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Original Article

A comparison of the efficacy between general anesthsia and local anesthesia in the interventional surgery for abdominal aortic dissection

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Abstract: Objective: To compare the anesthetic efficacy between general anesthesia and local anesthesia in the interventional surgery for abdominal aortic dissection. Methods: A total of 80 patients with abdominal aortic dissection receiving interventional treatment from January 2015 to June 2017 were randomly divided into Group A (n=40) and Group B (n=40). The patients in Group A received the interventional surgery for abdominal aortic dissection under general anesthesia and those in Group B received the interventional surgery under local anesthesia. The indicators such as general data, blood pressure, heart rate, bleeding volume and urine amount in the surgery, adverse reactions of anesthesia, duration of surgery, hospitalization duration and hospitalization cost of the two groups of patients were recorded and compared. Results: There were no obvious differences in the age, gender and other information between the two groups of patients (all $P>0.05$). The indicators including the duration of surgery, intraoperative bleeding volume, intraoperative urine amount and adverse reactions of anesthesia between the two groups of patients were not statistically significant (all $P>0.05$). The blood pressure and heart rate of the patients in Group A right at the beginning of the surgery (T_0), before stent release (T_1), during stent release (T_2) and at the end of the surgery (T_3) were lower than those of the patients in Group B (all $P<0.01$). The hospitalization duration of Group A was longer than that of Group B ($P<0.01$). There was no statistically significant difference in the hospitalization cost between Group A and Group B ($P=0.05$). Conclusion: Adequate sedation and analgesia can be achieved under general anesthesia. During the surgery under general anesthesia, the patient's muscles are relaxed, and the surgeon can be fully engaged in the surgery without being disrupted by the patient. The haemodynamics remain stable. Moreover, hypotension can be better controlled when the stent is released. However, it requires longer hospitalization duration and higher cost compared with local anesthesia.

Keywords: Abdominal aortic dissection, interventional surgery, general anesthesia, local anesthesia

Introduction

Aortic dissection refers to the disease that the blood in the aortic lumen flows from the tear site in the aortic tunica intima into the aortic tunica media, forcing the tunica media apart, which is then expanded along the long axis of the aorta to form a separation state between two (true and false) lumens in the aortic wall [1, 2]. Aortic dissection is rarely observed, occurring at an estimated rate of 5-10 patients per 1,000,000 people every year. It is frequently observed in people aged 50-70 years old. The rate of males to females is about 2-3:1. A total of 65%-70% of the patients may die of cardiac tamponade, arrhythmia and so on in the acute phase. Therefore, early diagnosis and treatment are of great necessity [3]. Abdominal aortic dissection occurs in abdominal aorta which is the body's main artery. Therefore, the possibility of occurrence is the most common [4, 5]. Immediate treatment should be conducted once abdominal aortic dissection occurs; otherwise it is likely to result in death. Minimally invasive interventional therapy is commonly used at present, which results in a significantly small trauma in the patients [6].

Local anesthesia is the main method adopted in the interventional surgery for abdominal aortic dissection currently. However, patient compliance and analgesic efficacy are not satisfactory during the surgery under local anesthesia. General anesthesia is characterized by full analgesia, complete patient compliance and so on. Now it replaces local anesthesia gradually, but its side effects have not been studied. General anesthetics include propofol and fentanyl. However, propofol is one of the most common short-acting anesthetics in surgery, and fentanyl is an "ultra-short-acting" opioid receptor agonist with significant analgesic efficacy. The study on the combined application of the two drugs in aortic intervention surgery is still in its infancy, and the evaluation on its clinical efficacy is still controversial. In this study, the therapeutic effects of different anesthetic methods in the interventional surgery for abdominal aortic dissection were compared, and the advantages and disadvantages of each method were summarized. Now it is reported as follows.

Materials and methods

General data

A retrospective analysis was conducted on 80 patients with abdominal aortic dissection who received interventional treatment in The First Affiliated Hospital of Nanchang University from January 2015 to June 2017. The patients included 68 males and 12 females aged 54-75 years old. They were randomly divided into Group A (n=40) and Group B (n=40). The patients in Group A received the interventional surgery for abdominal aortic dissection under general anesthesia and those in Group B received the interventional surgery under local anesthesia. This study was been approved by the Ethics Committee of The First Affiliated Hospital of Nanchang University. All the patients were free from contraindications of surgery, and they signed the informed consent before surgery.

Diagnostic criteria: 1) Medical history: patients aged about 60 years' old who were usually accompanied with the history of hypertension or sudden severe chest or back pain. If severe aortic regurgitation coexists, heart failure and cardiac tamponade will occur rapidly, leading to hypotension and syncope. 2) Computed tomography angiography, magnetic resonance angiography and other imaging materials suggested aortic dissection [7].

Inclusion criteria: Patients who met the diagnostic criteria for abdominal aortic dissection; patients who were classified into American Society of Anesthesiologists (ASA) Grade II-III; patients aged 54-75 years old.

Exclusion criteria: Patients with severe mental diseases; patients with severe cardiovascular and cerebrovascular diseases; patients with liver or kidney diseases; patients who were forbidden to receive general anesthesia or local anesthesia.

Anesthetic methods

General anesthesia: The patients abstained from food for 8 h and were deprived of water for 6 h prior to the surgery. The peripheral veins were opened after the patients entered the surgery room. Electrocardiogram, saturation of pulse oximetry, respiratory rate (RR) and the right radial artery pressure (invasive blood pressure) were monitored regularly. Atropine (0.3 mg), midazolam (0.03 mg/kg), propofol (15 mL), rocuronium bromide (50 mg) and fentanyl (1 mg) were given during anaesthetic induction. Tracheal intubation was conducted after the patients lost consciousness. The trachea was 23 cm away from the incisor for males and 22 cm for females. It was connected with the respirator. The tidal volume was set at 500 mL, and the frequency was 12 breaths/min. Remifentanil (50 μg/mL; 5 mL/h) was used for the maintenance of anesthesia, and propofol (2.5-3.0 μg/mL) was used for consistent target controlled infusion. The blood pressure was maintained within the normal range during surgery (100-140/50-90 mmHg). If the diastolic pressure is more than 130 mmHg controlled hypotension will be conducted with continuous infusion of sodium nitroprusside; if the systolic pressure is less than 30% of basal blood pressure, phenylephrine (50 μg/time) will be given by intravenous bolus injection. Infusion was stopped at half an hour prior to the end of the surgery. The systolic blood pressure (SBP) was controlled within 80-90 mmHg when the stent was released. The trachea was withdrawn after the patients awoke from the surgery. Then the patients were sent to the care unit to control the blood pressure.

Table 1. Comparison of general data between the two groups of patients (n (%), $\overline{x}$ ± sd)

Group	Group A	Group B	t/χ^2	P
Case	40	40		
Age (years)	65.3±6.2	66.5±7.3	0.7924	0.4306
Gender			0.3922	0.5312
Male	35 (87.5)	33 (82.5)		
Female	5 (12.5)	7 (17.5)		
BMI	24.6±2.8	25.8±3.2	1.7850	0.0782
Cardiovascular risk factors				
Smoke	28 (70.0)	26 (65.0)	0.2279	0.6331
Drink	29 (72.5)	30 (75.0)	0.0646	0.7994
Hypertention	36 (90.0)	35 (87.5)	0.1252	0.7235
Diabetes mellitus	12 (30.0)	15 (37.5)	0.5031	0.4781
Hyperlipemia	24 (60.0)	27 (67.5)	0.4868	0.4854
Coronary disease	22 (55.0)	25 (62.5)	0.4642	0.4957

Note: BMI, body mass index.

Local anesthesia: A total of 0.5% lidocaine was injected locally. The interventional surgery was conducted after the local site was painless. The patients were asked to cooperate during surgery, and they were required to hold their breaths during the injection of contrast agent. Respirator and other drugs and equipment for rescue were prepared well.

Observation indicators

Main observation indicators: The duration of the surgery, intraoperative bleeding volume, intraoperative urine amount, adverse reactions of anesthesia, blood pressure and heart rate right at the beginning of the surgery (T_0), before stent release (T_1), during stent release (T_2) and at the end of surgery (T_3) of the two groups of patients were recorded.

Minor observation indicators: Hospitalization duration and hospitalization cost.

Statistical analysis

All the data were analyzed using SPSS 17.0 and GraphPad Prism 6.01. All the measurement data were expressed as mean ± standard deviation ($\overline{x}$ ± sd). All the data were in line with normal distribution and homogeneity of variance test. The t test was adopted for the comparison between the two groups. The test level was set at 0.05. P<0.05 indicates that the difference was statistically significant.

Results

Comparison of general data between the two groups of patients

The differences were not statistically significant in the age, gender, body mass index (BMI), cardiovascular risk factors, etc. (**Table 1**).

Comparison of hemodynamic indexes between the two groups of patients

The SBP, diastolic blood pressure (DBP) and heart rate right at the beginning of the surgery (T_0), before stent release (T_1), during stent release (T_2) and at the end of surgery (T_3) of the patients in Group A were obviously lower than those of the patients in Group B. The differences were statistically significant (all P<0.01, **Figure 1**).

Comparisons of the duration of the surgery, intraoperative bleeding volume and intraoperative urine amount between the two groups of patients

There were no statistical differences in the duration of the surgery, intraoperative bleeding volume and intraoperative urine amount between the two groups of patients (all P>0.05, **Table 2**).

Comparisons of hospitalization duration and cost after surgery between the two groups of patients

The average hospitalization duration after surgery in Group A was significantly higher than that in Group B with statistically significant difference (P<0.0001, P=0.05). Moreover, there was no statistically significant difference in hospitalization cost after surgery between the two groups (P=0.05). See **Table 3**.

Comparisons of adverse reactions of anesthesia between the two groups of patients

There were no statistical differences in the incidence of adverse reactions (nausea, vomiting

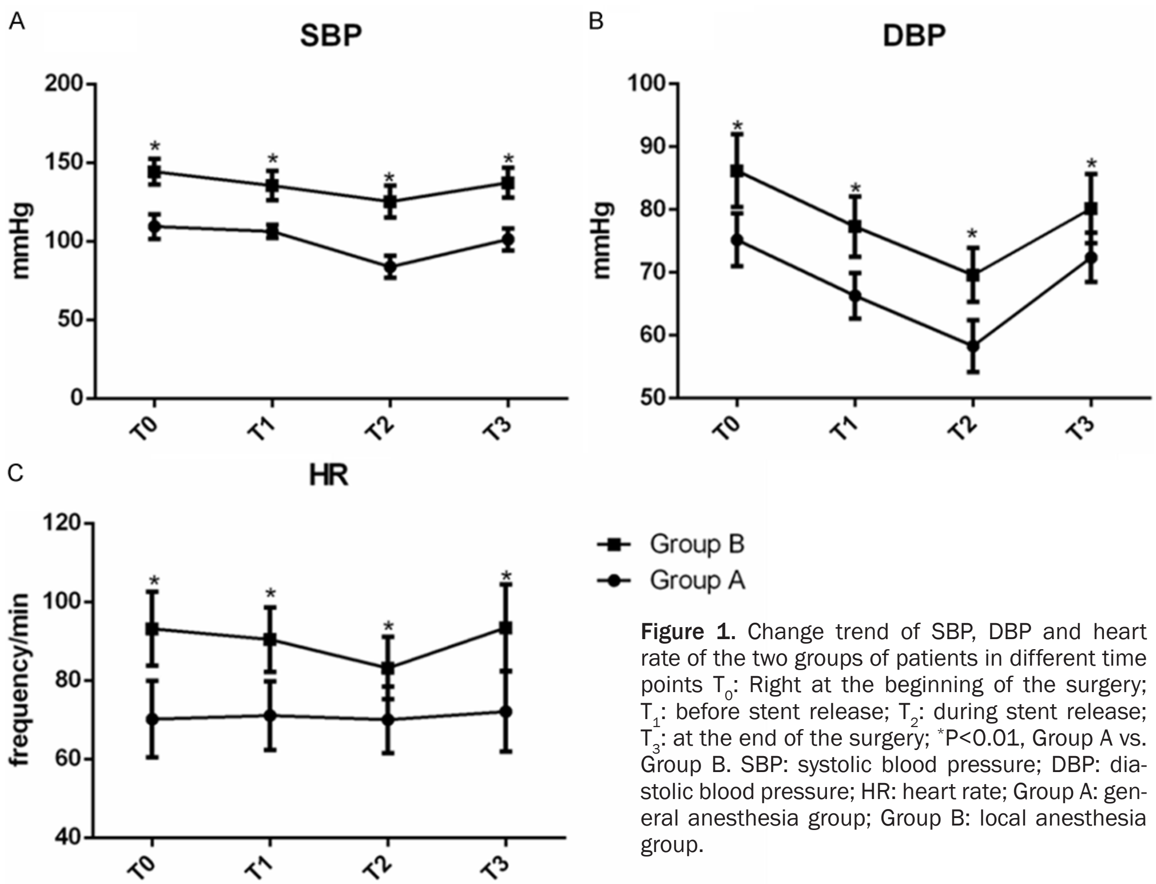

Figure 1. Change trend of SBP, DBP and heart rate of the two groups of patients in different time points T_0: Right at the beginning of the surgery; T_1: before stent release; T_2: during stent release; T_3: at the end of the surgery; $^*P<0.01$, Group A vs. Group B. SBP: systolic blood pressure; DBP: diastolic blood pressure; HR: heart rate; Group A: general anesthesia group; Group B: local anesthesia group.

Table 2. Comparisons of the duration of the surgery, intraoperative bleeding volume and intraoperative urine amount between the two groups of patients ($\bar{x}$ ± sd)

Group	Case	Operation time (min)	Peroperative bleeding (mL)	Urinary volume (mL)
Group A	40	125.2±15.1	98.3±21.4	182.6±29.1
Group B	40	129.4±17.8	92.5 ± 28.9	188.4±31.6
t		1.1380	1.0200	0.8539
P		0.2587	0.3111	0.3958

and dysphoria) after anesthesia between the two groups of patients (P=0.5562, P=0.3143, P=0.3143). Somnolence was not observed in the two groups of patients (**Table 4**).

Discussion

Aortic dissection is a result of the interactions between abnormal tunica media structure and abnormal hemodynamics. However, abnormal tunica media structure and abnormal hemodynamics are reciprocally cause and effect [8-10]. The aortic tunica media is composed of reticular elastic fibers, spaced support collagen fibers and regularly arranged smooth muscle cells, while smooth muscle cells form elastic fibers and collagen fibers [11]. They also support the nutritional layer. The elastic fibers maintain the vascular compliance, and the collagen fibers determine the lateral vascular resistance, but also affect the vascular compliance. The main factors affecting hemodynamics are the vascular compliance and the initial energy of the centrifugal blood, while the main factor of hemodynamics that influences the aortic wall is the stress of blood flow (including shear stress and residual stress) [12]. The representative index is the change rate of blood pressure [13]. When a variety of reasons result in decreased vascular compliance, the hemodynamic stress on the vascular wall is increased, leading to further damage to the vascular wall, which will once again make the hemodynamic stress on the vascular wall increase, thereby entering a vicious circle until the formation of aortic dissection aneurysm. Hypertension, degenerative change of aortic tunica media, aortic atherosclerosis and diabetes mellitus are risk factors of aortic dissection [14, 15].

Table 3. Comparisons of hospitalization duration and hospitalization cost after surgery between the two groups of patients ($\bar{x}$ ± sd)

Group	Case	Postoperative hospital stay (days)	Hospitalization expenses (ten thousand yuan)
Group A	40	8.9 ± 2.6	19.8 ± 3.2
Group B	40	6.2 ± 1.1	17.3 ± 2.9
t		6.0490	3.6610
P		<0.0001*	0.05

Note: *P<0.01

Table 4. Comparisons of adverse reactions of anesthesia between the two groups of patients (n, %)

Group	Case	Nausea	Vomit	Drowsiness	Dysphoria
Group A	40	2 (5.0)	1 (2.5)	0	1 (2.5)
Group B	40	1 (2.5)	0	0	0
χ^2		0.3463	1.0130		1.0130
P		0.5562	0.3143		0.3143

Conservative medical treatment or surgical aortic reconstruction under extracorporeal circulation with chest opened is the main traditional treatment method [16]. The conservative treatment has poor efficacy, while the incidence of accidents or complications is obviously increased after chest opening [17]. Therefore, the management requirements for anesthesia are relatively high according to the characteristics and the needs of the surgery. Under local anesthesia, the patients are conscious and in a highly stressful state with excessive secretion of epinephrine during surgery. Meanwhile, the circulatory state of the patients is unstable due to the disease. Therefore, intraoperative hemodynamic management of the patient is a very intractable problem. If the secretion of epinephrine induced by the nervousness of the patients can be relieved, the unstable haemodynamics during surgery can be remitted significantly. It is firstly reported in China that the surgery for aortic dissection under general anesthesia is characterized by small bleeding volume during surgery and small trauma, which is a way with higher safety than the surgery under local anesthesia, and the patients can recover quickly after surgery [18]. A study of Rousseau et al. showed that interventional surgery under general anesthesia is the most effective treatment method with minimal trauma [19].

This study compared the clinical efficacy between general anesthesia and local anesthesia in the surgery of abdominal aortic stent implantation. There were no statistical differences in the age, gender, BMI, cardiovascular risk factors, etc. between the two groups of patients. The SBP, DBP and heart rate right at the beginning of the surgery, before stent release, during stent release and at the end of the surgery of the patients receiving general anesthesia were notably lower than those of the patients receiving local anesthesia. It was found that the hemodynamics of the patients is more stable in the surgery of abdominal aortic stent implantation under general anesthesia, which may be caused by the adequate sedation and analgesia in the patients upon analysis. During the surgery under general anesthesia, the patient's muscles are relaxed, and the surgeon can be fully engaged in the surgery without being disrupted by the patient. The haemodynamics remain stable. Moreover, hypotension can be better controlled when the stent is released [20, 21]. However, patients who receive local anesthesia are conscious, and the haemodynamics of the patients is markedly unstable, which is higher than the general anesthesia group as the patients do not cooperate with the surgeon during operation because of sympathetic nervous excitement, accelerated heart rate, increased blood pressure or even pain.

It was found in this study that there were no statistical differences in the duration of the surgery, intraoperative bleeding volume and intraoperative urine amount between the surgery of abdominal aortic stent implantation under general anesthesia and that under local anesthesia. The surgery is characterized by small trauma and short duration. If the patients can cooperate during local anesthesia, the intraoperative bleeding volume and the duration of the surgery will not be poorer than general anesthesia. All the patients included in this study were adults and classified into ASA Grade II-III. The patients can cooperate with the surgeon to complete the surgery as long as they are painless. However, the average hospitalization duration and cost in the general anesthesia group are obviously higher than those in the local anesthesia group. The patients were sent to the care unit for observing the vital signs after general anesthesia. If there is any change in the blood pressure or the heart rate, drugs will be used timely to control the situation. However, the patients who undergo the surgery under local anesthesia are directly sent to common wards after surgery. Therefore, the average hospitalization cost of the patients undergoing general anesthesia is higher than that of the patients receiving local anesthesia.

However, as this study was conducted in a small number of patients, and the follow-up duration was relatively short, it cannot be excluded that there may be significant differences in the clinical efficacy between the two groups of patients after surgery if the study is conducted in a large sample size with a long-term follow-up. In addition, the failure of using a randomized and double-blind method may result in a great selection bias, which may affect the reliability of the results.

In conclusion, full sedation and analgesia in the patients can be achieved under general anesthesia. During the surgery under general anesthesia, the patient's muscles are relaxed, and the surgeon can be fully engaged in surgery without being disrupted by the patient. The haemodynamics remain stable. Moreover, hypotension can be better controlled when the stent is released. However, it requires longer stay in hospital and higher cost compared with local anesthesia.

Disclosure of conflict of interest

None.

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