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Specific Features Of Arterial Hypertension In Type 2 Diabetes Mellitus Associated With Obesity

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Abstract

Type 2 diabetes mellitus (T2DM) and arterial hypertension associated with obesity are important factors that increase the risk of cardiovascular complications. The aim of this study was to investigate the characteristics of circadian blood pressure variations in arterial hypertension in patients with T2DM accompanied by obesity. A 24-hour ambulatory blood pressure monitoring (ABPM) was performed in 60 patients. The results demonstrated a significantly higher prevalence of "non-dipper" and "night-peaker" patterns in obese patients with diabetes. This condition is considered an unfavorable prognostic factor that increases cardiovascular risk.

Keywords: Type 2 diabetes mellitus, obesity, arterial hypertension, non-dipper, night-peaker, ambulatory blood pressure monitoring, systolic and diastolic blood pressure time index, systolic and diastolic blood pressure variability.

Semizlik Bilan Kechuvchi 2-Tur Qandli Diabetda Arterial Gipertenziyaning O‘Ziga Xos Xususiyatlari

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Annotatsiya

Qandli diabet 2-tur (QD2) va semizlik bilan kechuvchi arterial gipertenziya (AG) yurak-qon tomir asoratlari xavfini oshiruvchi muhim omillardandir. Ushbu tadqiqotning maqsadi – semizlik bilan kechuvchi QD2da arterial gipertenziyaning sutkalik o‘zgarish xususiyatlarini aniqlash. Buning uchun 60 nafar bemorda 24 soatlik arterial bosim monitoringi (SABM) o‘tkazildi. Natijalar

semizlik bilan kechuvchi diabetda “non-dipper” va “night peaker” turlarining sezilarli darajada yuqori ekanini ko‘rsatdi. Bu holat yurak-qon tomir xavfini oshiruvchi salbiy prognoz omili hisoblanadi.

Kalit so‘zlar: qandli diabet 2-tur, semizlik, arterial gipertenziya, non-dipper, night-peaker, arterial bosim monitoring, SAB va DAB vaqt indeksi, SAB va DAB variabelligi.

Особенности Артериальной Гипертензии При Сахарном Диабете 2-Го Типа, Протекающем На Фоне Ожирения

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Аннотация

Сахарный диабет 2-го типа (СД2) и артериальная гипертензия (АГ), протекающая на фоне ожирения, являются важными факторами, повышающими риск сердечно-сосудистых осложнений. Целью данного исследования было изучение особенностей суточных изменений артериального давления при АГ у пациентов с СД2, сочетающимся с ожирением. У 60 пациентов было проведено суточное мониторирование артериального давления (СМАД). Полученные результаты показали значительное преобладание типов «non-dipper» и «night-peaker» у больных с сахарным диабетом, протекающим на фоне ожирения. Данное состояние является неблагоприятным прогностическим фактором, повышающим сердечно-сосудистый риск.

Ключевые слова: сахарный диабет 2-го типа, ожирение, артериальная гипертензия, non-dipper, night-peaker, мониторирование артериального давления, временной индекс САД и ДАД, вариабельность САД и ДАД.

Introduction

T2DM and arterial hypertension are the primary constituents of metabolic syndrome; their comorbidity substantially exacerbates the risks of cardiovascular disease, nephropathy, stroke, and overall mortality [1-3]. Hypertension has been identified as a contributing factor in 30–75% of cases involving diabetes-related

cardiac and renal complications [4]. A study conducted by Chen et al. (2011), published in the journal Hypertension, demonstrated that hypertensive patients with comorbid diabetes exhibit significantly higher rates of mortality and cardiovascular events. Furthermore, the findings indicated that approximately 30% of deaths among diabetic patients are attributable to arterial hypertension [5].

Obesity, particularly abdominal adiposity, is identified as a cornerstone in the pathogenesis of insulin resistance, disrupting the neuro-hormonal regulation of both glucose metabolism and blood pressure [6, 7]. Recent clinical research suggests that hypertension in obese patients is characterized by distinct circadian rhythm abnormalities, notably the absence of nocturnal blood pressure reduction (non-dipper status) and increased blood pressure variability [8, 9].

Objective

To evaluate the circadian variability of arterial hypertension and the degree of nocturnal blood pressure reduction in patients with Type 2 diabetes mellitus associated with obesity.

Materials and Methods

A prospective study was conducted involving 60 patients treated at the National Medical Center. The cohort comprised 33 females and 27 males, aged 30 to 69 years (mean age: 52.5 ± 0.9 years). Participants were stratified into two groups to analyze diurnal and nocturnal blood pressure fluctuations: an observation group consisting of 35 individuals (T2DM, BMI ≥ 30 kg/m²) and a control group of 25 individuals (diagnosed with hypertension without T2DM, BMI < 30 kg/m²). In the observation group, pharmacological management included calcium channel blockers (n=7), angiotensin-converting enzyme (ACE) inhibitors (n=6), angiotensin II receptor blockers (ARBs) (n=8), and combination therapy (calcium channel blockers + ARBs) (n=14). Patients with T2DM received glycemic control medications in accordance with national clinical protocols. The control group received calcium channel blockers (n=4), ACE inhibitors (n=5), ARBs (n=10), and combination therapy (n=6).

Hemodynamic parameters were evaluated using ABPM with the "CONTEC" system (China). Blood pressure measurements were recorded automatically at 15-minute intervals during the day and every 30 minutes at night. The mean arithmetic values of systolic (SBP) and diastolic (DBP) blood pressure for daytime and nighttime periods were utilized to assess the 24-hour blood pressure profile. Furthermore, the nocturnal dip or "diurnal index" (DI) was

calculated to identify "non-dipper" patterns. The DI was calculated using the following formula:

$$DI = \frac{Day\ time\ SBP - Night\ time\ SBP}{Day\ time\ SBP} \times 100\%$$

Dipper: DI ≥ 10%; Non-dipper: DI < 10%. Threshold values for hypertension were defined as ≥ 135/85 mmHg during the day and ≥ 120/70 mmHg at night. A "non-dipper" profile was defined as a failure of nocturnal blood pressure to decrease by at least 10% relative to daytime levels, while a "night peaker" status referred to cases where nocturnal blood pressure exceeded daytime values.

Results

As illustrated in Table 1, the ABPM parameters were compared between the control group (n=25) and the observation group (n=35). Statistical significance was assessed using Student's t-test and the χ^2 (chi-squared) test.

In the observation group, mean daytime SBP and DBP values were significantly higher compared to the control group: 148.2 ±10 mmHg vs. 140.1 ± 6 mmHg ($p < 0.03$) and 92.2 ± 8 mmHg vs. 76.4 ± 4 mmHg ($p < 0.01$), respectively. These findings indicate a more severe clinical course of arterial hypertension within the observation cohort. Mean nocturnal SBP and DBP were also substantially elevated in the observation group (136.1 ± 9 mmHg and 84.4 ± 6 mmHg) relative to the control group (128.3 ± 5 mmHg and 68.4 ± 3 mmHg; $p < 0.005$ and $p < 0.01$, respectively). This pattern suggests an impairment of the physiological nocturnal blood pressure decline. The "non-dipper" profile was notably more prevalent in the observation group, occurring in 74.3% of cases compared to 16% in the control group. Furthermore, the "night-peaker" phenotype was significantly more frequent in the observation group at 42.9%, versus 12% in the control group. These alterations demonstrate a profound disruption of the circadian blood pressure rhythm, characterized by the absence of a physiological nocturnal dip and, in some instances, paradoxical nocturnal hypertension.

Table 1

Comparison of Ambulatory Blood Pressure Monitoring Parameters Across Study Groups

Parameter	Control Group (n=25)	Observation Group (n=35)	p-value (Student's t-test)

Mean daytime SBP (mmHg)	140,1 ± 6	148,2 ± 10	<0,03
Mean daytime DBP (mmHg)	76,4 ± 4	92,2 ± 8	<0,01
Mean nighttime SBP (mmHg)	128,3 ± 5	136,1 ± 9	<0,005
Mean nighttime DBP (mmHg)	68,4 ± 3	84,4 ± 6	<0,01
Non-dipper pattern, n (%)	4 (16%)	26 (74,3%)	
Night-peaker pattern, n (%)	3 (12%)	15 (42,9%)	

The results of the analysis indicate that obese patients with diabetes exhibit significantly higher 24-hour ambulatory blood pressure levels and a diminished degree of nocturnal blood pressure reduction (non-dipper profile). Furthermore, increased blood pressure variability was observed in this cohort, suggesting a substantial hemodynamic burden on the cardiovascular system.

Discussion

Arterial hypertension represents one of the most critical risk factors in the onset and progression of chronic complications in patients with T2DM. Compared to office-based blood pressure measurements, ABPM provides superior diagnostic value regarding target organ damage. Furthermore, ABPM facilitates a comprehensive evaluation of various hemodynamic parameters, including 24-hour, daytime, and nighttime systolic and diastolic means, the absence of nocturnal dipping, and the identification of "white-coat" and "masked" hypertension phenotypes.

The results of this study are consistent with previous literature. Within the observation group, 74% (26 out of 35) of patients exhibited a "non-dipping" pattern, while 42.9% (15 out of 35) were classified as "night-peakers." These findings align with Pistrosch F et al., who identified a non-dipping status in 70% of hypertensive T2DM patients [10]. Similarly, Charan N et al. reported a non-dipping prevalence of 75% [11]. In the present study, the non-dipper profile was observed in 74% of hypertensive diabetic participants, with a mean age of 52.5 ± 0.9 years. The duration of hypertension at the time of presentation did not differ significantly between the observation and control groups. The high prevalence of

the non-dipping status was strongly associated with an elevated BMI, corroborating the findings of Kotsis V et al., who reported a 71.4% prevalence of non-dipping in obese populations [12].

The pathogenetic mechanism underlying both the non-dipping phenomenon and postprandial hyperglycemia is centered on oxidative stress [13]. Postprandial hyperglycemia triggers the formation of reactive oxygen species, which play a pivotal role in chronic and acute inflammatory processes, endothelial dysfunction, and diabetic-related organ damage [14]. In obese T2DM patients, the "non-dipping" status is further elucidated by insulin resistance, heightened sympathetic nervous system activity, and overactivation of the renin-angiotensin-aldosterone system (RAAS). Additionally, concomitant hyperglycemia and dyslipidemia exacerbate endothelial dysfunction, leading to increased blood pressure variability [2, 15, 16].

ABPM is instrumental in diagnosing "white-coat" hypertension, thereby preventing the unnecessary prescription of antihypertensive agents. Conversely, it enables the timely detection of "masked" hypertension, ensuring that therapeutic interventions are initiated promptly. Research indicates that once blood pressure is normalized, the relative contribution of diabetes to cardiovascular risk is significantly mitigated [4]. This underscores the clinical imperative of assessing arterial pressure variability to optimize patient outcomes.

Conclusion

Arterial hypertension in patients with Type 2 diabetes mellitus associated with obesity is characterized by elevated 24-hour mean blood pressure levels and a diminished nocturnal decline (non-dipper profile). Diurnal blood pressure variability is significantly higher in obese patients, which substantially increases the overall cardiovascular risk. Utilizing ABPM enables the early detection of blood pressure fluctuations in this population, facilitating the selection of individualized antihypertensive therapy. Consequently, routine implementation of ABPM is highly recommended for the management of obese patients with T2DM.

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