetic application effect of this drug in TC surgery. The report is as follows.

2. Materials and methods

2.1. General information

From January 2023 to December 2023, 90 patients were included and evenly divided into an observation group and a control group using a lottery method. There was no significant difference in baseline data between the two groups ($p > 0.05$). Specific data are shown in **Table 1**.

Table 1. Comparison of baseline data between the two groups

Group	n	Male (n)	Female (n)	Age (years)
Observation group	45	23	22	50.23 ± 3.41
Control group	45	24	21	50.33 ± 3.28
t/χ^2		0.044		0.142
p		0.832		0.888

2.1.1. Inclusion criteria

Patients should not have any serious systemic diseases such as heart disease, lung disease, or liver and kidney dysfunction that may affect the study outcomes or anesthesia risk; patients should not have a known history of allergies to the study drugs; patients should be able to understand and consent to participate in the study and provide informed consent.

2.1.2. Exclusion criteria

Patients with mental illness or cognitive dysfunction who are unable to provide informed consent; patients currently receiving medications that may affect the study results, such as long-term use of analgesics, antidepressants, etc.; patients who do not meet other requirements specified in the study design.

2.2. Methods

Both groups of patients received routine preoperative preparations before surgery, including an assessment of their overall health status, inquiry about medical history, physical examination, and review of relevant test results to determine their suitability for general anesthesia. Patients were routinely required to fast and abstain from water, and were given anti-anxiety and sedative medications as part of the preoperative routine. After entering the operating room, patients routinely had intravenous access established and were connected to electrocardiographic monitoring. Rapid induction was performed using intravenous anesthetics: midazolam (Fuan Pharmaceutical Group Qingyutang Pharmaceutical Co., Ltd., National Medical Products Administration

Approval Number H20243614, 1 mL: 5 mg) at a dose of 0.05 mg/kg, etomidate (Jiangsu Nhwa Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H20020511, 20 mg) at a dose of 0.15–0.3 mg/kg, and sufentanil (Yichang Humanwell Pharmaceutical Co., Ltd., Approval Number 20054171, 50 μg) at a dose of 3–5 μg/kg. Subsequently, a muscle relaxant, cisatracurium besylate (Shanghai Pharmaceuticals (Group) Co., Ltd. Dongying Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H20233427, 10 mg), was administered at a dose of 0.15 mg/kg to ensure muscle relaxation. Depending on the need, inhalational anesthetic sevoflurane may also be used for anesthesia maintenance. During the operation, propofol was continuously infused at a rate of 1–3 mg/(kg·h), remifentanil (Yichang Humanwell Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H20030198, 1 mg) at a rate of 3–5 μg/(kg·h), and cisatracurium besylate at a rate of 0.06–0.12 mg/(kg·h) to maintain an appropriate depth of anesthesia. Vital signs such as heart rate, blood pressure, respiration, and blood oxygen saturation were routinely monitored during the operation, and the doses of anesthetic drugs were adjusted based on the patient's response and surgical procedures, increasing or decreasing the amounts of propofol and remifentanil as needed. Before the end of the surgery, the doses of anesthetic drugs were gradually reduced to facilitate patient awakening. After ensuring that the patient could breathe autonomously and was conscious, the endotracheal tube was removed. Postoperative monitoring continued until consciousness and physiological functions were restored, with the same postoperative pain management approach applied to both groups.

2.2.1. Observation group

On the aforementioned basis, a continuous intravenous infusion of dexmedetomidine hydrochloride (Sichuan Guorui Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H20233657, 10 mL: 1.0 mg) at a rate of 0.3 μg/(kg·h) was administered after the initiation of anesthesia induction.

2.2.2. Control group

On a routine basis, a continuous intravenous infusion of an equal volume of sodium chloride injection (Southwest Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H50021610, 500 mL) was administered.

2.3. Observation indicators

The following indicators were compared between the two groups:

(1) The doses of propofol and remifentanil used during surgery in both groups of patients were recorded.
(2) The incidence rates of adverse events such as dyspnea, dizziness, nausea and vomiting, and restlessness in the two groups after surgery were recorded.
(3) The Visual Analogue Scale (VAS) for pain assessment was used to evaluate the pain levels of patients at rest and during activity at 4 hours, 12 hours, 24 hours, and 48 hours after surgery.

The VAS scale has a total score of 10 points, with patients rating their pain based on their personal experience; higher scores indicate stronger pain sensations.

2.4. Statistical analysis

All data in this experiment were subjected to statistical analysis using SPSS 28.0 software. Measurement data were presented in the form of [$\overline{x} \pm s$] and analyzed using *t*-tests, while count data were expressed as percentages and

compared using chi-square tests. A p-value less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of remifentanil and propofol dosages between the two groups

The dosages of remifentanil and propofol in the observation group were lower than those in the control group ($p < 0.05$), as shown in **Table 2**.

Table 2. Comparison of remifentanil and propofol dosages between the two groups [$\overline{x} \pm s$]

Group	n	Remifentanil (μg)	Propofol (mg)
Observation group	45	671.62 ± 89.67	378.64 ± 88.49
Control group	45	809.78 ± 92.47	511.37 ± 94.57
t		7.195	6.875
p		0.000	0.000

3.2. Comparison of incidence rates of complications between the two groups

The incidence rate of complications in the observation group was significantly lower than that in the control group ($p < 0.05$), as shown in **Table 3**.

Table 3. Comparison of incidence rates of complications between the two groups (n = 90)

Group	n	Dyspnea	Dizziness	Nausea & Vomiting	Irritability	Incidence(%)
Observation group	45	1	3	4	2	22.22
Control group	45	0	1	1	0	4.44
t						6.153
p						0.013

3.3. Comparison of VAS scores at different postoperative time points between the two groups

When comparing VAS scores at different postoperative time points between the two groups, the observation group had lower scores than the control group both at rest and during activity ($p < 0.05$), as shown in **Table 4** and **5**.

Table 4. Comparison of VAS scores at different postoperative time points (4 and 12 hours) between the two groups ($\overline{x} \pm s$, points)

Group	n	4 hours postoperative		12 hours postoperative	
		At rest	During activity	At rest	During activity
Observation group	45	2.01 ± 0.22	2.82 ± 0.34	2.52 ± 0.14	3.21 ± 0.41
Control group	45	2.55 ± 0.40	3.06 ± 0.33	2.91 ± 0.40	3.87 ± 0.36
t		7.935	3.398	6.173	8.114
p		0.000	0.001	0.000	0.000

Table 5. Comparison of VAS scores at different postoperative time points (24 and 48 hours) between the two groups ($\overline{x}$ ± s, points)

Group	n	4 hours postoperative		12 hours postoperative	
		At rest	During activity	At rest	During activity
Observation group	45	3.11 ± 0.30	3.40 ± 0.51	2.12 ± 0.21	2.45 ± 0.32
Control group	45	3.67 ± 0.18	3.99 ± 0.32	2.61 ± 0.29	2.90 ± 0.26
t		10.738	6.574	9.180	7.321
p		0.000	0.000	0.000	0.000

4. Discussion

The clinical manifestations of patients with thyroid carcinoma (TC) are diverse and are influenced by various factors, including tumor cell invasion, tumor size, and the presence or absence of cervical lymph node metastasis or distant metastasis. Patients may present with symptoms such as neck masses, dysphagia, and dyspnea. Surgical treatment is the primary approach for TC, with common surgical methods including thyroid lobectomy, total thyroidectomy, and cervical lymph node dissection, depending on tumor size, invasiveness, and pathological type. The main objective is to completely remove the tumor tissue and reduce the risk of recurrence. During surgery, anesthetic drugs play a crucial role in ensuring the smooth progress of the operation, reducing postoperative pain, and minimizing the occurrence of complications. Anesthetic drugs primarily exert their sedative and analgesic effects by blocking the conduction of nerve impulses and the excitation of central neurons. Although anesthesia can alleviate pain and improve comfort during surgery, anesthetic drugs may have certain impacts on patients' physiological functions, such as inhibiting thyroid function and affecting the respiratory and circulatory systems [4]. Therefore, in clinical practice, when selecting anesthetic drugs, it is essential to ensure minimal impact on patients' physiological functions and avoid adverse effects. Additionally, the impact of anesthetic drugs on postoperative recovery should be considered, and drugs that promote rapid awakening in patients should be chosen.

Dexmedetomidine is a highly selective α2-adrenergic receptor agonist that exerts corresponding pharmacological effects by acting on α2 receptors in both the central and peripheral nervous systems. It primarily produces sedative and anxiolytic effects by activating α2 receptors located in the locus coeruleus of the brain [5]. The locus coeruleus is a significant neuronal population in the brain, situated in the upper part of the brainstem, close to the thalamus and cerebral cortex. It consists of a large number of α-striatal cells that are rich in tyrosine hydroxylase, the primary enzyme for noradrenaline synthesis. These neurons are responsible for transmitting signals throughout the body, regulating emotions, attention, and wakefulness. Activation of α2 receptors in the brain, particularly those in the locus coeruleus region, by this drug can effectively alleviate discomfort in patients experiencing tension and anxiety, providing a quieter and more relaxed anesthetic environment. Additionally, at the spinal cord level, it can activate α2 receptors to exert analgesic effects. The spinal cord is a crucial hub for pain signal transmission, located within the vertebral canal of the spine, serving as the main conduit connecting the brain to other parts of the body. When the body is injured or affected by disease, pain receptors send signals to the spinal cord, which processes these signals and transmits them to the brain. The brain perceives pain and responds accordingly through these signals. Activation of α2 receptors can effectively reduce the transmission of pain

signals, thereby alleviating the patient's pain, which is of great significance for patients undergoing surgery [6].

The results of this study show that the doses of remifentanil and propofol in the observation group were lower than those in the control group ($p < 0.05$), indicating that the application of this drug can reduce the demand for remifentanil and propofol in surgical patients. Remifentanil is a potent sedative drug that produces its effects by activating μ-opioid receptors in the brain, while propofol is an intravenous anesthetic that induces hypnosis and sedation by inhibiting neuronal activity in the brain. However, both drugs may cause side effects such as respiratory depression, nausea, and vomiting, and may suppress the circulatory system, leading to a decreased heart rate and blood pressure. Dexmedetomidine produces sedative and sympatholytic effects by activating α2-adrenergic receptors, and can synergize with remifentanil and propofol to reduce the doses of these two drugs, thereby lowering the anesthesia risk for patients. In this survey, the observation group outperformed the control group in terms of complication rates and postoperative pain control ($p < 0.05$), suggesting that the application of this drug has potential advantages in reducing postoperative adverse reactions and pain, and has a positive impact on patients' postoperative recovery. This drug has sedative, hypnotic, and sympatholytic effects, can weaken the body's stress response, and reduce the incidence of adverse reactions in patients. Postoperative pain is one of the important factors affecting patients' postoperative recovery. Alleviating pain helps patients engage in early activity, reduces the occurrence of postoperative complications, and promotes overall patient recovery. This medication can effectively reduce postoperative pain by activating α2-adrenergic receptors and decreasing the transmission of pain signals.

5. Conclusion

In summary, the application of dexmedetomidine in anesthesia for patients undergoing TC surgery offers significant advantages. It can reduce the dosage of anesthetic drugs, lower the incidence of adverse reactions in patients, alleviate postoperative pain, enhance patient comfort, and thus holds clinical value.

Disclosure statement

The authors declare no conflict of interest.

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