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Original Research Article

Effect of combination of intravenous general anesthesia with propofol and fentanyl on surgery for aortic dissection repair in patients, and its influence on respiratory and circulatory functions

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Abstract

Purpose: *To investigate the effect of application of propofol in combination with fentanyl intravenous anesthesia in interventional surgery for aortic dissection repair, and its influence on respiratory and circulatory functions in patients.*
Methods: *100 patients undergoing interventional surgery for aortic dissection repair in Xiangyang No. 1 People's Hospital, Hubei University of Medicine, Xiangyang. China from November 2018 to May 2020 were assigned equally to control group (CG) and study group (SG). CG received general anesthesia with propofol, while those in SG received combined intravenous general anesthesia with propofol and fentanyl. Time of anesthesia onset, postoperative awakening time, extubation time, respiratory function indicators and circulatory function indicators before operation (T0), and at intraoperative 1 h (T1), intraoperative 2 h (T2) and postoperative 2 h (T3); as well as postoperative VAS pain scores, and Ramsay sedation scores were determined and compared.*
Results: *Compared with CG, SG had shorter anesthesia onset, shorter postoperative awakening and extubation times, and lower postoperative VAS pain and Ramsay sedation scores ($p < 0.05$). At T1, T2 and T3, indicators of respiratory and circulatory functions were better in SG than in CG ($p > 0.05$).*
Conclusion: *Combined intravenous general anesthesia using propofol and fentanyl was more effective in interventional surgery for repair of aortic dissection, and it enhanced respiratory and circulatory functions in the patients.*

Keywords: *Combined intravenous general anesthesia, propofol, fentanyl, interventional surgery, aortic dissection, respiratory function, circulatory function*

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INTRODUCTION

Aortic dissection (also known as aortic dissection aneurysm) is a frequently occurring and serious aortic disease. The disease is caused by rupture of aortic vessel wall due to external force or other reasons, leading to entry of blood between the aortic vessel walls and the layering of vessel

walls [1-3]. In general, patients with aortic dissection experience sudden severe pain accompanied by nausea, vomiting and dizziness, significantly increased blood pressure, abnormal pulse, and possibility of cardiovascular diseases. The treatment of patients with aortic dissection involves immediate intervention and control of indicators such as blood pressure and pulse [4-6]. Before intervention, the patients need to be treated with general anesthesia. Propofol and fentanyl are anesthetic drugs used very regularly in the clinics for all types of procedures. Studies have shown that combined intravenous general anesthesia with propofol and fentanyl is secure for patients undergoing interventional treatment, and it stabilizes patients' indicators such as blood pressure and oxygen saturation [7,8].

This study was performed for determining the anesthetic effect of combined intravenous general anesthesia with propofol and fentanyl in interventional surgery for repair of aortic dissection, and its influence on respiratory and circulatory functions of patients undergoing surgery for aortic dissection in our hospital.

METHODS

General patient information

One hundred patients undergoing interventional surgery for aortic dissection repair in our hospital from November 2018 to May 2020 were equally and randomized into control group (CG) and study group (SG), with the age ranges of 47 – 75 and 45 – 76 years, respectively. No obvious differences in general information such as gender, age and disease onset time were found between the two groups ($p > 0.05$; Table 1).

Inclusion/exclusion criteria

Inclusion criteria

The patients below were included: those given interventional surgery of aortic dissection in Xiangyang No. 1 People's Hospital, Hubei University of Medicine, Xiangyang, China; patients aged ≥ 18 years; patients who had no co-morbidities or coagulation disorders, and patients who did not take anticoagulation drugs at a time close to the study. Moreover, patients with no history of drug allergy, or history of drug abuse, or adverse drug preferences, were included.

Exclusion criteria

The excluded patients were those who underwent other types of surgical procedures prior to the study, as well as those who had impairment of consciousness, and patients who could not cooperate during the study. Moreover, patients refusing to participate, or whose family members refused their participation in the study, were excluded.

Treatments

This study was approved by the ethics committee of Xiangyang No. 1 People's Hospital, Hubei University of Medicine (approval no. 20180981), and followed the guidelines of the Declaration of Helsinki (as revised in 2013) [9]. All patients agreed to the study, and they submitted signed informed consent forms.

General anesthesia with propofol was given to CG patients, with midazolam (Jiangsu Nhwa Pharmaceutical Co. Ltd; NMPA approval no. H10980026) at a dose of 0.03 mg/kg; propofol (Sichuan Guorui Pharmaceutical Co. Ltd.; NMPA approval no. H20040079; specification: 10 ml: 0.1 g) at a dose of 2 mg/kg, and cisatracurium (Jiangsu Hengrui Medicine Co. Ltd.; NMPA approval no. H20060869; specification: 10 mg) at a dose of 0.1 mg/kg, while propofol (2.5 μg/mL) and 2 mg of vecuronium (Yangtze River Pharmaceutical (Group) Co. Ltd; NMPA approval no. H20066941) were used for anesthesia maintenance. Tracheal intubation was performed to assist breathing after the procedure.

Table 1: Comparison of general information (mean ± SD)

Group	SG	CG	t/χ^2	*P*
Gender (male/female)	22/28	24/26	0.16	0.69
Age (years)	59.34±7.22	59.08±7.36	0.18	0.86
Height (cm)	167.38±10.55	165.80±10.31	0.76	0.45
Weight (kg)	66.78±11.05	65.89±11.07	0.40	0.69
Onset time (h)	3.36±0.13	3.39±0.11	1.25	0.22
History of smoking (years)	7.75±1.39	7.50±1.34	0.92	0.36
History of drinking (years)	11.37±2.37	11.07±2.55	0.61	0.54
Hypertension cases (n)	11	10	0.06	0.81
Diabetes cases (n)	9	12	0.54	0.46
Hyperlipidemia cases (n)	4	7	0.92	0.34

Anesthesia was induced in patients in SG using combined intravenous propofol and fentanyl, with midazolam (0.03 mg/kg), propofol (2 mg/kg), fentanyl (2.5 mg/kg) (Jiangsu Nhwa Pharmaceutical Co. Ltd.; NMPA approval no. H20113508) and cisatracurium (0.1 mg/kg), while anesthesia was maintained using propofol (2.5 μg/mL), 2 mg of vecuronium per time, and fentanyl (2 ng/kg). After the procedure, tracheal intubation was performed to assist breathing after the procedure.

Assessment of treatment outcomes/indexes

Anesthesia onset time, postoperative awakening time and extubation time

The anesthesia onset time, postoperative awakening time and extubation time were recorded and compared for the two groups.

Respiratory function indicators

A respiratory monitor (Beijing Kesijia Technology Co. Ltd.; model: K5061044) was used to determine respiratory function indicators in both groups before operation (T0), at intraoperative 1 h (T1), intraoperative 2 h (T2) and postoperative 2 h (T3). The parameters measured were respiratory rate and oxygen saturation.

Circulatory function indicators

A dynamic electrocardiograph (Shenzhen Borsam Medical Device Co. Ltd.; model: Borsam) was used to determine circulatory function indicators such as blood pressure and heart rate in both groups before operation (T0), at intraoperative 1 h (T1), intraoperative 2 h (T2) and postoperative 2 h (T3).

Postoperative pain

Postoperative pain levels in both groups were rated on the VAS pain scale in which 0 point indicated no pain, 1 - 3 points indicated slight and tolerable pain, 4 - 6 points were for tolerable pain that affected sleep, while 7 - 10 points indicated severe and intolerable pain. A score of 2 or 3 points indicated fine analgesia, while a score above 3 points reflected incomplete analgesia.

Postoperative sedation effect

Postoperative sedation effect in each group was rated on the Ramsay self-rating (SS) scale. A score of 1 point indicated anxiety and irritability, 2 points indicated that the patient was awake and cooperative, 3 points indicated drowsy patient who responded to instructions, 4 points indicated that the patient was asleep but could be awakened, 5 points was for a patient who was asleep but with weak responsiveness to strong external stimulus, while a patient who was deeply asleep and unresponsive to strong external stimulus was scored 6 points. Scores of 2 - 4 points indicated good sedation, while scores of 5 and 6 points indicated excess sedation.

Statistical analysis

Data processing was done with the software SPSS20.0, while graphs were prepared using GraphPad Prism 7 (GraphPad Software, San Diego, USA). Enumeration data are presented as numbers and percentages [n (%)], and were compared with chi squared (λ^2) test. Measurement data are expressed as mean ± standard deviation SD), and were compared using *t*-test. Differences were considered statistically significant at $p < 0.05$.

RESULTS

Anesthesia onset time, postoperative awakening time and extubation time

Anesthesia onset time, postoperative awakening time and extubation time were shorter in SG than in those in CG ($p < 0.05$). See Table 2.

Respiratory function indicators

Respiratory function indicator values at T1, T2 and T3 were markedly lower in SG than in CG ($p < 0.05$), but the values of these indicators in both groups were comparable at T0 ($p > 0.05$), as shown in Figure 1 and Figure 2.

Table 2: Comparison of anesthesia onset time, postoperative awakening time and extubation time (min)

Group	Anesthesia onset time	Postoperative awakening time	Extubation time
SG	16.59±4.41	133.28±11.05	9.55±3.96
CG	20.87±4.90	149.96±12.22	13.87±5.19
t	4.59	7.16	4.68
P-value	<0.001	<0.001	<0.001

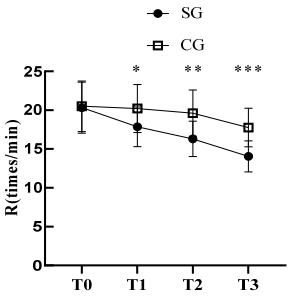

Figure 1: Comparison of respiratory rate values. *P < 0.05, respiratory rate of SG at T1 vs respiratory rate of CG at T1; **p < 0.05, respiratory rate of SG at T2 vs respiratory rate of CG at T2; ***p < 0.05, respiratory rate of SG at T3 vs respiratory rate of CG at T3

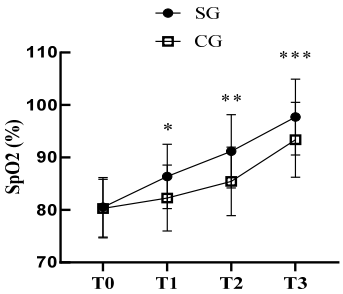

Figure 2: Comparison of oxygen saturation. *P < 0.05, oxygen saturation of SG at T1 vs oxygen saturation of CG at T1; **p < 0.05, oxygen saturation of SG at T2 vs oxygen saturation of CG at T2; ***p < 0.05, oxygen saturation of SG at T3 vs oxygen saturation of CG at T3

Circulatory function indicators

After comparison, the values of circulation function indicators at T1, T2 and T3 were better in SG than in CG, (p < 0.05), but the values of these parameters in the two groups were comparable at T0 (p > 0.05), as shown in Figure 3 and Figure 4.

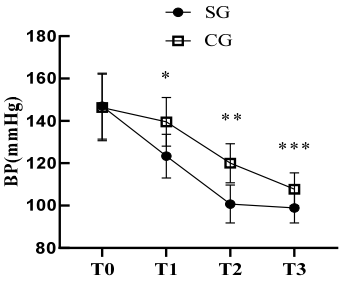

Figure 3: Comparison of blood pressure values. *P < 0.05, blood pressure value of SG at T1 vs blood pressure value of CG at T1; **p < 0.05, blood pressure value of SG at T2 vs blood pressure value of CG at T2; ***p < 0.05, blood pressure value of SG at T3 vs blood pressure value of CG at T3

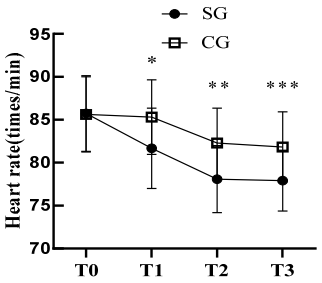

Figure 4: Comparison of heart rate. *P < 0.05, heart rate of SG at T1 vs heart rate of CG at T1; **p < 0.05, heart rate of SG at T2 vs heart rate of CG at T2; ***p < 0.05, heart rate of SG at T3 vs heart rate value of CG at T3

Postoperative VAS pain scores and Ramsay sedation scores

As shown in Table 3, the postoperative VAS pain scores and Ramsay sedation scores in SG were lower than those in CG (p < 0.05).

Table 3: Postoperative VAS pain scores and Ramsay sedation scores (mean ± SD, n = 50)

Group	VAS	Ramsay
SG	3.22±0.88	3.67±1.02
CG	4.75±1.04	5.00±1.13
t	8.05	6.18
P-value	< 0.001	< 0.001

DISCUSSION

Anesthesia, which is often used in clinical medicine, makes patients lose awareness of their surroundings and become oblivious of pain sensation for a specific period of time [10,11]. Anesthesia is required for patients before various types of surgery in order to reduce pain and guarantee proper procedure. However, the usage and dosage of anaesthetic drugs must be strictly controlled to avoid adverse reactions in patients [12,13]. For instance, overdose of anaesthetic drugs may affect the brain and cause cognitive dysfunction, coma and other manifestations. On the other hand, the use of very low doses of anesthetic drugs makes patients feel pain during surgery, thereby negatively affecting the surgical outcome. Propofol and fentanyl are anesthetic drugs often used in various types of surgery. They have the advantages of limited side effects and good anesthetic outcomes [14,15].

Patients with aortic dissection can be treated effectively with interventional surgery which is required immediately at the onset of the disease, and general anesthesia is necessary before the surgery [16,17]. In the present study, the

anesthetic effect of combined intravenous general anesthesia with propofol and fentanyl in interventional surgery of aortic dissection, and its influence on respiratory and circulatory functions, were investigated in patients undergoing surgery in our hospital. The anesthesia onset time, postoperative awakening time, extubation time, respiratory function indicators and circulatory function indicators before operation (T0), at intraoperative 1 h (T1), intraoperative 2 h (T2), and postoperative 2 h (T3), were compared between patients who received the combined anaesthesia and those who got general anesthesia and propofol. Moreover, postoperative VAS pain scores, and Ramsay sedation scores were compared. The results showed that compared with CG, anesthesia onset time, postoperative awakening time and extubation time were markedly shorter in SG, and postoperative VAS pain scores and Ramsay sedation scores were lower.

To ascertain the anesthesia effect, there was need to determine anesthesia onset time, i.e., the time from injection of the anesthetic drugs to the time when the patients became unconscious. A shorter onset time indicates better anesthesia effect, resulting in effective reduction in operation time while improving efficiency of utilization of the operating room. The role of tracheal intubation is to assist breathing while the patient is still under anesthesia because of their inability to breathe autonomously. Extubation is possible only when the patient is able to breathe spontaneously. Therefore, extubation time also indicates the awakening time of the patient, and the shorter it is, the less the effect of anesthetic drugs on the patient.

The VAS pain and Ramsay sedation scores are rating scales that indicate the postoperative perception of patients as well as the efficacy of anesthesia. The above results suggest that combination of intravenous general anesthesia with propofol and fentanyl produced a smaller effect on patients undergoing interventional surgery for aortic dissection due to shorter anesthesia onset time and postoperative awakening time, indicating that it was safer than general anesthesia plus propofol.

Respiratory function and circulatory function indicator levels in SG were better, but at T0, the levels of these indicators in the two groups were comparable. Patients with aortic dissection generally present with significantly increased blood pressure and decreased respiratory function after the onset, and in severe cases, pulmonary infection may be present, all of which have negative impacts on the lives of the patients. Respiratory function and circulatory function are useful for assessing vital functions. Thus, stable indicators indicate reduced risk of complications and few adverse reactions. The results of this study suggested that the indicators of respiratory and circulatory functions gradually returned to normal after surgery, and patients given combined intravenous general anesthesia with propofol and fentanyl had better respiratory and circulatory functions. These laid a good foundation for the success of surgery.

In another study, it was reported that combined intravenous general anesthesia with propofol and fentanyl effectively improved circulatory and lung functions in patients undergoing interventional surgery for repair of aortic dissection, enhanced anesthesia effect, lowered surgical risk, and increased surgical success [18]. These findings are similar to the results obtained in the present study.

CONCLUSION

A combination of intravenous general anesthesia using propofol and fentanyl produces improved respiratory and circulatory functions in patients who undergo interventional surgery for repair of aortic dissection. Therefore, the combined anesthesia has potential for use in surgery but further clinical trials are required.

DECLARATIONS

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. Zhuoya Bai conceived and designed the study, and drafted the manuscript. Yuhua Kong and Lin Chen collected, analyzed and interpreted the data. Lingling Wang revised the manuscript for important intellectual content. All authors read and approved the final manuscript. The authors contributed equally to this study.

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