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Correlative study on dorsalis pedis artery blood pressure and brachial artery blood pressure in the state of epidural anesthesia and recovery

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ABSTRACT

The relevance of dorsalis pedis artery blood pressure and brachial artery blood pressure in supine position has been studied, in the state of epidural anesthesia and shock recovery, in different age groups, to investigate the clinical value of perioperative monitoring dorsalis pedis artery blood pressure.100 orthopedic and obstetrics patients undergoing epidural anesthesia, and 80 hypovolemic shock (trauma, hemorrhagic shock) with recovery, were collected. The left dorsalis pedis artery and brachial Blood pressure were monitored by the multi-function monitor in all patients, during the period of pre-anesthesia, anesthesia satisfaction and post-surgery, and the shock and the recovery process in supine position; 150 selected-surgery patients, included 50 children, 50 young and middle-aged cases and 50 old age cases, also were collected. The left dorsalis pedis artery blood pressure and brachial blood pressure has been monitored in all cases. There was no significant difference between the SBP and DBP of the left arteria dorsalis pedis and the SBP and DBP of brachial artery, during the time of pre-anesthesia and anesthesia satisfaction. But compared to the brachial artery, SBP and DBP of the left arteria dorsalis pedis were higher, in 9mmHg and 7mmHg each (P <0.01), and the blood pressure of the two parts was linear correlation in these three time point. There was high relevance between the dorsalis pedis artery blood pressure and brachial Blood pressure during the period of shock and the recovery using of vasoactive drugs. There was no significant difference between the dorsalis pedis artery blood pressure and the brachial blood pressure in the children's group; but SBP and DBP of the left arteria dorsalis pedis were higher than the brachial artery, in 20 mmHg and 5 mmHg in the young and middle-aged group (P <0.01, P <0.05), and in 21 mmHg and 6 mmHg in the old aged group (P <0.01). The circumference of distal lower leg and upper arm were almost equal in different ages patients, and the dorsalis pedis artery blood pressure and brachial Blood pressure were significantly correlated (P <0.01). The results showed that there was a high positive correlation between the dorsalis pedis artery blood pressure and the brachial blood pressure in the state of spinal anesthesia, recovery and in different ages. Monitoring the dorsalis pedis artery blood pressure can reflect the hemodynamic changes timely and objectively. This method can substitute monitoring the brachial blood pressure when necessary, and has an important clinical value.

KEYWORDS

Arteria dorsalis pedis;
Brachial artery;
Blood pressure monitoring;
Epidural anesthesia;
Shock;
Recovery.

INTRODUCTION

Indirect measurement of brachial artery blood pressure is still the most commonly used indicators of clinical observation of patients with hemodynamic changes and assessing the circulatory function. Objective, accurate and timely monitoring of blood pressure is the most basic and most important hemodynamic dynamic monitoring tools in first aid and shock resuscitation[1]. In the case of trauma or burns of both upper extremities, surgery on both upper extremities, or deformity of congenital coarctation of the aorta, for which the method cannot be implemented or cannot truly reflect the hemodynamic changes in the body, we have to monitor the lower extremity blood pressure[2-4]. Studies have shown that, comparing with the popliteal arterial blood pressure and invasive blood pressure monitoring on lower extremity arteries which needs certain technology and equipments, ankle dorsalis pedis arterial blood pressure monitoring is simple and easy, and can objectively reflect the body's hemodynamic changes[5], but, in the state of epidural anesthesia and shock resuscitation and at different ages, supine ankle dorsalis pedis artery is still lack of systematic research. The experiment researched the differences and correlation between supine ankle dorsalis pedis artery and brachial artery blood pressure in the state of epidural anesthesia and shock resuscitation and at different ages, to evaluate the clinical value of ankle dorsalis pedis artery blood press resuscitation.

MATERIALS AND METHODS

Clinical data

Among all hospitalized patients who would accept operations under epidural anesthesia at Department of Orthopedics and Department of Gynecology and Obstetrics of our hospital from June 2011 to June 2012, 100 patients without cardiovascular system disease, central nervous system disease, endocrine disease, blood volume and abnormal internal environment were selected randomly, including 50 men and 50 women, who were aged from 20 to 60 and whose weight was from 59-75 kg. 80 cases of hypovolemic shock (trauma, hemorrhagic shock) and resuscitation were selected, which including 40 males and 40 females, aged 24 to 55 years old, weighing 54 to 80 kg; 50 hospitalized patients in three age brackets were selected: (1) Children group (<12 years old), aged 5 to 12 years old, weighing 18 to 32 kg; (2)Younger group, aged 20 to 59 years old, weighing 58 to 78 kg; (3) Elderly group, aged 60 to 80 years old, weighing 61 to 74 kg. There was no Gender constituent ratio difference of the three groups.

Measurement methods

Blood pressure monito ring methods: (1) measure the left ankle dorsalis pedis artery blood pressure and brachial artery blood pressure using the GE multi-function monitor; (2) brachial artery blood pressure measurement: wrap the cuff on the mid upper arm, leave cuff lower edge 2 to 3 cm from the cubital fossa, align the cuff markings with the arterial pulse position. Ankle dorsalis pedis artery blood pressure measurement: wrap the cuff on the lower leg, leave cuff lower edge 2 to 3 cm from the medial malleolus, align the cuff markings with the dorsalis pedis artery pulse position; measure the perimeter of upper arm and lower leg at the midpoint where the cuff wrapped for patients at different ages.

Time point of the blood pressure measurement

Under the condition of narcosis, patients' blood pressure was monitored at three time points, i.e., 5 minutes before narcosis, after satisfaction with level of anesthesia and when the operation was completed. the shock resuscitation group patients monitoring the blood pressure during shock, using of vasoactive drugs (Dopamine, Phenylephrine) and after blood pressure recovered satisfactorily. The blood pressure of all groups of patients of different ages were monitored at about 8:00.

Statistical treatment

The experimental data were expressed asmean± standard deviation (mean±SD), and analyzed using analysis of variance, paired t-test and linear regression by the SPSS13.0 software package, $P < 0.05$ was statistically significant for difference or correlation coefficient.

RESULTS AND DISCUSSION

There was no significant difference among corresponding values of SBP and DBP of the left ankle's

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dorsal pedal artery and the blood pressure of the brachial artery before narcosis and after satisfaction with level of anesthesia (P>0.05). However, SBP and DBP of the left ankle's dorsal pedal artery were higher than the blood pressure of the brachial artery by 9mmHg and 7mmHg when the operation was completed, respectively, and their difference was significant (P<0.01 and P<0.05), as shown in TABLE 1. The blood pressure of the two parts at the three time points had significant positive correlation.

TABLE 1 : Comparison between blood pressure of the left ankle's dorsal pedal artery and that of the brachial artery under the condition of narcosis (n=100, mmHg, mean±SD)

Target	Before narcosis		After anesthesia satisfaction		After the surgery	
	Ankle dorsalis pedis artery	Brachial artery	Ankle dorsalis pedis artery	Brachial artery	Ankle dorsalis pedis artery	Brachial artery
SBP	137.95±18.18	127.14±14.28	113.23±19.39	110.12±18.22	129.25±5.36**	120.41±13.11
DBP	84.63±11.18	83.08±8.93	71.21±15.23	69.31±14.27	82.07±9.21*	76.27±11.01

Between the 2 groups, *P<0.05, **P<0.01 was considered significant differences

In the two time points during process of shock and using of vasoactive drugs, the difference between SBP and DBP of left ankle Dorsalis pedis artery blood pressure and corresponding value of brachial artery blood pressure was not statistically significant (P> 0.05). While resuscitation to the blood pressure returned to normal, compared with the brachial artery, SBP and DBP of ankle dorsalis pedis artery, respectively, were 11mmHg and 9mmHg higher (all P <0.01). The SBP and DBP correlation test between the two parts of the three time points were highly significant, as shown in TABLE 2.

TABLE 2 : Comparison of the left ankle dorsalis pedis artery blood pressure and brachial artery blood pressure in shock and resuscitation process (n=80, mmHg, mean±SD)

Target	Shock		Using of vasoactive drugs		Blood pressure recovered satisfactorily	
	Ankle dorsalis pedis artery	Brachial artery	Ankle dorsalis pedis artery	Brachial artery	Ankle dorsalis pedis artery	Brachial artery
SBP	73.2±8.6$^{\#\#}$	71.8±6.5	94.2±7.4$^{\#\#}$	92.5±3.6	117.9±10.8$^{\#\#}$	106.7±8.5
DBP	48.4±5.3$^{\#\#}$	47.9±5.2	59.8±4.5$^{\#\#}$	60.3±4.7	74.5±7.4$^{*\#}$	65.4±7.1

Between the 2 groups, *P<0.05, $^{\#}P$<0.05, $^{\#\#}P$<0.01 was considered significant differences

At different ages, measure the perimeters of cuff wrapped around the upper arm and lower leg at the midpoint, results show that: the children groups were 16.45 ± 4.78 cm, 17.16 ± 3.79 cm, the younger group were 26.43 ± 3.29 cm, 27.21 ± 2.64 cm, the elderly group were 25.75 ± 3.26 cm, 26.64 ± 3.32cm, and the difference between two values in above three groups was, respectively, 0.71cm in the children group, 0.78cm in the younger group, and 0.89cm in the older group, which were very close with no significant difference (P> 0.05).

In the children group, the SBP and DBP of left ankle dorsalis pedis artery were only 2mmHg and the 1mmHg higher than that of brachial artery, respectively, the corresponding values were similar without statistically significant (P> 0.05); in younger group, SBP and DBP of ankle dorsalis pedis artery were 21mmHg and 6mmHg higher than that of brachial artery, respectively (P <0.01, P <0.05); in elderly group, SBP and DBP of ankle dorsalis pedis artery were 20mmHg and 7mmHg higher than that of brachial artery, respectively (P <0.01, P <0.05). The SBP and DBP of the left ankle dorsalis pedis artery and brachial artery blood pressure tests in group of children, younger and elderly groups had a significant positive correlation (P <0.001 or P <0.05), as shown in TABLE 3.

Blood pressure monitoring includes non-invasive and invasive blood pressure monitoring, in which noninvasive brachial artery blood pressure monitoring, as the blood pressure close to the aortic blood pressure, is still the most common and important clinical method, is important clinical indicators and monitoring means for assessment of cardiovascular function and circulatory function in resuscitation. Invasive blood pressure monitoring can provide accurate, reliable and continuous arterial blood pressure data, but the technical

requirements of its equipment and operation, invasive complications and "implementation period" limits its clinical application, especially in the early periods of resuscitation. Previous studies have shown that, for the same intravascular pressure, the blood pressure values measured by the indirect method were positively correlated to the extremity perimeters. Monitoring perimeter of the popliteal fossa is much larger than the upper extremity, therefore, popliteal artery blood pressure measured with the conventional elbow arterial blood pressure measurement cuff is often significantly higher[5], the monitor cuff requirements and inconvenient limit its application, which is only commonly used for auxiliary diagnosis in diseases in coarctation of the aorta, Takayasu arteritis, or arteriosclerosis obliterans[6], but the following cases require clinical monitoring of the lower extremity invasive or non-invasive blood pressure[7,8]: (1) The first aid when double upper extremity trauma or burns, especially the resuscitation with systemic trauma; (2) The intraoperative and postoperative guardianship of both upper extremities surgery at the same time; (3) congenital coarctation of the aorta deformities which need to monitor blood pressure to guide treatment of trauma, shock, or other surgical diseases.

TABLE 3 : Comparison and correlation tests of the left ankle dorsalis pedis artery blood pressure and brachial artery blood pressure at different ages (n=80, mmHg, mean±SD)

Groups	Target	Ankle dorsalis pedis artery	Brachial artery	r	P
Children	SBP	105.1±14.8	103.5±12.3	0.93	0.001
	DBP	69.5±9.6	68.4±11.5	0.94	0.001
Younger	SBP	149.5±11.7	128.9±13.1**	0.82	0.001
	DBP	85.1±8.6	79.2±9.4*	0.86	0.001
Elderly	SBP	178.2±10.3	158±12.2**	0.79	0.01
	DBP	95.5±12.6	88.2±9.7*	0.72	0.05

Between the 2 groups, *$P<0.05$, **$P<0.01$ was considered significant differences.

According to this observation, it was found that, when a supine position was adopted, corresponding values of SBP and DBP of the left ankle's dorsal pedal artery as well as the blood pressure of the brachial artery before narcosis and after satisfaction with level of anesthesia had no significant difference, while SBP and DBP of the left ankle's dorsal pedal artery were only higher than the blood pressure of the brachial artery by 9mmHg and 7mmHg when the operation was completed, respectively. At the three time points, straight lines of the blood pressure of the two parts had positive correlation. It was implied that monitoring the ankle's dorsal pedal artery could reflect changes in an organism's hemodynamics and was a reliable way to replace monitoring of brachial artery's blood pressure clinically during intraspinal anesthesia. The author has applied monitoring of the blood pressure of the ankle's dorsal pedal artery to children's upper limbs' fracture open and internal fixation operation, scald of adults' upper limbs or traumatic patients' recovery and perioperative period care during operations and proved that this method is safe, reliable, convenient and applicable. However, its clinical value in monitoring of patients with cardiovascular disease during the perioperative period still needs to be observed.

In the case of shock, resuscitation and first aid, arterial blood pressure is one of the most commonly used indicator of clinical human data collection process, the accuracy of measurement is directly related to the condition analysis, judgment and processing, so no matter what measurement method is used, accuracy and dynamic change is extremely important. This study shows that, in mild and moderate shock and resuscitation process, with vasoactive drugs, ankle dorsalis pedis arterial blood pressure and brachial artery blood pressure values are close, consistent with the change. When the blood pressure returned to normal after basic resuscitation success, the two parts of blood pressure is still highly significant, prompt that, to common clinical hypovolemic shock, during first aid resuscitation, monitoring of the ankle dorsalis pedis artery blood pressure also can be a timely, realistic assessment of the body's circulatory function. However, brachial artery blood pressure monitoring cannot be implemented in a severe trauma, shock rescue process, the implementation of the ankle dorsalis pedis artery noninvasive blood pres-

sure monitoring in a short period, at the same time with a timely implementation of the lower extremity invasive arterial monitoring is necessary.

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