

Effect of controlled hypotension on myocardial ischemia marker in eye-nose related surgery

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Abstract: We aimed to investigate the effect of different controlled hypotension levels on myocardial enzymes and myocardial ischemia protein in elderly hypertension patients, and then provide clinical evidence of suitable controlled hypotension level for them. Then, 45 elderly hypertension patients received elective eye-nose related surgery with nasal endoscope, who were randomly and evenly divided into three groups, including A, B and C groups, with mean arterial pressure (MAP) decreased by 20%, 30% and 40% respectively. The change of myocardial enzymes, myocardial ischemia modified albumin, score of surgical field quality and 12-lead electrocardiogram at different perioperative points were recorded. Then operative time, urine output and postoperative adverse complications of the patients were recorded too. Myocardial enzymes of group C were higher than that of both group A and B at T4, T5 points ($p < 0.05$); Myocardial ischemia modified albumin of group C were higher than that of group A and B at T2, T3, T4 and T5 points ($p < 0.05$); The score of surgical field quality of group A were higher than that of group B and C ($p < 0.05$); Operation time of group C is less than that of group A and B ($p < 0.05$); The change of ST segment in group C is more obvious than that in group A and B ($p < 0.05$); The incidence of adverse complications of group C is higher than that of group A and B ($p < 0.05$). Controlled hypotension with MAP reduced by 30% brings minimum myocardial damage and fewer complications, while meeting the demand of surgical field. Thus it is an ideal controlled hypotension level and can be used for elderly hypertension patients safely.

Keywords: Controlled hypotension, elderly patients, myocardial enzymes, myocardial ischemia modified albumin.

INTRODUCTION

Eye-nose related minimally invasive surgery is often performed under general anesthesia combined with controlled hypotension. The cardiac muscle requires much oxygen and is very sensitive to ischemia. In addition, for elderly hypertension patients, the pathologic vessel changes make ischemic myocardium damage easily to happen in perioperation. This paper studies the effect of different controlled hypotension levels on myocardial enzymes and myocardial ischemia modified albumin of elderly hypertension patients in perioperation. It also discusses safe and effective methods of controlled hypotension and provides clinical evidence of suitable controlled hypotension level for elderly hypertension patients.

MATERIAL AND METHODS

General Information

45 cases of elderly hypertension patients that will accept elective eye-nose associated surgery in Eye Hospital of Wenzhou Medical University were chosen. They were 60-70 years old, including 18 males and 27 females. Preoperative blood pressure of all patients was controlled under 140/90 mmHg. Patients complicated with severe

liver and kidney dysfunction, cardiac and cerebral vascular diseases, respiratory dysfunction, anemia, diabetes and central nervous system were not included.

Methods

Premedication was not applied to all patients and vital signs were monitored regularly. After routine anesthesia induction and tracheal intubation, breathing was controlled mechanically. Radial artery and internal jugular vein puncture and catheterization were performed after intubation. Sevoflurane combined with propofol and remifentanyl were inhaled to perform target-controlled anesthesia, and the BIS value was maintained at 40~50. Esmolol combined with nitroglycerin was used to control blood pressure and heart rate, and MAP was reduced by 20%, 30% and 40%, respectively. When main steps of the operation were completed, the utilization of nitroglycerin and esmolol was stopped. Blood transfusion was performed at rate of 8 ml/kg/h during operation to maintain fluid balance.

Observed indicator

The changes of myocardial enzyme spectrum, including aspartate transaminase (AST), serum creatine kinase (CK), serum creatine kinase isoenzyme (CK-MB), lactate dehydrogenase (LDH) and ischemia modified albumin (IMA) were observed and recorded for patients in the three groups at pre-operation (T0), 30 min after blood

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Table 1: Changes of myocardial enzyme spectrum and IMA in patients of three groups ($\bar{x} \pm s$, n=15)

Groups	Indicators	T0	T1	T2	T3	T4	T5
Group A	AST	37.4±11.5	38.2±7.9	36.9±6.5	37.6±7.3	35.1±9.5*	38.3±4.7*
	CK	72.6±4.9	79.7±11.2	75.8±6.9	79.7±15.1*	77.2±10.3*	80.1±2.3*
	CK-MB	14.7±6.1	17.1±7.2	11.9±9.1	16.8±4.4*	14.4±6.9*	15.9±8.2*
	LDH	168.2±24.7	163.3±18.3	170.4±22.9	177.9±19.2	168.4±25.4*	172.4±11.2*
	IMA	78.6±14.2	76.4±17.8	74.7±23.1*	80.2±11.5*	78.4±15.2*	82.1±12.9*
Group B	AST	33.8±9.8	36.9±10.3	37.8±8.1	39.2±4.9	40.5±7.8*	39.9±2.9*
	CK	76.1±6.5	77.3±8.5	79.3±10.4	83.5±9.4*	81.4±8.8*	84.1±10.2*
	CK-MB	12.5±11.6	14.8±3.4	15.9±6.8	15.5±9.8	16.1±10.6*	17.3±2.1*
	LDH	178.6±34.7	160.5±20.6	180.1±14.6	175.3±19.1	173.7±15.2*	167.5±23.1*
	IMA	81.3±20.1	83.6±14.4	78.2±15.9*	85.7±9.8*	81.8±18.8*	81.5±18.4*
Group C	AST	35.7±8.4	40.8±5.7	42.3±8.6	40.8±5.4	45.9±6.2	46.7±8.3
	CK	73.8±5.2	74.5±14.1	80.2±8.7	96.6±7.3	93.2±9.3	95.3±5.9
	CK-MB	16.3±8.4	16.5±10.1	15.5±4.9	22.7±5.3	23.4±3.2	22.5±4.3
	LDH	156.2±41.2	167.2±19.2	173.7±11.3	181.6±17.4	189.3±18.2	188.5±15.9
	IMA	75.9±16.3	96.1±18.2	90.8±16.5	94.6±13.3	93.6±10.9	92.7±14.6

Table 2: SESFQ scores, changes in ST segment and adverse complications in patients of three groups ($\bar{x} \pm s$, n=15)

Indicators Groups	SESFQ scores	Changes in ST segment	Complications (case)	Operation time (min)
Group A	3.3±0.6*	0.017±0.002*	0*	102.5±10.2*
Group B	1.9±0.4	0.021±0.005*	0*	91.4±7.9*
Group C	1.6±0.5	0.047±0.003	4	85.4±5.1

NOTE: * indicates the comparison result with group C, P< 0.05.

pressure lowering (T1) and 2h (T2), 6h (T3), 12h (T4), 24h (T5) after the operation. The score of surgery field quality and ST segment changes of 12-lead electrocardiogram were recorded 30 minutes after blood pressure decreased. Besides, the amount of colloidal crystal input, urine output, blood transfusion, bleeding and operation time were recorded and perioperative complications were observed.

According to the improved nasal endoscopic surgery field quality score (SESFQ) standard (Fromme Ga, 1986. Boezaart AP, 1995), surgery field quality score was determined by the same performer for all patients at T1 point.

STATISTICAL ANALYSIS

The obtained data were processed with software SPSS 18.0 for statistical analysis. The measurement was represented as mean ± standard deviation ($\bar{x} \pm s$). One-way analysis of variance was used in inter-group comparison. Repeated measures analysis of variance were adopted in inner-group comparison. Counting data was determined using chi-square test. Results of P<0.05 were considered to be statistically significant.

RESULTS

Comparison of general situation

There was no significant difference in age, body mass index, gender and preoperative blood pressure between patients in the three groups (P>0.05).

Comparison of observed indicators in three groups

Myocardial enzyme spectrum of group C was higher than that of group A and B at T4, T5 and the difference was of statistical significance (P<0.05). Ischemia modified albumin (IMA) of group C were significantly higher than that of group A and B at T2, T3, T4, T5 with a statistical difference (P<0.05). Data were shown in table 1. Surgical field quality scores of group B and C were significantly lower than that of group A with a statistical difference (P<0.05). Operation time of group C was significantly less than that of group A and B with a statistical difference (P<0.05). Depression of ST segment of group C was more obvious than that of group A and B and the difference was statistically significant (P<0.05). There are 4 cases of delirium in group C during recovery period. No perioperative complications of controlled hypotension were found in group A and B. Data were shown in table 2.

DISCUSSION

According to statistics, at present the aged population of China is more than 194 million, 14.3% of the total population. It is predicted to be more than 400 million in 2050 (Chen Zhou, 2014). In an aging society, more and more elderly patients need to accept surgery treatment. Nasal endoscopic surgery of nose and eyes is an emerging interdisciplinary science involving ophthalmology and rhinology. There are advantages in dealing with ophthalmic lesion through rhinology surgery, such as small trauma, quick recovery and no scar on face (YH Tu,

2014). There are also disadvantages like deep surgical site, narrow surgical field and rich mucosa blood vessels. Besides, many patients are complicated with deflection of nasal septum, nasal polyps, etc. Therefore, general anesthesia combined with controlled hypotension is often applied in this kind of surgery. The concept of controlled hypotension was first brought by Cushing and others in 1917 and applied to clinical use by Gardner and others in 1946 (Gardener WJ, 1946. XL Zhuang, 2005). In the 50s, sympathetic ganglion blockers were used to reduce arterial pressure. Now the joint use of antihypertensive agents and technology to keep the blood pressure to a safe and low level has become a common technique during anesthesia surgery. Different blood pressure level produces different effect on organs. Complications of controlled hypotension often happen in heart as it consumes the most oxygen and is less tolerant to ischemia and hypoxia, especially for elderly patients. In addition, ischemic myocardium damage is easy to happen in perioperation for them because of the pathologic vessel changes. So early diagnosis of myocardial ischemia damage in perioperative is the key to prevent and reduce cardiac complications. At present, low sensitivity means such as continuous blood pressure monitoring, simulated electrocardiogram and pulse oxygen saturation are applied to the assessment of myocardial ischemia. Those methods, although easy to use, are lack of objectivity as the large disturbance. It has not been reported that high specificity and sensitivity serum markers to myocardial injury such as myocardial enzymes and myocardial ischemia modified protein are used to guide controlled hypotension for elderly hypertension patients. Detection of myocardial injury markers is one of the indispensable clinical diagnoses of acute coronary syndrome. Myocardial ischemia modified protein is the first FDA approved biomarker of early diagnosis of myocardial ischemia (Collinson PO, 2007). After tissue ischemia and reperfusion, due to the increase of local reactive oxygen, acidosis and damage of ion pump on cell membrane, N-terminal structure is changed, transforming albumin to IMA. When tissue ischemia happens, the density of IMA in peripheral blood increases rapidly and continues to rise during the process. The detection of serum IMA level can provide scientific basis for the diagnosis of ischemic diseases as soon as possible (XQ Zhang, 2012). This study estimates the myocardial damage under different controlled blood pressure from the change of myocardial enzyme spectrum and myocardial ischemia modified protein, so as to provide guidance for clinical controlled hypotension.

Controlled hypotension is utilized to reduce MAP by 20%, 30%, 40% respectively. CK, CK-MB of group C are both higher than that of group A and B at T3, T4 and T5. AST and LDH of group C are higher than that of group A and B at T4 and T5. The difference is statistically significant ($P < 0.05$). The level of myocardial ischemia

modified protein of group C is higher than group A and B from T2, with statistically significant difference ($P < 0.05$), indicating that it is more sensitive than myocardial enzymes. The capacity of coronary reservation and expansion is weakened by hypotension due to the 40% reduction of MAP and the myocardial oxygen demand is increased under stress. Thereby the cardiac blood supply is relatively insufficient. For this reason, myocardial enzymes and myocardial ischemia-modified protein are changed. In this study, nitroglycerin combined with esmolol is used in controlled hypotension. They don't produce reflex tachycardia, and also can avoid myocardial depression. Therefore, myocardial ischemia is prevented when MAP is reduced by 20% and 30%. The change of ST segment of group C is more obvious than that of group A and B, which consists with the subsequent change of myocardial ischemia and myocardial enzyme modified protein. The score of surgical field quality of group B and C are higher than that of group A, showing that 30%-40% reduction of MAP can provide good surgical field, thus the operation time is reduced. The difference of operation time between group B, C and group A is statistically significant. During recovery period there are 4 cases of delirium in group C and no one in group A and B ($p < 0.05$), indicating that 40% reduction of blood pressure may have impact on cognitive function for the elderly. The reason is deduced that the consequences of controlled hypotension, including insufficient brain blood supply, energy metabolism disturbance, decreased glucose utilization protein, synthesis abnormalities and changes in neurotransmitters, result in short-term cognitive impairment (Yocum GT, 2009).

CONCLUSION

In conclusion, applying controlled hypotension with MAP reduced by 30% to eye-nose related surgery with nasal endoscope is effective in blood pressure suppress, safe, reliable and of small myocardial impact. It can be safely used on elderly hypertension patients.

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