Clinical research of different analgesia methods on perianesthetic pain of patients with moderate and severe craniocerebral injury who have emergency operation

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Abstract. – OBJECTIVE: To compare the effects of two different analgesia methods on postoperative pain of patients with moderate and severe craniocerebral injury who had an emergency operation.

PATIENTS AND METHODS: In this study, 64 patients who were treated in our hospital from January 2015 to January 2016 and diagnosed with acute craniocerebral injury, were consecutively selected. The patients were divided into the propofol total intravenous anesthesia group (the observation group) and the isoflurane intravenous-inhalation combined anesthesia group (the control group) randomly with 32 cases each. Mean arterial pressure (MAP), partial pressure of oxygen (SpO_2), and heart rate (HR) were compared and analyzed before and after anesthesia. At the first, second, and third day after the operation, adopt visual analogue scale (VAS), and sedation-agitation scale (GCS) were used to evaluate sedative and analgesic effects of patients.

RESULTS: After anesthesia had succeeded, HR, SpO_2, and MAP of patients in these two groups decreased, but the decrease in the observation group was less than that in the control group. The differences had statistical differences ($p<0.05$). At the first, second, and third day after the operation, scores of VAS and GCS in the observation group were obviously lower than those in the control group, and the differences had statistical differences ($p<0.05$). The total effective rate of anesthesia in the observation group was higher than that in the control group, and the differences had statistical differences ($p<0.05$).

CONCLUSIONS: For patients with moderate and severe craniocerebral injury who had an emergency operation, propofol total intravenous anesthesia is more stable and has a better postoperative pain comparing with isoflurane intravenous-inhalation combined anesthesia.

Key Words

Total intravenous anesthesia, Intravenous-inhalation combined anesthesia, Craniocerebral injury, Pain.

Introduction

Due to primary injury or secondary ischemia, hypoxia and other changes, the mortality rate of acute craniocerebral injury patients increases significantly[1]. Blood-brain barrier, endocrine dysfunction, and other diseases after the patient trauma, easily increase microvascular permeability and hinder cerebral circulation, which will cause brain edema and intracranial pressure increasing, and even severe secondary reactions such as angiorrhexis, cerebral hemorrhage and so on[2]. This study has compared and analyzed the clinical effects of propofol total intravenous anesthesia and propofol-isoflurane combined anesthesia on perianesthetic pain of patients with moderate and severe craniocerebral injury, who had emergency operation. The clinical effects are presented in the following sections.

Patients and Methods

Patients

In this study, 64 patients who were treated in our hospital from January 2015 to January 2016 and diagnosed with acute craniocerebral injury were consecutively selected, including 39 males and 25 females, on average of (49.3 ± 9.7) years (aged 26-68). This study was approved by the Ethics Committee of Linzi District People's Hospital. Signed written informed consents were obtained from all participants before the study. Injury type: 52 cases of traffic accident injury and 12 cases of falling injury. Clinical diagnosis of injury type: 20 cases of subdural hematoma, 20 cases of epidural hematoma, and 24 cases of subarachnoid hemorrhage. Before the emergency operation, all

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the patients had a different degree of nausea and disturbance of consciousness, as well as positive Babinski sign. There were 27 cases of combined limb fractures, 4 cases of hemopneumothorax, 6 cases of hernia of brain, 9 cases of abdominal of organ injuries, 11 cases of pelvic fractures, and 7 cases of renal injury. The evaluation of patients with craniocerebral injury degree of integration in accordance with Glasgow Coma Scale (GCS) method was done as follows: 12 cases of extremely severe traumatic brain injury (<5 points), 27 cases of severe brain injury (9-12 points) and 25 cases of moderate traumatic brain injury (6-8 points). Inclusion criteria: 1- with a coma after an injury for more than 12 h, unconsciousness or even worse serious coma; 2- with neurological positive symptom of dizziness, vomiting transient coma, and others; 3- with abnormalities of temperature, blood pressure, and respiratory. Exclusion criteria: 1- history of psychosis and fuzzy cognition; 2- visual or hearing impairment; 3- other-severe-combined organ dysfunctions; 4- patients unwilling to accept this study.

Anesthesia Methods

They were randomly divided into two groups: propofol total intravenous anesthesia group (observation group) and isoflurane intravenous-inhalation combined anesthesia group (control group). Each group included 32 cases. Preoperative half an hour, give 0.5 mg atropine and 100 mg phenobarbital intramuscular injection; induct with f 2.5-4 $\mu g \cdot kg^{-1}$ fentanyl, 0.1-0.15 $mg \cdot kg^{-1}$ vecuronium and 0.25-0.3 $mg \cdot kg^{-1}$ etomidate. After induction, anesthesia machine was connected through photopic endotracheal intubation to give intermittent positive pressure ventilation (IPPV), with respiratory rate of 12 beats/min, tidal volume 8-10 $ml \cdot kg^{-1}$ and an expiratory ratio of 1:2. Fentanyl was used for pain relief and vecuronium was used as muscle relaxants[3]. The observation group used No. 20 trocar independently for opening venous access. For patients in the observation group, venous channel was established and then injection of propofol was performed at the following speeds: 10 mg/h in the first 10 min; 8 mg/h in the second 10 min; 6 mg/h from 20 min later till the end. Isoflurane was given to the contrast group, with end-tidal isoflurane concentration (PETISO) as 1.5%[4]. Before and during the surgery, the patient's ECG, blood pressure, and pulse oxygen saturation were observed, and 6% hydroxyethyl starch or ringer's lactate was selected as intraoperative fluid. All patients did not conduct blood transfusion before and after surgery.

Observation Index

Mean arterial pressure (MAP), blood oxygen (SpO_2), and heart rate (HR) were compared and analyzed before and after anesthesia; visual analog scale and Glasgow coma scale (GCS) method were used to evaluate anesthesia sedation analgesic effects from the first to the third day after surgery. Anesthesia effects included: excellent (no pain), good (little pain), poor (with pain), and non-effective (other anesthesia drugs needed).

Statistical Analysis

SPSS 17.0 statistical software (IBM Corporation, Armonk, NY, USA) was used for all data statistics in this study. Measurement data were shown by mean ± standard deviation ($\bar{x} \pm s$). Comparison between two groups was made by *t*-test. Data statistics were shown by % and was tested by χ^2-test. If $p<0.05$, the difference statistically significant.

Results

Comparison of HR, SpO_2, and MAP in Two Groups Before and After Anesthesia

The difference of comparison of HR, SpO_2, and MAP in two groups before and after anesthesia was statistically significant ($p>0.05$). HR, SpO_2, and MAP after successful anesthesia dropped but observation group dropped less, so the difference was statistically significant ($p<0.05$) (Table I).

Table I. Comparison of HR, SpO_2, and MAP in two groups before and after anesthesia.

Group	HR (time/score)		SpO_2 (%)		MAP (mmHg)	
	Before	After	Before	After	Before	After
Control group	89.3 ± 11.4	74.5 ± 9.6	99.8 ± 4.7	95.6 ± 3.7	87.7 ± 4.6	74.2 ± 8.6
Observation group	88.7 ± 12.7	78.8 ± 6.7	99.7 ± 5.5	97.8 ± 4.6	86.9 ± 5.3	79.8 ± 6.2
t	0.744	1.556	0.536	1.866	0.366	2.011
p	0.352	0.042	0.732	0.039	0.127	0.037

Table II. Comparison of postoperative VAS and GCS score in two groups.

Group	VAS score			GCS score		
	1st	2nd	3rd	1st	2nd	3rd
Control group	6.7 ± 0.9	5.6 ± 0.4	4.7 ± 0.3	5.9 ± 0.7	5.6 ± 0.4	4.6 ± 0.3
Observation group	6.1 ± 0.6	4.8 ± 0.5	3.5 ± 0.6	5.4 ± 0.3	4.7 ± 0.5	3.9 ± 0.7
t	2.747	2.869	3.122	2.566	2.745	2.969
p	0.028	0.026	0.013	0.031	0.030	0.023

Comparison of Postoperative VAS and GCS Score in Two Groups

From the first to the third day after surgery, VAS and GCS scores of observation group were significantly lower than the control group, so the differences were statistically significant ($p<0.05$) (Table II).

Comparison of Anesthesia Effect in Two Groups

Anesthesia effect of observation group was significantly higher than that of control group, so the difference was statistically significant ($p<0.05$) (Table III).

Discussion

The Mechanism of Craniocerebral Injury

After a moderate and severe craniocerebral injury, the patient can doze off more than 6 h or fall into a coma again after waking up[5]. The patient may also appear mental confusion, epilepsia, nausea, vomiting, and even aphasia. The patient can appear cerebrospinal otorrhea or cerebrospinal fluid rhinorrhea after the skull base fracture; brain-stem injury easily leads to confusion, a serious obstacle to the respiratory cycle and ultimately even severe cases may die of cerebral hernia[6]. Therefore, the anesthetic treatment goal of moderate or severe craniocerebral injury is to stabilize the hemodynamics in order to ensure the normal breath, reduce intracranial pressure, improve cerebral perfusion pressure, cerebral blood flow and reduce the secondary brain damage within the scope of the whole brain. Therefore, the proper utilization of anesthetic methods and drugs is as important as the improvement survival rate of patients and the prognosis quality[7].

The Anesthetic Effect of Emergency Operation of Craniocerebral Injury

As a short-acting sedative drug, propofol can effectively protect the brain and reduce intracranial pressure, being used widely in the induction and maintenance of general anesthesia[8]. By controlling the sympathetic adrenal medullary system, propofol can improve the cerebral tissue oxygenation and reduce CMRO2, and this kind of protective effect has a great relationship with dose[9]. This study has compared and analyzed the effects on pain of propofol total intravenous anesthesia and isoflurane intravenous-inhalation combined anesthesia during perioperative period. It concludes that HR, SpO_2 and MAP of patients in two groups are all lower after the successful anesthesia but the observation group decreases less than the control group. The VAS and GCS scores of the observation group are significantly lower than those in the control group in 1 day, 2 days, and 3 days after the operation; the total anesthesia effective rate of the observation group is significantly higher than that of the control group. Therefore, for patients with moderate and severe craniocerebral injury who have emergency operation, propofol total intravenous anesthesia is more stable and has a better postoperative pain comparing with isoflurane intravenous-inhalation combined anesthesia.

Table III. Comparison of anesthesia effect in two groups [%].

Group	Cases	Excellent	Good	Poor	Total efficiency
Control group	32	15	13	4	87.5
Observation group	32	11	13	8	75.0
χ^2					3.213
p					<0.001

The Operation Points in Patients with Craniocerebral Injury During Perioperative Period

Keep fresh breathing: the unobstructed respiratory tract is the key of the anesthesia treatment[10]. Therefore, nurses should carefully observe the airway patency status of patients. If the patient is prone to vomiting, or has a nasal or oral trauma hemorrhage due to the intracranial pressure increase, an aspiration or respiratory tract obstruction can happen[11]. Before the trachea cannula, the nurse should help the patient to clean up the vomit in mouth and throat keep the air tube smooth[12]. Keep the patient's vital signs stable and control intracranial pressure: the patient's vital signs should be stable in the anesthesia. For patients with brain trauma and high intracranial pressure, they should be maintained as stable as possible during the induction and maintenance period of anesthesia[13]. Before injection, intravenous fentanyl should be given to reduce the sympathetic response of the guide tube. Propofol is commonly used for the induction of general anesthesia, which can effectively reduce the intracranial pressure and cerebral blood flow and prevent ischemia and reperfusion injury[14]. For different patients, the anesthetics should be different[15]. Monitoring during operation: operation monitoring is the key link. Only a careful monitoring on the patient's condition will ensure that the doctors can deal with kinds of unexpected conditions timely and accurately, thus increasing the success rate of surgery. At the time of anesthesia, the staff should avoid the damaging phenomenon of the patient's life, such as tracheal barrier, improper posture, excessive transfusion, or infusion[16]. The medical staff should take appropriate measures to deal with the situation immediately if it arises.

Conclusions

We observed that for patients with moderate and severe craniocerebral injury, who had emergency operation, propofol total intravenous anesthesia is more stable and has a better postoperative pain while comparing with isoflurane intravenous-inhalation combined anesthesia.

Conflict of Interest

The authors declare no conflict of interest.

References

1) Chen JW, Paff MR, Abrams-Alexandru D, Kaloostian SW. Decreasing the cerebral edema associated with traumatic intracerebral hemorrhages: use of a minimally invasive technique. Acta Neurochir Suppl 2016; 121: 279-284.
2) McBride DW, Donovan V, Hsu MS, Obenaus A, Rodgers VG, Binder DK. Reduction of cerebral edema via an osmotic transport device improves functional outcome after traumatic brain injury in mice. Acta Neurochir Suppl 2016; 121: 285-289.
3) Sosunov SA, Ameer X, Niatsetskaya ZV, Utkina-Sosunova I, Ratner VI, Ten VS. Isoflurane anesthesia initiated at the onset of reperfusion attenuates oxidative and hypoxic-ischemic brain injury. PLoS One 2015; 10: e120456.
4) Braz MG, Braz LG, Freire CM, Lucio LM, Braz JR, Tang G, Salvadori DM, Yeum KJ. Isoflurane and propofol contribute to increasing the antioxidant status of patients during minor elective surgery: a randomized clinical study. Medicine (Baltimore) 2015; 94: e1266.
5) Biester RC, Krych D, Schmidt MJ, Parrott D, Katz DI, Abate M, Hirshson CI. Individuals with traumatic brain injury and their significant others' perceptions of information given about the nature and possible consequences of brain injury: analysis of a national survey. Prof Case Manag 2016; 21: 22-33.
6) Talari HR, Fakharian E, Mousavi N, Abedzadeh-Kalahroudi M, Akbari H, Zoghi S. The Rotterdam scoring system can be used as an independent factor for predicting traumatic brain injury outcomes. World Neurosurg 2016; 87: 195-199.
7) Grathwohl KW, Black IH, Spinella PC, Sweeney J, Robalino J, Helminiak J, Grimes J, Gullick R, Wade CE. Total intravenous anesthesia including ketamine versus volatile gas anesthesia for combat-related operative traumatic brain injury. Anesthesiology 2008; 109: 44-53.
8) Kahveci FS, Kahveci N, Alkan T, Goren B, Korfali E, Ozluk K. Propofol versus isoflurane anesthesia under hypothermic conditions: effects on intracranial pressure and local cerebral blood flow after diffuse traumatic brain injury in the rat. Surg Neurol 2001; 56: 206-214.
9) Li F, Yuan Y. Meta-analysis of the cardioprotective effect of sevoflurane versus propofol during cardiac surgery. Bmc Anesthesiol 2015; 15: 128.
10) Sturesson LW, Bodelsson M, Jonson B, Malmkvist G. Anaesthetic conserving device AnaConDa: dead space effect and significance for lung protective ventilation. Br J Anaesth 2014; 113: 508-514.
11) Joshi GP, Kamali A, Meng J, Rosero E, Gasanova I. Effects of fentanyl administration before induction of anesthesia and placement of the laryngeal mask airway: a randomized, placebo-controlled trial. J Clin Anesth 2014; 26: 136-142.
12) Nakajima M, Kase Y, Kamijo A, Inoue T, Araki R. Postural and conditional variations of nasal patency in patients under general anesthesia approximating sleep as assessed with acoustic rhinometry. Nihon Jibiinkoka Gakkai Kaiho 2015; 118: 651-656.

13) Ayrian E, Kaye AD, Varner CL, Guerra C, Vadivelu N, Urman RD, Zelman V, Lumb PD, Rosa G, Bilotta F. Effects of anesthetic management on early postoperative recovery, hemodynamics and pain after supratentorial craniotomy. J Clin Med Res 2015; 7: 731-741.
14) Zhao CH, Li GH, Wang Q, Zhao B, Wang ZB. Mechanisms of propofol attenuation of ketamine-induced neonatal brain injury. Eur Rev Med Pharmacol Sci 2016; 20: 133-137.
15) Vutskits L. General anesthetics in brain injury: friends or foes? Curr Pharm Des 2014; 20: 4203-4210.
16) Craig D. Substance use disorder in Canadian university departments of anesthesia. Can J Anaesth 2016; 63: 365-366.