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Dorsalis Pedis Artery Blood Pressure is a Good indicator for Blood Pressure Monitoring during Shock and Recovery

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Abstract

To compare Supine ankle dorsalis pedis artery and brachial artery blood pressure in patients during shock resuscitation and of different ages was compared, in order to evaluate the clinical value of ankle dorsalis pedis artery blood press monitoring. 80 hypovolemic shock (trauma, hemorrhagic shock) patients and 150 selected patients, including 50 children, 50 young and 50 old patients, were enrolled in this study. The left dorsalis pedis artery and brachial blood pressure were monitored by multi-function monitor in all patients. We observed a correlation between dorsalis pedis artery blood pressure and brachial blood pressure during the period of shock and the recovery with the use of vasoactive drugs. In addition, the values of dorsalis pedis artery blood pressure and brachial blood pressure were significantly correlated in three groups with different ages. There is a positive correlation between dorsalis pedis artery blood pressure and brachial blood pressure in the state of shock and recovery as well as in populations of different ages. Monitoring dorsalis pedis artery blood pressure can reflect the hemodynamic changes timely and accurately, and has important clinical value.

Keywords: Arteria dorsalis pedis; Brachial artery; Blood pressure monitoring; Shock

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Introduction

Indirect measurement of brachial artery blood pressure is still the most commonly used indicator of hemodynamic changes and circulatory function in the clinical [1]. Objective, accurate and timely monitoring of blood pressure is one of the most important tools for hemodynamic dynamic monitoring in first aid and shock resuscitation [2]. 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 can not be implemented or truly reflect the hemodynamic changes in the body, we have to monitor the lower extremity blood pressure [3-5]. Compared with the popliteal arterial blood pressure and invasive blood pressure monitoring on lower extremity arteries which need certain technology and equipments, ankle dorsalis pedis arterial blood pressure monitoring is simple and easy, and can accurately reflect the hemodynamic changes in the body [6].

However, the application of ankle dorsalis pedis arterial blood pressure monitoring in patients during shock resuscitation and of different ages has not bee reported. In this study, we measured and compared supine ankle dorsalis pedis artery and brachial artery blood pressure in patients during shock resuscitation and of different ages, to evaluate the clinical value of ankle dorsalis pedis artery blood press monitoring.

Subjects and Methods

Patients

Eighty cases of hypovolemic shock (trauma, hemorrhagic shock) and resuscitation were selected, including 40 males and 40 females, aged 24 to 55 years old, weight 54 to 80 kg. 150 hospitalized patients in three age ranges were selected: (1) children group (<12 years old), aged 5 to 12 years old, weight 18 to 32 kg; (2) young group, aged 20 to 59 years old, weight 58 to 78 kg; (3) elderly group, aged 60 to 80 years old, weight 61 to 74 kg. There was

no gender ratio difference of the three groups (n=50). The protocol was approved by Ethics Committee of Jingzhou Central Hospital and all participants signed informed consent.

Measurement of blood pressure

The left ankle dorsalis pedis artery blood pressure and brachial artery blood pressure were measured using the GE multi-function monitor. For 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. For 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.

The blood pressure of all groups of patients of different ages was monitored at about 8:00 am. For the shock resuscitation patients, the blood pressure was monitored during shock, use of vasoactive drugs (Dopamine, Phenylephrine) and after the recovery of blood pressure.

Statistical analysis

The experimental data were expressed as mean±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 considered statistically significant.

Results

Correlation of left ankle dorsalis pedis artery blood pressure and brachial artery blood pressure during shock and resuscitation

During shock and the use of vasoactive drugs, the differences between SBP and DBP of left ankle Dorsalis pedis artery blood pressure and brachial artery blood pressure were not statistically significant (P> 0.05). During resuscitation the blood pressure returned to normal. Compared with the brachial artery blood pressure, SBP and DBP of ankle dorsalis pedis artery were 11mmHg and 9mmHg higher, respectively (P <0.01). Correlation analysis of SBP and DBP measured at the three time points showed that left ankle dorsalis pedis artery blood pressure and brachial artery blood pressure were highly correlated during shock and resuscitation ,$^{\#}P$<0.05,$^{\#\#}P$<0.01, Table 1).

Table 1. *Comparison and correlation of left ankle dorsalis pedis artery blood pressure and brachial artery blood pressure during shock and resuscitation (n=80, mmHg, mean±SD)*

	Shock		Using vasoactive drugs		Blood pressure recovery	
	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

SBP: systolic blood pressure; DBP: diastolic blood pressure. $^{*}P$<0.05 vs. brachial artery blood pressure.
$^{\#}P$<0.05, $^{\#\#}P$<0.01 indicated the correlation between left ankle dorsalis pedis artery blood pressure and brachial artery blood pressure.

Table 2. *Correlation of left ankle dorsalis pedis artery blood pressure and brachial artery blood pressure in patients of different ages (n=50, 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
Young	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

*SBP: systolic blood pressure; DBP: diastolic blood pressure. *P<0.05,**P<0.01 vs. ankle dorsalis pedis artery blood pressure.*

Correlation of left ankle dorsalis pedis artery blood pressure and brachial artery blood pressure in patients of different ages

In patients of different ages, the perimeters of cuff wrapped around the upper arm and lower leg at the midpoint were measured. The results showed that the perimeters of the upper arm and lower leg were 16.45 ± 4.78 cm and 17.16 ± 3.79 cm in children groups; 26.43 ± 3.29 cm and 27.21 ± 2.64 cm in young group; 25.75 ± 3.26 cm and 26.64 ± 3.32 cm in the elderly group, respectively. The differences in the perimeters in all three groups were not significantly different (P> 0.05).

In the children group, SBP and DBP of left ankle dorsalis pedis artery were only 2 mmHg and 1 mmHg higher than that of brachial artery, respectively, and they showed no significant difference ($P > 0.05$). In young group, SBP and DBP of ankle dorsalis pedis artery were 21 mmHg and 6 mmHg 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 20 mmHg and 7 mmHg higher than that of brachial artery, respectively ($P < 0.01$, $P < 0.05$). SBP and DBP of left ankle dorsalis pedis artery and brachial artery blood pressure in children, young and elderly groups had a significant positive correlation ($P < 0.01$ or $P < 0.05$, Table 2)

Discussion

Blood pressure monitoring includes non-invasive and invasive blood pressure monitoring. The noninvasive brachial artery blood pressure monitoring is still the most commonly used for the 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 the equipment and operation, invasive complications and "implementation period" limit 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 indirect method were positively correlated to the extremity perimeters. However, popliteal artery blood pressure measured with conventional elbow arterial blood pressure measurement cuff is often significantly higher [5]. Thus popliteal artery blood pressure monitoring is only commonly used for auxiliary diagnosis in diseases in coarctation of the aorta, Takayasu arteritis, or arteriosclerosis obliterans [7].

However, in the following cases clinical monitoring of the lower extremity blood pressure is necessary: (1) double upper extremity trauma or burns, especially the resuscitation with systemic trauma; (2) intraoperative and postoperative guardianship of both upper extremities surgery at the same time; (3) congenital coarctation of the aorta deformities [8,9]. In the case of shock, resuscitation and first aid, arterial blood pressure is one of the most commonly used indicator of hemodynamic changes in the body. In this study we found that during mild to moderate shock and resuscitation process, the values of ankle dorsalis pedis arterial blood pressure and brachial artery blood pressure were very close and consistent with the changed conditions such as the use of vasoactive drugs. In addition, we analyzed the correlation of left ankle dorsalis pedis artery blood pressure and brachial artery blood pressure in patients of different ages. The results showed that the two values were significantly correlated in three groups with different ages.

In conclusion, we demonstrated a positive correlation between dorsalis pedis artery blood pressure and brachial blood pressure in the state of shock and recovery as well as in populations of different ages. Monitoring dorsalis pedis artery blood pressure can reflect the hemodynamic changes timely and accurately. When brachial artery blood pressure monitoring can not be implemented in situations such as severe trauma and shock rescue process, it could be substituted with ankle dorsalis pedis artery noninvasive blood pressure monitoring.

Conflict of interest

None

References

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