·临床研究·

老年高血压患者动态血压特点及其影响因素

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【摘 要】 目的 观察老年高血压患者动态血压的特点,探讨老年高血压患者血压昼夜节律的影响因素。**方法** 回顾性分析 2021 年 1 月至 6 月山西白求恩医院高血压门诊收治的符合条件的 296 例老年高血压患者(年龄≥60 岁)的临床资料。根据血压昼夜节律将患者分为杓型组(56 例)、非杓型组(134 例)和反杓型组(106 例)。收集患者一般资料,完善 24 h 动态血压监测、动脉硬化监测、24 h 尿电解质及 24 h 尿微量白蛋白检测。采用 SPSS 26.0 统计软件进行数据分析。根据数据类型,分别采用单因素方差分析、Kruskal-Wallis H 检验或 χ^2 检验进行组间比较。采用二分类 logistic 回归分析血压昼夜节律的影响因素。**结果** 血压昼夜节律异常(非杓型组和反杓型血压组)患者比例明显高于血压节律正常(杓型组)患者比例(81.1%和 18.9%);杓型组患者年龄低于非杓型组和反杓型组[68.00(65.00,70.00)和 70.00(68.00,73.00),71.00(69.00,74.00)岁];杓型组吸烟比例明显低于非杓型组和反杓型组(7.1%和 39.6%,47.2%),差异均有统计学意义(P<0.05)。杓型组、非杓型组和反杓型组夜间血压下降率依次递减[12.40%(10.70%,14.78%)、3.70%(1.58%,5.83%)和-4.50%(-8.00%,-2.30%)],差异有统计学意义(P<0.05)。反杓型组右肱-踝脉搏波传导速度(baPWV)高于非杓型组、杓型组[(1 851.57±215.87)和(1 747.81±244.65),(1 687.00±201.61)cm/s];反杓型组左 baPWV 高于非杓型组、杓型组[(1 869.13±232.15)和(1 758.57±259.18),(1 692.25±205.34)cm/s],差异均有统计学意义(P<0.05)。反杓型组 24h 尿钠低于杓型组[83.00(59.00,114.75)和 102.50(84.00,126.75)mmol/24h];24 h 尿微量白蛋白高于杓型组[48.25(36.33,61.64)和 41.09(32.00,48.94)mg/24 h],差异均有统计学意义(P<0.05)。二分类 logistic 回归分析结果显示,年龄(OR=1.328,95% CI 1.178~1.496;P<0.001)和吸烟史(OR=14.953,95% CI 4.706~47.511;P<0.001)是老年高血压患者血压昼夜节律的独立危险因素;24 h 尿钠(OR=0.988,95% CI 0.979~0.998;P=0.021)是老年高血压患者血压昼夜节律的独立保护因素。**结论** 老年高血压患者血压昼夜节律异常发生率明显增高;年龄、吸烟史是老年高血压患者血压昼夜节律的独立危险因素,24 h 尿钠是老年高血压患者血压昼夜节律的独立保护因素。

【关键词】 老年人;高血压;动态血压;昼夜节律

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Characteristic and influencing factors of ambulatory blood pressure in elderly patients with hypertension

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【Abstract】 Objective To observe the characteristics of ambulatory blood pressure in elderly patients with hypertension and explore the factors affecting the circadian rhythm of blood pressure in them. **Methods** A retrospective study was conducted of the clinical data of a total of 296 eligible elderly hypertensive patients (aged ≥60 years) treated at the Hypertension Clinic of Shanxi Bethune Hospital from January to June of 2021. According to the circadian rhythm of blood pressure, they were divided into a dipper group (n=56), a non-dipper group(n=134), and a reverse dipper group (n=106). The data collected included the general clinical information of the patients, 24 h ambulatory blood pressure monitoring, arteriosclerosis monitoring, 24 h urine electrolytes, and 24 h urine microalbumin detection. SPSS statistics 26.0 was used for data analysis. According to the data type, one-way ANOVA, Kruskal-Wallis H test or χ^2 test was used to compare the groups. Binary logistic regression was performed to analyze the factors influencing the circadian rhythm of blood pressure. **Results** Abnormal circadian rhythm of blood pressure (non-dipper group and reverse dipper group) was found in 81.1% of the elderly hypertensive patients, which was significantly higher than that of the normal blood pressure rhythm group (dipper group). The age of the dipper group was lower than that of the non-dipper group and the reverse dipper group [68.00 (65.00, 70.00) *vs* 70.00 (68.00, 73.00), 71.00 (69.00, 74.00) years], and the differences were statistically significant (P<0.05). The proportion of smokers in the dipper group was lower than that in non-dipper group and reverse dipper group(7.1% *vs* 39.6%, 47.2%), and the differences were statistically significant (P<0.05). The nocturnal blood pressure drop rate in the dipper group, non-dipper group and

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reverse dipper group decreased gradually [12.40% (10.70%, 14.78%), 3.70% (1.58%, 5.83%), -4.50% (-8.00%, -2.30%)], and there were significant differences among all groups ($P<0.05$). The right brachial-ankle pulse wave velocity (baPWV) in the reverse dipper group was significantly higher than that in the non-dipper group and the dipper group [(1 851.57±215.87) *vs* (1 747.81±244.65), (1 687.00±201.61) cm/s]; the left baPWV in the reverse dipper group was higher than that in the non-dipper group and the dipper group [(1 869.13±232.15) *vs* (1 758.57±259.18), (1 692.25±205.34) cm/s]; the differences were statistically significant ($P<0.05$). The 24 h urinary sodium in the reverse dipper group was lower than that in the dipper group [83.00 (59.00, 114.75) *vs* 102.50 (84.00, 126.75) mmol/24h]; the 24 h urine microalbumin in the reverse dipper group was higher than that in the dipper group [48.25 (36.33, 61.64) *vs* 41.09 (32.00, 48.94) mg/24h]; the difference was statistically significant ($P<0.05$). Binary logistic regression analysis showed that age ($OR=1.328$, 95%*CI* 1.178-1.496; $P<0.001$) and smoking history ($OR=14.953$, 95%*CI* 4.706-47.511; $P<0.001$) were independent risk factors, and 24 h urinary sodium ($OR=0.988$, 95%*CI* 0.979-0.998; $P=0.021$) was an independent protective factor of the circadian rhythm of blood pressure in elderly hypertensive patients. **Conclusion** The incidence of abnormal circadian rhythm of blood pressure significantly increase in the elderly hypertensive patients. Age and smoking history are independent risk factors, and 24 h urine sodium was an independent protective factor of the circadian rhythm of blood pressure in elderly hypertensive patients.

【Key words】 aged; hypertension; ambulatory blood pressure; circadian rhythm

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老年高血压患者血压昼夜节律常发生紊乱，据调查老年人非杓型血压节律发生率是中青年人的 3 倍以上，在≥80 岁的老年人群中有 83.3% 发生血压昼夜节律异常[1]。血压昼夜节律表现为杓型、反杓型、超杓型和非杓型[2]。血压昼夜节律由多种因素调节，其核心分子是时钟基因[3]。当时钟基因突变时不仅血压昼夜节律发生紊乱，人体其他昼夜节律也会发生紊乱，如体温、睡眠-觉醒周期、新陈代谢等[4]。有关研究表明血压的昼夜节律还由睡眠-觉醒周期、肾素-血管紧张素-醛固酮系统（renin-angiotensin-aldosterone system，RAAS）、自主神经系统、内皮功能、激素、年龄、体质量等多种因素调节[5]。Zeng 等[6]研究表明血压节律异常与心律失常及靶器官损伤相关。本研究主要探讨老年高血压患者动态血压特点及血压昼夜节律的影响因素，为指导临床用药及预防危险因素提供依据，使老年人血压得到更好控制并尽可能恢复血压正常节律，从而减少心脑肾血管事件的发生率及死亡率。

1 对象与方法

1.1 研究对象

回顾性分析 2021 年 1 月至 6 月山西白求恩医院高血压门诊收治的符合条件的 296 例老年高血压患者的临床资料，根据血压昼夜节律将患者分为 3 组，杓型组（56 例）、非杓型组（134 例）和反杓型组（106 例）。超杓型组由于数量太少，未纳入研究。杓型为夜间血压较白天血压下降 10%～20%；非杓型为夜间血压较白天血压下降<10%；反杓型为夜间血压>白天血压；超杓型夜间血压下降较白天血压>20%。纳入标准：（1）符合《中国高血压防治指南（2018 年修订版）》[7]中的原发性高血压的诊断标准；（2）年龄≥60 岁。排除标准：（1）严重肝脏、肾脏或肺脏疾病；（2）恶性肿瘤、血液疾病、免疫系统疾病及先天性心脏病；（3）精神疾病史；（4）有心律失常影响电子血压计测量。患者及家属对研究内容知情同意并签署知情同意书。

1.2 方法

（1）收集患者一般资料，包括年龄、性别、身高、体质量、吸烟史、饮酒史，计算体质量指数（body mass index，BMI）。（2）使用贝克曼 58 分析仪检测 24 h 尿电解质、尿微量白蛋白。（3）采用斯坦德利 W-BPB 型 24 h 动态血压监测仪对患者进行 24 h 动态血压监测，记录患者全天、白天、夜间平均收缩压、平均舒张压，全天血压负荷值。夜间血压下降率=日间平均血压-夜间平均血压/日间平均血压×100%。（4）动脉硬化监测：使用 BP-203RPEⅢ网络化动脉硬化检测装置采集患者肱-踝脉搏波传导速度（brachial-ankle pulse wave velocity，baPWV）、踝臂指数（ankle-branchial index，ABI）数值。

1.3 统计学处理

采用 SPSS 26.0 统计软件进行数据分析。符合正态分布的计量资料以均数±标准差（$\bar{x}\pm s$）表示，组间比较单因素方差分析，多组间两两比较采用邦弗伦尼（Bonferroni）多重比较；不符合正态分布的计量资料使用中位数（四分位数间距）[$M(Q_1, Q_3)$]表示，组间比较采用 Kruskal-Wallis H 检验，多组间两两比较采用 Bonfferoni 校正法。计数资料以例数（百分率）表示，组间比较采用 χ^2 检验。采用二分类 logistic 回归分析血压昼夜节律的影响因素。$P<0.05$ 为差异有统计学意义。

2 结 果

2.1 3 组患者一般资料比较

296 例患者中，杓型组 56 例（18.9%），非杓型组 134 例（45.3%），反杓型组 106 例（35.8%），血压节律异常（非杓型血压组与反杓型血压组）患者比

例明显高于血压节律正常(杓型血压组)患者比例(81.1%和18.9%)。杓型组年龄低于非杓型组和反杓型组,吸烟比例低于非杓型组和反杓型组,差异均有统计学意义($P<0.05$)。3组患者BMI、性别、饮酒史比较,差异均无统计学意义($P>0.05$;表1)。

2.2 3组患者24 h动态血压比较

3组患者24 h平均收缩压(24 h mean systolic blood pressure,24hSBP)、24 h平均舒张压(24 h mean diastolic blood pressure,24hDBP)比较,差异无统计学意义($P>0.05$);白天平均收缩压(daytime mean systolic blood pressure,dSBP)、白天平均舒张压(daytime mean diastolic blood pressure,dDBP)、夜间平均收缩压(nocturnal mean systolic blood pressure,nSBP)、夜间平均舒张压(nocturnal mean diastolic blood pressure,nDBP)、夜间血压下降率比较,差异有统计学意义($P<0.05$;表2)。

2.3 3组患者baPWV与ABI比较

3组患者右ABI、左ABI比较,差异无统计学意义($P>0.05$);右baPWV、左baPWV比较,差异有统计学意义($P<0.05$);反杓型组baPWV较非杓型组和杓型组均高,差异有统计学意义($P<0.05$;表3)。

2.4 3组患者24 h尿电解质、24 h尿微量白蛋白比较

反杓型组24 h尿钠低于杓型组,24 h尿微量白蛋白高于杓型组,差异有统计学意义($P<0.05$);3组患者24 h尿钾、24 h尿氯比较,差异无统计学意义($P>0.05$;表4)。

2.5 二分类logistic回归分析老年高血压患者血压昼夜节律的影响因素

将血压节律异常组与血压节律正常组作为因变量,年龄、性别、BMI、吸烟史、baPWV、24 h尿钠、24 h尿微量白蛋白作为自变量,进行二分类logistic回归分析,结果显示:年龄($OR=1.328$,95% CI 1.178~1.496;$P<0.001$)、吸烟史($OR=14.953$,95% CI 4.706~47.511;$P<0.001$)是老年高血压患者血压昼夜节律的独立危险因素;24 h尿钠($OR=0.988$,95% CI 0.979~0.998;$P=0.021$)是老年高血压患者血压昼夜节律的独立保护因素(表5)。

表1 3组患者一般资料比较

Table 1 Comparison of general data among three groups

Group	n	Age [years, $M(Q_1, Q_3)$]	BMI [kg/m^2, $M(Q_1, Q_3)$]]	Smoking [n(%)]	Alcohol drinking [n(%)]	Male [n(%)]
Dipper	56	68.00(65.00,70.00)	25.55(24.04,27.95)	4(7.1)	12(21.4)	27(48.2)
Non-dipper	134	70.00(68.00,73.00)*	25.70(23.83,27.59)	53(39.6)*	34(25.4)	62(46.3)
Reverse dipper	106	71.00(69.00,74.00)*	25.74(23.43,27.57)	50(47.2)*	20(18.9)	49(46.2)
χ^2/Z		28.293	0.346	26.663	1.476	0.070
P value		<0.001	0.841	<0.001	0.478	0.965

BMI: body mass index. Compared with dipper group, *$P<0.05$.

表2 3组患者动态血压比较

Table 2 Comparison of ambulatory blood pressure among three groups

Item	Dipper group (n=56)	Non-dipper group (n=134)	Reverse dipper group (n=106)	F/Z	P value
24hSBP(mmHg, $\bar{x}\pm s$)	132.20±10.21	135.04±11.52	134.95±10.26	1.521	0.220
24hDBP(mmHg, $\bar{x}\pm s$)	72.34±5.62	73.87±8.36	72.69±7.97	1.182	0.309
dSBP(mmHg, $\bar{x}\pm s$)	136.89±10.98	136.43±11.71	133.08±10.20*#	3.415	0.034
dDBP(mmHg)	74.88±6.13	75.07±8.41	72.25±8.09*#	4.183	0.016
nSBP(mmHg, $\bar{x}\pm s$)	119.20±9.03	130.97±11.49*	140.39±11.43*#	68.751	<0.001
nDBP(mmHg, $\bar{x}\pm s$)	65.46±5.66	70.97±8.09*	73.87±8.81*#	29.026	<0.001
Nocturnal blood pressure drop rate[%, $M(Q_1, Q_3)$]	12.40(10.70,14.78)	3.70(1.58,5.83)*	−4.50(−8.00,−2.30)*#	250.572	<0.001

24hSBP: 24 h mean systolic blood pressure; 24hDBP: 24 h mean diastolic blood pressure; dSBP: daytime mean systolic blood pressure; dDBP: daytime mean diastolic blood pressure; nSBP: nocturnal mean systolic blood pressure; nDBP: nocturnal mean diastolic blood pressure. 1 mmHg = 0.133 kPa. Compared with dipper group, *$P<0.05$; compared with non-dipper group, #$P<0.05$.

表3 3组患者baPWV、ABI比较

Table 3 Comparison of baPWV and ABI among three groups ($\bar{x}\pm s$)

Group	n	Right baPWV(cm/s)	Left baPWV(cm/s)	Right ABI	Left ABI
Dipper	56	1687.00±201.61	1692.25±205.34	1.15±0.09	1.16±0.75
Non-dipper	134	1747.81±244.65	1758.57±259.18	1.15±1.00	1.14±0.09
Reverse dipper	106	1851.57±215.87*#	1869.13±232.15*#	1.16±0.09	1.15±1.00
F		11.199	11.483	0.386	0.499
P value		<0.001	<0.001	0.680	0.608

baPWV: brachial ankle pulse wave velocity; ABI: ankle brachial index. Compared with dipper group, *$P<0.05$; compared with non-dipper group, #$P<0.05$.

表 4 3 组患者 24 h 尿电解质、24 h 尿微量白蛋白及血生化指标比较

Table 4 Comparison of 24h urinary electrolyte, 24h urinary microalbumin and blood biochemical indexes among three groups

[$M(Q_1, Q_3)$]

Group	n	24h urine potassium (mmol/24 h)	24h urine chloride (mmol/24 h)	24h urine sodium (mmol/24 h)	24h urine microalbumin (mg/24 h)
Dipper	56	24.55(18.37,33.40)	72.00(51.25,107.75)	102.50(84.00,126.75)	41.09(32.00,48.94)
Non-dipper	134	25.91(20.00,31.69)	72.50(51.00,105.50)	88.50(64.75,123.00)	43.54(31.62,56.98)
Reverse dipper	106	22.73(16.37,29.56)	65.00(46.50,94.25)	83.00(59.00,114.75) *	48.25(36.33,61.64) *
Z		5.912	2.469	10.627	7.239
P value		0.052	0.291	0.005	0.027

Compared with dipper group, * $P<0.05$; compared with non-dipper group, # $P<0.05$.

表 5 影响老年高血压患者血压昼夜节律因素的二分类 logistic 回归分析

Table 5 Logistic regression analysis of factors affecting circadian rhythm of blood pressure in elderly patients with hypertension

Factor	B	OR	95%CI	P value
Age	0.283	1.328	1.178-1.496	<0.001
Gender	-0.575	0.563	0.260-1.219	0.145
BMI	0.049	1.050	0.936-1.178	0.401
Smoking	2.705	14.953	4.706-47.511	<0.001
Right baPWV	0.001	1.001	0.996-1.006	0.575
Left baPWV	0.001	1.001	0.996-1.005	0.698
24h urine sodium	-0.012	0.988	0.979-0.998	0.021
24h urine microalbumin	-0.001	0.999	0.990-1.007	0.773

BMI: body mass index.

3 讨 论

在健康人群中,生理性的 24 h 血压昼夜节律在保护血管的结构和功能方面起着至关重要的作用。血压昼夜节律异常与心脑肾靶器官损伤有关。Coccina 等[8]研究指出 24h 血压、白天血压和夜间血压是新发心房颤动的独立预测因子。Kario 等[9]研究表明昼夜节律紊乱与总心血管疾病发生率独立相关,尤其是心力衰竭。Yang 等[10]指出急性脑梗死的发作与反杓型和非杓型血压昼夜节律可能相关,同时反杓型和非杓型血压昼夜节律也是急性脑梗死的独立危险因素。Rahman 等[11]研究指出血压节律模式紊乱(尤其是非杓型)是慢性肾脏病早期的常见表现,同时昼夜节律系统的基因在慢性肾脏病受试者血压非杓型模式的发展中起着关键作用。

动脉粥样硬化是全世界发病和死亡的主要原因。有关研究表明动脉僵硬可能是中老年人心血管事件和全因死亡率的有力预测指标[12]。大量文献表明动脉粥样硬化在高血压的发展中至关重要,而有关动脉硬化对血压节律的影响尚无明确定论。Zhang 等[13]研究表明昼夜节律紊乱可能促进动脉粥样硬化的进展。Park 等[14]研究表明非杓型血压节律与动脉硬度密切相关。Liu 等[15]研究表明夜间收缩压与动脉硬化显著且独立相关。baPWV 作为评估动脉硬化程度的指标,本研究发现反杓型组 baPWV 较非杓型组和杓型组均高,差异有统计学意义($P<0.05$),而多因素 logistic 回归分析表明 baPWV 并非血压昼夜节律的独立影响因素,这可能与本研究样本量不足有关,因此 baPWV 对血压昼夜节律影响尚不明确,下一步我们将通过扩大样本量进一步分析。

关于 24 h 尿钠对血压昼夜节律的影响目前仍有争议,钠调节机制的功能障碍可导致钠潴留,从而导致动脉血压慢性升高。钠排泄的昼夜节律受损即白天尿钠排泄减少,与夜间血压升高有关[16]。本研究结果显示,反杓型组 24 h 尿钠较杓型组低,差异有统计学意义($P<0.05$)。二分类 logistic 回归分析结果显示,24 h 尿钠是引起老年高血压患者血压昼夜节律异常的独立影响因素。本研究进一步证明 24 h 尿钠对血压昼夜节律调节至关重要,而关于白天尿钠、夜间尿钠在血压昼夜节律中的具体影响尚不明确,下一步我们将通过分别收集记录白天、夜间尿钠进一步分析。

年龄对血压昼夜节律的影响目前已明确,随着年龄的增长,内皮源性一氧化氮(NO)及 NO 合酶活性的抑制会导致血管功能障碍,从而导致血压节律异常。有研究指出高达 43% 的老年高血压患者可能会出现夜间血压升高[17]。还有研究表明随着年龄的增长,白天排泄钠的能力下降更为普遍,从而影响血压昼夜节律[16]。本研究中,杓型组患者年龄较非杓型组和反杓型组低,差异有统计学意义($P<0.05$)。二分类 logistic 回归分析结果显示,年龄是引起老年高血压患者血压昼夜节律异常的独立影响因素。

吸烟与多种心血管疾病相关,尤其是动脉高血压、冠状动脉疾病、心力衰竭、腹主动脉瘤、缺血性卒中、短暂性脑缺血发作和外周动脉疾病[18]。Manta

等[19]研究表明吸烟会伴随较高的交感神经系统激活,这可能与夜间血压下降减低相关。本研究中,杓型组患者吸烟人数比例明显低于非杓型组和反杓型组,差异有统计学意义($P<0.05$)。二分类 logistic 回归分析结果显示,吸烟史是引起老年高血压患者血压昼夜节律异常的独立影响因素。本研究进一步证实了吸烟对血压昼夜节律的影响。

目前高血压仍是我国所面临的重大问题,而血压节律异常所导致的靶器官损伤也很关键,血压昼夜节律已经成为许多疾病的风险预测指标,恢复正常血压昼夜节律对靶器官保护有着重大意义。Yan 等[20]研究发现,与清晨给药相比,睡前给药更有利于逆转非杓型节律,改善左心室结构,调节血管内皮功能。因此,我们在控制血压水平的同时,也应注重患者血压昼夜节律,及时预防血压节律异常的危险因素,尽可能使患者的血压昼夜节律恢复,以保护靶器官。本研究的局限性:(1)样本量不足、超杓型病例数太少未纳入研究;(2)未统计各组患者降压药物服用情况,尚不清楚药物对血压昼夜节律的影响。下一步我们将扩大样本量,完善相关激素指标,随访患者服用降压药物种类、半衰期、用药时间等情况,使研究更具参考价值。

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