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Correlation of blood pressure variation with frailty and nutritional status in elderly patients

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Abstract: **To explore the correlation of blood pressure variation with frailty and nutritional status in elderly population. 126 elderly patients were selected. According to fried frailty scale, there were 42 cases in the frailty group, 42 cases in the pre-frailty group and 42 cases in the non-frailty group. 24h ambulatory blood pressure monitoring was performed in each group. Systolic pressure and diastolic pressure variability were analyzed at 24h, day, night. Meanwhile, the NRS-2002 evaluation table of nutrition risk screening for inpatients was used to evaluate the nutritional risk, and the relationship between blood pressure variability, frailty and nutritional status was determined. Correlation analysis showed that the standard deviation of systolic blood pressure at 24h, standard deviation of systolic blood pressure at day time and standard deviation of systolic blood pressure at night were positively correlated with frailty ($p<0.05$). 24h pulse pressure difference, daytime pulse pressure difference and nocturnal pulse pressure difference were positively correlated with frailty ($p<0.05$). The loading values of 24h diastolic pressure, day diastolic pressure and night diastolic pressure were negatively correlated with the frailty ($p<0.05$). The loading values of 24h diastolic pressure, day diastolic pressure and night diastolic pressure were negatively correlated with the nutritional risk ($p<0.05$). Patients aged 80 or older in the frailty group were significantly higher than those in the non-frailty group, the number of drugs and the number of comorbidities were significantly higher than that of non-frailty group ($p<0.05$). There was correlation between the variation of blood pressure and frailty, nutritional status in the aged. The systolic blood pressure standard deviation and pulse pressure difference were larger and the diastolic pressure load was lower in the elderly patients with frailty. The higher the diastolic load was, the lower the nutritional risk score was. The number of drugs taken and diseases was more appear in the frail elderly patients.**

Keywords: Blood pressure variation; Frailty; Nutritional status; Elderly; Ambulatory blood pressure monitoring

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1. Introduction

Frailty is a special disease in the elderly population which involves the decline of multi-system physiological and cognitive reserve functions. The severity of frailty lies in the fact that the elderly with frailty are at higher risk of multiple adverse health events, and may also worsen their physical health with less stress[1]. Hypertension were significantly associated with frailty status[2]. In clinical, old people concomitant hypertension produces frailty easily, and serious frailty can aggravate hypertension in turn. There is scarce information about the prevalence of hypertension among frail elderly patients[3]. Data show that the variation of blood pressure is closely related to diabetes, nephropathy, obstructive sleep apnea syndrome and chronic pain. Target organ damage is not only related to blood pressure level, but also may be related to blood pressure variability. Abnormal blood pressure changes are a risk marker for organ damage, mortality and cardiovascular events. Studies have shown a link between body mass index and blood pressure. People who are obese are more likely to have high blood pressure[4]. We conducted ambulatory blood pressure monitoring in 126 elderly patients, aiming to understand the correlation between blood pressure variation and frailty , nutritional status in the elderly population.

2. Materials and methods

2.1. Research object

From January to November 2018, 126 elderly patients were selected from the Department of Geriatrics of Affiliated Hospital of Qingdao university. There were 72 males and 54 females aged 65-96 (78.54 ± 8.20). According to the Fried frailty scale, 42 cases were divided into the frailty group, 25 cases were male, 17 cases were female, and the age was 69-96 (84.97±4.63). There were 42 cases in the pre-frailty group, 23 cases in male and 19 cases in female (78.20±3.80). 42 patients, 24 males and 18 females, aged from 67 to 90, were in the non-frailty group (72.45±5.67). Exclusion criteria: malignancy, severe mental and neurological history, severe cardiac and renal insufficiency, severe infection in the last 6 months, hemorrhage, fracture, deep vein thrombosis and other obvious stress or injury. A complete inability to complete a frailty assessment. Subjects signed informed consent .

2.2. Method

2.2.1. General information

The general clinical data of the patients were collected, including age, sex, height, weight, drug use and comorbidity.

2.2.2. Diagnosis of senile frailty syndrome

At present, there is no recognized "gold standard" for the diagnosis of senile frailty, different scholars use different diagnostic methods[5]. Fried scale is now widely accepted as a measure of frailty, including body mass decline, walking time, grip strength, physical activity and fatigue: (1) body mass decline: An unexpected weight loss of > 4.5kg or > 5% over the past year; (2) walking time: It is determined by the speed cut-off point of the gender at a given height; (3) grip strength: It is determined by the specific demarcation points of hand grip strength and body mass index of different genders; (4) physical activity: The kcal energy consumption and the following two issues are evaluated: "Have you done any regular exercise in last one year? " "Have you done any strenuous exercise in last one year? " Participants with low caloric intake (men<685 kcal/week, women<420 kcal/week, 1 kcal=4.1840 kJ) or who answered "no" to these questions were defined as having low physical activity; (5) fatigue: Assess the following two indicators published by the center for epidemiology, depression scale: In the past week: " I feel like everything I do takes effort" and "I can't walk forward." If participants had "occasional (3-4d)" or "most (5-7d)" of any of the above, they were classified as fatigued.

3 or more of the above 5 are the frailty syndrome, and 1 or 2 are the pre-frailty[6].

2.2.3. 24h ambulatory blood pressure monitoring

Patients were monitored for 24h with the U.S. WelchAllyn 6100 ambulatory blood pressure monitor. Monitoring time are day time (08:00 ~ 23:00) and night time (23:00 ~ 08:00). It is measured once every 30min during the day and once every 1h at night. Try to avoid strenuous activities during the monitoring period, with no restriction on normal life.

2.2.4. Nutritional risk screening

Nutritional risk was assessed according to the NRS2002 scale, which takes into account severity of disease (mild, moderate and severe) and impaired nutritional status (mild, moderate and severe), with an adjustment for age of ≥70 years. For the sections on "severity of disease" and "age", patients were scored according to the individual medical history and age records. For "impaired nutritional status", patients were scored according to weight, body mass index (BMI) or food intake change. A score of ≥3 indicated nutritional impairment[7].

2.3. Observational index

The index are as following: 24h systolic blood pressure, day systolic blood pressure, night systolic blood pressure standard deviation; 24h diastolic blood pressure, day diastolic blood pressure and night diastolic blood pressure standard deviation; 24h, day and night pulse pressure difference; 24h systolic blood pressure, day systolic blood pressure, night systolic blood pressure load value; 24h diastolic blood pressure, day diastolic blood pressure and night diastolic blood pressure load value; blood pressure loading value is the proportion of blood pressure measured above the threshold of hypertension. The higher the percentage of excess, the greater the likelihood of hypertension. Diastolic loading value: The load of diastolic pressure reflects the elasticity of the arterial wall.

2.4. Statistical approach

Use SPSS 21.0 statistical software, measuring data to $\bar{x} \pm s$. Univariate anova was used for comparison between groups. Count data was analyzed by chi-square test of Pearson correlation and Spearman rank correlation analysis. $p<0.05$ for the difference was statistically significant.

3. Results

3.1. Comparison of drug species and co-morbidity in 3 groups

The general characteristic index of patients older than 80 years in the frailty group was significantly higher than that of the non-fraitly group ($p<0.05$). The number of drugs in the frailty group was significantly higher than that in the non-frailty group ($p<0.05$). The number of co-morbidity in the pre-frailty group and the frailty group was more than that in the non-frailty group ($p<0.05$, Table 1).

Table 1. comparison of drug species and co-morbidity in group 3 [cases (%)]

Characteristic	Non-frailty group	Pre-frailty group	Frailty group
Sex			
Male	28 (66.7)	27 (64.3)	25 (59.5)
Female	14 (33.3)	15 (35.7)	17 (40.5)
Age in years			
65~79	29 (69.0)	15 (35.7)	6 (14.3)
80~93	13 (31.0)	27 (64.3)	36 (85.7)[a]
The number of drugs			
＜5	28 (66.7)	24 (57.1)	17 (40.5)
≥5	14 (33.3)	18 (42.9)	25 (59.5)

The number of comorbid			
<2	8 (19.0)	5 (11.9)	2 (4.8)
≥2	34 (81.0)	37 (88.1)[a]	40 (95.2)[a]

Compared with the non-frailty group, [a] p< 0.05.

Table 2. Correlation of 24h ABPM for groups 3 (frailty)

	Standard deviation			Pulse pressure difference			Load values		
	24hSBP	dSBP	nSBP	24h	Daytime	Night	24hDBP	dDBP	nDBP
r	0.789**	0.732	0.621*	0.454*	0.408*	0.346*	-0.537**	-0.591**	-0.399**
p	0.000	0.000	0.000	0.001	0.002	0.005	0.000	0.000	0.001

Table 3. Correlation of 24h ABPM load values for groups 3 (nutritional risk)

24hDBP		dDBP		nDBP	
r	*p*	*r*	*p*	*r*	*p*
-0.460**	0.008	-0.480**	0.005	-0.513**	0.003

** The correlation is significant when the confidence (bilateral) is 0.01.
* The correlation is significant when the confidence (bilateral) is 0.05.

3.2. Correlation analysis

The correlation analysis showed that the standard deviation of systolic blood pressure at 24h, the standard deviation of diurnal systolic blood pressure, and the standard deviation of night systolic blood pressure were positively correlated with frailty (p<0.05). 24h pulse pressure, diurnal pulse pressure difference and nocturnal pulse pressure difference were positively correlated with frailty (p<0.05). The loading values of 24h diastolic pressure, day diastolic pressure and night diastolic pressure were negatively correlated with the frailty (p<0.05), Table 2. The loading values of 24h diastolic pressure, day diastolic pressure and night diastolic pressure were negatively correlated with the nutritional risk (p<0.05), Table 3.

4. Discussion

Frailty is a disease involving several system abnormalities of the body, mainly manifested in neuroendocrine changes, immune system disorders, excessive release of inflammatory mediators, activation of coagulation pathways, metabolic abnormalities and related system dysfunction. The occurrence and development of frailty are closely related to age, especially the elderly patients[8]. Among those aged 60 or older, 35% had frailty, and 1/4 of those aged 85 or older had frailty[9]. Studies have shown a correlation between senile frailty and blood pressure variability. With changing in physiology and environmental conditions, blood pressure fluctuates is constantly to maintain sufficient blood flow to organs, known as blood pressure variability. The variation of blood pressure indicates the disappearance of normal blood pressure rhythm, which is closely related to immune regulation, blood flow dynamics, endothelial injury, platelet activation, etc. The variation of blood pressure affects the self-regulation of human function and is related to the occurrence and development of many diseases. Standard deviation and blood pressure load can reflect blood pressure variability to some extent. Studies have shown that low systolic blood pressure is an early warning of an overall decline in the health of the elderly[10,11]. Other studies have shown that obesity are related to higher prevalence of hypertension, which is consistent with previous studies[12-14]. A relationship was determined between nutritional status and blood pressure. The higher the BMI, the higher the prevalence of hypertension[15]. Study shows that optimal nutrition, nutraceuticals, weight loss, in addition to other lifestyle modifications, can prevent, treat and control hypertension in many patients [16]. Ambulatory blood pressure monitoring has been widely applied in recent years, and its control rate for hypertension is more than twice that of general blood pressure monitoring, which strengthens the importance of ambulatory blood pressure monitoring in the clinical assessment of hypertension[17]. This study focused on the relationship between the dynamic changes of blood pressure, the frailty and nutritional status of the elderly. By monitoring a series of blood pressure variability indicators of the patients, it was concluded that the blood pressure variation of the elderly was correlated with the frailty and nutritional status. The systolic blood pressure standard deviation and pulse pressure difference were larger and the diastolic pressure load was lower in the elderly patients with frailty. Patients with high nutritional risk scores had lower diastolic loading value.

With the in-depth study of blood pressure variability, people gradually realize that the purpose of antihypertensive therapy not only needs to reduce excessive hypertension to the appropriate size, but also should pay attention to the restoration of normal blood pressure rhythm. There was no significant

benefit in controlling blood pressure in older adults[18]. According to the Chinese expert consensus on blood pressure management for elderly people formulated in 2016 by the hypertension branch of the Chinese geriatric medical association, the target blood pressure control for elderly people should not be less than 130/60mmHg. Patients with frailty should avoid radical blood pressure control [19].

Limitations of this experiment: (1) small sample size; (2) the coexistence of multiple diseases and frailty in the elderly is closely related, and the pathogenesis is not completely clear; (3) as a disease with no single indicator or single system, the diagnostic criteria of frailty were 5 items according to fried scale, so it is not clear. The research on the frailty of the elderly population was started late in China. As a special disease of the elderly population, frailty is more common in the elderly. Studies have shown that there was a positive correlation between the SBP/SBP percentile and BMI Z-score/N[20]. The risk of malnutrition in the elderly population is much higher than that in the non-elderly population.

5. Conclusion

Our study concluded that the poorer the overall health, the greater the blood pressure variability. Patients with high nutritional risk scores had lower diastolic loading value. Therefore, the blood pressure regulation of senile physicians for senile frailty and malnutrition patients should not only reduce excessive blood pressure, but also use long-term and combined drugs to reduce blood pressure variability, and at the same time, new anti-hypertension drugs with stabilizing blood pressure are urgently needed. Perhaps blood pressure variability can be used as a risk factor for senile frailty syndrome and malnutrition, predicting the occurrence and development of senile frailty and malnutrition, which needs further study and confirmation by experiments.

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