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Effects of target-controlled infusion of propofol and remifentanil on the intraoperative awareness in patients undergoing epilepsy surgery.

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Abstract

Objective: To investigate the effects of target-controlled infusion of propofol and remifentanil on intraoperative awareness of patients undergoing epilepsy surgery.

Methods: A total of 100 epileptic patients admitted in the neurosurgery department in our hospital to undergo minimally invasive surgery were selected from May 2015-2016. The patients were randomly and equally divided into the observation (propofol and remifentanil) group and control (conventional manual-controlled infusion) group. The heart rate (HR) and blood oxygen concentration (SpO_2) of the patients were recorded before the operation, after anaesthesia administration for 3 min and 10 min, and post operation. Intraoperative awareness of patients was observed to assess the aesthetic effect. Pain degrees of patients were evaluated at 3, 6, 10 and 15 days post operation.

Results: Preoperative HR index in the observation group was 78.1 ± 9.5, with no statistically significant difference compared with the control group. The HRs in the observation group after anaesthesia administration for 3 min and 10 min were 76.4 ± 8.9 and 77.3 ± 6.8, respectively, compared with the control group, and no statistically significant difference was found (P<0.05). The preoperative SpO_2 level in the observation group was 99.1 ± 0.2, and no significant difference compared with the control group was found. After administration for 3 min, the SpO_2 level was (97.6 ± 2.8), which did not significantly differ compared with the control group (P<0.05). No significant difference in postoperative blood pressures was found between the two groups (P>0.05). By contrast, significant difference in intraoperative awareness was found between the two groups (P<0.05). The pain scores of patients in the observation group were significantly lower than those of the control group at 3, 6, 10, and 15 days post operation. Significant difference was found in the scores between the two groups (P<0.05).

Conclusion: Propofol and remifentanil target-controlled infusion anaesthesia resulted in more rapid induction and lower intraoperative awareness of patients undergoing epilepsy surgery. Moreover, the maintenance of anaesthesia was more stable, and the effect was better.

Keywords: Target-controlled infusion, Controlled infusion, Epilepsy, Surgery.

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Introduction

Epilepsy, which is commonly known as "Yangjiaofeng" or "Yangdianfeng," is an abnormal brain neuron discharge, resulting in the paroxysmal motor, sense, consciousness, and vegetative nerve dysfunctions caused by various factors [1]. Approximately 20%-30% of patients still experience intractable epilepsy after standard antiepileptic drug treatment. Surgery is a new therapeutic method to treat epilepsy. Approximately 50% of patients with medically intractable epilepsy seizure can be controlled or cured by surgery, improving the prognosis of refractory epilepsy to a certain extent [2]. Moreover, compared with traditional anaesthesia administration, one of the key epilepsy procedures for the anaesthetists is the target-controlled infusion technique, which is a new individualized anaesthesia administration. Compared with the manual-controlled technology, the timing and quantitative anaesthetics in the target-controlled technique can be infused according to the intraoperative requirement of patients [3]. The latter anaesthetic technique has many advantages and is currently one of the hot topics in anaesthesia technology. Reports have confirmed the exact anaesthetic effect of this technology in various surgeries. However, the intraoperative awareness of patients with epilepsy administered with target-controlled infusion was rarely reported [4]. The effects of target-controlled infusion of propofol and remifentanil on the intraoperative awareness of patients undergoing epilepsy surgery were investigated in this study.

Data and Methods

General data

A total of 100 epileptic patients admitted in the Department of Neurosurgery in our hospital to undergo minimally invasive surgery were selected from May 2015-2016. The patients were randomly and equally divided into the observation (propofol and remifentanil) group and control (conventional manual-controlled infusion) group. The observation group consisted of 24 males and 26 females aged 43-65 y old, with average age of 50.12 ± 10.23 y. The control group consisted of 23 males and 27 females aged 42-63 y old, with an average age of 51.25 ± 10.25 y. No statistically significant differences in the genders, ages, and types of disease were found between the two groups (P>0.05). The American Society of Anaesthesiologists (SAS) grading was 1-2. All patients underwent the regular antiepileptic drug treatment for more than 5 y, but the symptoms were uncontrolled. Focal spikes were observed in repeated EEG examinations. The patients intended to undergo surgery and had no serious heart, lung, liver, and kidney diseases. The patients were selected in accordance with the inclusion criteria. The patients and their families gave their informed consent. This study was approved by the hospital ethics committee.

Methods

The preoperative venous needle was indwelled in the upper limb. Arterial blood pressure (BP), heart rate (HR), and blood oxygen saturation (SpO_2) were invasively monitored. Propofol was infused in the patients in the observation group using the computer-controlled GRASEBY3500 infusion pump and Stelpump software. The targeted initial concentration of propofol infusion was 3 μg/mL, which was increased by 1 μg/mL every 2 min and 0.3 μg/kg remifentanil was intravenously injected. Then, remifentanil (0.2-0.5 μg/(kg.min)) was intravenously injected until the calling reaction disappeared. Afterward, the spinal surgery was started. For the control group, 50 mg of propofol was intravenously injected in the patients before the operation. The dose was increased gradually and 8 mg/(kg.h) propofol was infused for maintenance. If the HR was less than 50/min, 0.5 mg of atropine was intravenously infused. If SpO_2 was lower than 90%, high flow oxygen uptake with oxygen mask was promptly performed. The mask oxygen-inspiration was performed when necessary.

Observation indices

The HR, SpO_2, and BP of patients in the two groups were recorded before the operation, after anaesthesia administration for 3 min, 10 min and post operation. The pain scores of patients in the two groups were investigated using a questionnaire at 3, 6, 10 and 15 d post operation. The following information was derived in the survey: the last thing the patients recalled before falling asleep; the first thing the patients remembered when they woke up; whether the patients could remember all things; whether the patients could remember having a dream; and the most unpleasant experience during the operation.

Statistical processing

The data were analysed using the SPSS 26.0 statistical software and expressed as $\bar{x} \pm s$. The data were compared using the two independent sample t-tests. Count data and ratio were compared with χ^2 test.

Result

Comparison of HR and SpO_2 of patients in the two groups

The preoperative HR of the observation group was 78.1 ± 9.5, with no statistically significant difference compared with the control group. The HRs of patients in the observation group after anaesthesia administration for 3 min and 10 min were 76.4 ± 8.9 and 77.3 ± 6.8, with statistically significant difference compared with the control group (P<0.05). The preoperative SpO_2 level of patients in the observation group was 99.1% ± 0.2%, with no statistically significant difference compared with the control group. After anaesthesia administration for 3 min, the SpO_2 level in the observation group was 97.6% ± 2.8%, with statistically significant difference compared with the control group (P<0.05). No significant difference in the postoperative BP was found between the two groups (Table 1) (P>0.05).

Table 1. *Comparison of heart rate (HR) and blood oxygen saturation (SpO_2) of patients between the two groups during and after operation.*

Index	Group	Preoperative	After anesthesia administration for 3 min	After anesthesia administration for 10 min	Postoperative
HR	Observation group	78.1 ± 9.5	76.4 ± 8.9*	77.3 ± 6.8*	80.6 ± 9.4
	Control group	75.4 ± 9.1	71.4 ± 6.8*	73.7 ± 9.4*	75.7 ± 7.4
SpO_2 (%)	Observation group	99.1 ± 0.2	97.6 ± 2.8*	98.8 ± 0.6	98.5 ± 0.1
	Control group	98.1 ± 0.3	93.2 ± 3.1*	98.3 ± 0.5	98.2 ± 0.2
BP (mmHg)	Observation group	92.2 ± 1.2	90.2 ± 1.2*	91.0 ± 1.3	92.3 ± 1.1
	Control group	93.1 ± 1.1	90.1 ± 1.0*	91.4 ± 1.4	93.0 ± 0.9

Note: *Compared with the preoperative indices, *P<0.05; Compared with the control group, P<0.05.

Comparison of intraoperative awareness rates of patients in the two groups

Intraoperative awareness significantly differed between the two groups (Table 2) (P<0.05).

Table 2. *Comparison of intraoperative awareness of patients between the two groups.*

Group	Case (n)	Intraoperative awareness	
		Awareness	Unawareness
Observation group	50	5 (10%)	45 (90%)
Control group	50	16 (32%)	34 (68%)
T		7.29	38.8
P		<0.05	<0.05

Comparison of depression and anxiety scores of patients in the two groups before and after operation

The postoperative SDS and SAS scores of patients in the two groups were significantly higher than those before the intervention. Moreover, the SDS and SAS scores of patients in the observation group were significantly higher than those of the control group, and the difference was statistically significant (Table 3) (P<0.05).

Table 3. *SDS and SAS scores before and after operation in the two groups ($\bar{x} \pm s$).*

Group	SDS		SAS	
	Preoperative	Postoperative	Preoperative	Postoperative
Observation group (n=38)	54.05 ± 7.05	39.03 ± 6.81	54.32 ± 6.58	38.37 ± 6.65
Control group (n=38)	53.89 ± 7.23	47.23 ± 7.25	55.12 ± 7.00	46.95 ± 7.22
T	0.05	-2.61	-0.26	-2.76
P	>0.05	<0.05	>0.05	<0.05

Comparison of pain scores of patients in the two groups

The pain scores of patients in the observation group at 3, 6, 10 and 15 d post operation were significantly lower than those of the control group, and the difference between the two groups was significant (Table 4) (P<0.05).

Table 4. *Comparison of pain scores of patients between the two groups (±s).*

Group	n	3 d post operation	6 d post operation	10 d post operation	15 d post operation
Observation group	50	2.92 ± 1.52	1.22 ± 0.93	0.96±0.80	0.86 ± 0.93
Control group	50	3.04 ± 1.46	2.17 ± 1.21	1.76 ± 1.18	0.11 ± 0.23
T	/	0.362	8.254	9.321	6.258
P	/	P>0.05	P<0.05	P<0.05	P<0.05

Discussion

Epilepsy has complex etiology and pathogenesis and is difficult to prevent. Approximately 70% of epileptic patients are unknown, hampering the prevention of this disease [5]. Although a considerable number of symptomatic epilepsy has clear etiology, prevention of brain tumours and arteriovenous malformation, among others, is challenging. In addition, epilepsy seizure is the comprehensive result of multiple factors, including seizure threshold, neurological lesions, and induction factors, which further complicates the difficulty of prevention [6]. Patients with status epilepticus and those under long-term sedatives eat less, resulting in malnutrition and severe electrolyte disturbances. If the patients fail to acquire enough potassium to supplement the potassium excreted daily through urine, sweat, and digestive juices, the patients' serum potassium will decrease [7]. Serum potassium is important to maintain the normal function of brain cells. Therefore, potassium should be appropriately increased in the diet of epileptic patients. Epileptic patients, especially those under long-term antiepileptic drugs, easily suffer from lack of magnesium [8]. Thus, magnesium intake should be appropriately added in the diet of these patients. Approximately 20-25 g is the recommended magnesium dosage for adults. Approximately 50% of magnesium exists in the bone, and this magnesium cannot be consumed by the body cells. Compared with drug treatment, surgery treatment poses a certain risk. However, if long-term application of drugs is ineffective, surgery is the optimal choice [9]. In such case, the patient's epileptic foci should be precisely identified after careful examination. After the lesion is resected, most patients can still be cured well. For patients with unresected foci, the number of epilepsy seizures is significantly reduced.

Target-controlled infusion is a new method for administering anaesthesia and theoretically based on pharmacokinetics-pharmacodynamics. The metabolic processes and effect of drug are simulated using a computer to determine the most reasonable controlled anaesthesia scheme [10]. Further research and practice of the drug pump have resulted in the determination of the recommended drug concentration or stable concentration of the expected target concentration, thus controlling the depth of anaesthesia. In addition, the speed of administration should be adjusted according to the intraoperative need at any time. Target-controlled infusion can

enable the rapid acquisition of the target concentration. The patient's hemodynamic is very stable during the induction of anaesthesia, and the depth of intravenous anaesthesia is easily controlled. The whole anaesthesia process is smooth. Moreover, the patient's resuscitation and recovery time can be predicted. The target-controlled technology is simple, accurate, and controllable. Target-controlled infusion involves rapid recovery, stable blood concentration, and good controllability. The development of the anaesthetic technology and the new anaesthesia administration has greatly enriched the traditional anaesthesia technology, which has been facing a greater challenge. Target-controlled infusion of anaesthesia results in more accurate and stable intravenous anaesthesia, and the depth of anaesthesia are easy to control. This technology has gradually become one of the thrusts of anaesthesia technology.

The amounts of propofol used in the two groups at different times are listed in Table 1. The dosage of propofol in the observation group was significantly less than that of the control group. This result is similar to the result from a study in which target-controlled infusion of sufentanil and remifentanil was applied in gynaecological laparoscopy surgery. The similarity was due to the accurate control of the drug concentration under target-controlled infusion. The results of intraoperative awareness in the two groups are listed in Table 2. The results show the low rate of awareness of patients in the observation group compared with the control group, and the results were statistically significant. Thus, target-controlled infusion was effective and could ensure a more stable blood concentration. Stable target concentration could be achieved by adjusting the infusion of drugs at any time. Medication time and total amount of the drug could be derived from the data. Drug infusion could be automatically compensated, which could reduce the amount of drug infused and infusion time. In addition, the incidence rate of chronic pain, VAS score, character, influence on the daily life, and work of patients in two groups were evaluated at 3, 6, 10 and 15 d post operation. The pain score of patients in the observation group was significantly lower than that of the control group, and the scores significantly differed between the two groups. This result indicates that target-controlled infusion of propofol and remifentanil could reduce the pain of patients.

Conclusion

In conclusion, target-controlled infusion of propofol and remifentanil resulted in stable intraoperative vital signs of patients during anaesthesia. Compared with the conventional-controlled anaesthesia techniques, this new technology presents a wide range of applications.

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