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*The comorbidity between hypertension with diabetes leads to an increase in the risk of death and cardiovascular events by 44% and 41%, respectively, compared with 7% and 9% risks in people suffering only from diabetes and having no hypertension. Purpose. To determine the effect of the criteria for the diagnosis of hypertension proposed by ACC/AHA (2017) and ESC/ESH (2018) on the detection of this disease in people with normal carbohydrate metabolism, prediabetes and type 2 diabetes mellitus. Materials and methods. A retrospective analysis of the database of the Azerbaijan Association of Endocrinology, Diabetology and Therapeutic Training was carried out. The data of 596 examined patients were analyzed, then three main groups were formed: a group with normal carbohydrate metabolism (n=99), a group with prediabetes (n=47), a group with type 2 diabetes mellitus (n = 450). The patients included in the study were divided into 2 samples: those, who have DM2; those, who have no DM2. Including the patients in the group of with DM2 was based medical history data about the presence of DM2 and / or taking hypoglycemic drugs. Results. When applying the ACC/AHA criteria (2017), normotension (systolic blood pressure <130 mmHg and diastolic blood pressure <80 mmHg) occurred in 40.4% (95% CI 30.69%; 50.12) of the control group, while 59.6% (95% CI 49.88; 69.31) there was arterial hypertension. 14.9% of the prediabetes group (95% CI 4.60%; 25.18)% had normotension according to the same criteria, while the majority of the participants in this group – 85.1 (95% CI 74.82; 95.40)% had arterial hypertension. In the type 2 diabetes mellitus group, normotension was found in 15.8 (95% CI 12.41%; 19.15)%, and arterial hypertension – in 84.2 (95% CI 80.85; 87.59)%. Thus, arterial hypertension was statistically significantly less common in the control group than in prediabetes ( $p < 0.01$ ) and type 2 diabetes mellitus ( $p < 0.001$ ). Conclusion. Thus, in people with normal carbohydrate metabolism, prediabetes and type 2 diabetes mellitus, the use of ACC/AHA diagnostic criteria (2017) led to a statistically significantly higher incidence of hypertension than when using the criteria for the diagnosis of hypertension according to ESC/ESH (2018).*

Key words: Arterial hypertension, normal carbohydrate metabolism, prediabetes, type 2 diabetes.

**Introduction**

Arterial hypertension (AH) is the leading cause of death worldwide, resulting in 10.4 million deaths per year [1]. The total number of patients with hypertension in 2010 was 1.39 billion people [2]. At the same time, only 349 million people suffering from hypertension live in high-income countries and 1.04 billion people with this disease live in the rest of the world [2], including our country [3].

The number of patients with diabetes mellitus (DM) globally has increased from 151 million in 2000 to 537 million in 2021 and is expected to reach 783 million in 2045 [4]. About 90% of DM patients are individuals with type 2 diabetes (DM2) [5]. The comorbidity between hypertension and diabetes leads to an increase in the risk of death and cardiovascular events by 44% and 41%, respectively, compared with 7% and 9% risks in people suffering only from diabetes and having no hypertension [6].

The comorbidity between prediabetes (PD) with hypertension also increases the risk of cardiovascular diseases [7, 8]. However, the role of hypertension, the frequency of its occurrence and the significance as a comorbid condition in PD has not been sufficiently studied and represents a field for research of both clinicians and researchers.

The issue of the diagnosis of hypertension still

cannot be considered as definitively resolved. Currently, there are two main documents in the world that define the approach to the diagnosis of hypertension. The 2017 recommendations of the American College of Cardiology/American Heart Association (ACC/AHA, 2017) were prepared by a group of American medical organizations [9], and the 2018 recommendations of the European Society of Cardiology/European Society of Hypertension (ESC/ESH, 2018) were prepared by European medical societies [10]. Our country has traditionally adhered to the European recommendations, that is, the ESC/ESH recommendations [10]. However, traditions, for all their undoubted importance, cannot be considered strict scientific proof.

Purpose. To determine the effect of the criteria for the diagnosis of hypertension proposed by ACC/AHA (2017) and ESC/ESH (2018) on the detection of this disease in people with normal carbohydrate metabolism, prediabetes and type 2 diabetes mellitus.

**Materials and methods**

A retrospective analysis of the database of the Azerbaijan Association of Endocrinology, Diabetology and Therapeutic Training, created on the basis of outpatient records of the endocrinologists who first applied to the team participating in the creation of this archive, was carried out.

The criteria for inclusion in the study assumed the following data in the outpatient records: surname and name of the attending physician; date of initial examination; sex of the patient; age of the patient; height; body weight; blood pressure values (BP); information about the presence of diabetes and / or taking hypoglycemic drugs in the anamnesis; glycohemoglobin (A1c); fasting glycaemia; lipidograms (total cholesterol (TH), high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), triglycerides (TG), as well as the glomerular filtration rate (GFR) of 60 ml/min/1.73 m<sup>2</sup> or more.

The criteria for exclusion from the study are: the presence of type 1 diabetes mellitus or other (specific) types of diabetes; pregnancy; pronounced independent or comorbid endocrine pathology, which can significantly affect both the level of A1c and other indicators of metabolism and blood pressure; pronounced comorbid pathology on the part of internal organs, which can significantly affect the state of carbohydrate metabolism, and on the BP values.

Initially, the participants included in the study were divided into 2 groups:  
 – patients having DM 2;  
 – patients having no DM2.

Distributing the patients between the groups of patients with DM2 was based on medical history data about the diagnosis of DM2 and / or taking hypoglycaemic drugs. In case of having no DM 2 diagnosis, the criterion for inclusion in group C 2 was the presence of at least two of the given diagnostic indicators [11, 12, 13, 14]:

- A1 level with 6.5% (48 mmol/mol) and above;
- fasting venous plasma glycemia 126 mg/dl (7.0 mmol/L) and higher;
- glycemia in venous plasma 2 hours after a load of 75.0 g of glucose 200 mg/dl (11.1 mmol/L) and higher.

The group of people with normal carbohydrate metabolism (NCM) included those who met all three of the following criteria [15]:

1. A1c level was 5.6% (38 mmol/mol) and lower;
2. fasting glycemia in venous plasma less than 110 mg/dl (6.1 mmol/L);
3. glycemia 2 hours after loading 75.0 g of glucose less than 140 mg / dl (7.8 mmol/l).

In the future, the group with NCM will be designated as a control group (CG).

The rest of the study participants, whose state of carbohydrate metabolism did not meet both the criteria of DM and the criteria of normal carbohydrate metabolism, made up the PD group.

In the course of statistical analysis, the value of the fractions (%) was determined. The confidence interval of the fractions was determined for a 95% probability using the Wilson method using an online calculator [16]. The significance of the differences between the fractions was calculated using the method  $\chi^2$  [17].

### Results and discussion

Table 1 presents data on the comparative analysis of the occurrence rate in CG, PD and DM2 normotension and hypertension according to ACC/AHA criteria (2017) [1].

Table 1  
Occurrence rate in CG, with PD and with DM2 normotension and hypertension according to ACC/AHA criteria (2017)

№	Group	Indicator	Condition AH	
			Normotension	AH
1	CG (n=99)	%	40.4	59.6
		95% CI	30.69; 50.12	49.88; 69.31
2	PD (n=47)	%	14.9	85.1
		95% CI	4.60; 25.18	74.82; 95; 40
3	DM 2 (n = 450)	%	15.8	84.2
		95% CI	12.41; 19.15	80.85; 87.59
Statistical significance of differences in frequency of occurrence between groups (p)				
p 1-2			< 0.01	
p 1-3			< 0.001	
p 2-3			> 0.05	

Table 1 shows that when applying the ACC/AHA criteria (2017) [9], normotension (systolic blood pressure (SBP) <130 mmHg and diastolic blood pressure (DBP) <80 mmHg) occurred in 40.4% (95% CI 30.69%; 50.12) representatives of CG, whereas 59.6% (95% CI 49.88; 69.31) had hypertension. 14.9% of the PD group (95% CI 4.60%; 25.18)% had normotension according to the same criteria [9], whereas the majority of the participants in this group, 85.1 individuals (95% CI 74.82; 95.40), % had hypertension.

In the DM2 group, according to the ACC/AHA

criteria (2017) [9], normotension was present in 15.8 (95% CI 12.41%; 19.15) %, and hypertension in 84.2 (95% CI 80.85; 87.59) %. Thus, hypertension was statistically significantly less common in CG than in P (p <0.01) and DM2 (p <0.001). The frequency of normotension and hypertension in PD and DM2 did not differ statistically significantly (p >0.05).

Table 2 presents data on a comparative analysis of the frequency of occurrence in CG, PD and DM2 normotension and hypertension according to ESC/ESH criteria (2018) [10].

Table 2  
Occurrence rate in CG with PD and with DM2 normotension and hypertension according to ESC/ESH criteria (2018)

№	Group	Indicator	Condition AH	
			Normotension	AH
1	CG(n=99)	%	67.7	32.3
		95% CI	58.42; 76.94	23.06; 41.58
2	PD (n=47)	%	34.0	66.0
		95% CI	20.35; 47.74	52.26; 79.65
3	DM 2 (n = 450)	%	43.6	56.4
		95% CI	38.97; 48.14	48.14; 61.03
Statistical significance of differences in the occurrence rate between groups (p)				
p 1-2			< 0.001	
p 1-3			< 0.001	
p 2-3			> 0.05	

Table 3  
The incidence of hypertension in patients with DM2 in the diagnosis of hypertension according to ACC/AHA criteria (2017) [9] and according to ESH/ESH criteria (2018) [10]

Group	Diagnostic criteria	Patients with AH	
		%	95%CI
CG (n=99)	ESC/ESH	32.3	23.06; 41.58
	ACC/AHA	59.6	49.88; 69.31
	P	< 0.001	
PD (n=47)	ESC/ESH	66.0	52.26; 79.65
	ACC/AHA	85.1	74.82; 95.40
	P	< 0.05	
DM 2 (n=450)	ESC/ESH	56.4	51.86; 61.03
	ACC/AHA	84.2	80.85; 87.59
	P	< 0.001	

Table 2 demonstrates, when applying the ESC/ESH criteria (2018) [10], normotension (SAD <140 mmHg and DAD <90 mmHg) occurred in 67.7% (95% CI 58.42%; 76.94) of the control group, whereas 32.3% (95% CI 23.06; 41.58) had AH. In the PD group, normotension according to the ESC/ESH criteria (2018) [10] occurred in 34.0% (95% CI 20.35%; 47.74) of the surveyed, while the majority of the participants in the PD group, 66.0% (95% CI 52.26; 79.65) had hypertension. With DM2, 43.6 (95% CI 38.97%; 48.14) had normotension according to ESH/ESH criteria (2018) [10], and 56.4% (95% CI 48.14; 61.03) % had hypertension. AH was statistically significantly less common in CG than in P (p=0.001) and C2 (p<0.001). The incidence of hypertension in PD and DM2 did not differ statistically significantly (p> 0.05).

Table 3 presents data on the occurrence rate of AH and normotension in the examined patients, people with PD and patients with DM2 in the diagnosis of AH according to the ACC/AHA criteria (2017) [9] and according to the ESC/ESH criteria (2018) [10].

Table 3 indicates that in CG, the occurrence rate of AH in its diagnosis according to the ACC/AHA criteria (2017) [9] was significantly (p<0.001) higher than the occurrence rate of AH when using the ESC/ESH diagnostic criteria (2018) [10]: 32.3 (95% CI 23.06; 41.58) % vs. 59.6 (95%CI 49.88; 69.31) %. A similar situation was in the PD group. The occurrence rate of AH in its diagnosis according to the ACC/AHA criteria (2017) [9] was significantly (p <0.05) higher than the frequency of occurrence of AH when using the ESC/ESH diagnostic criteria (2018) [10]: 66.0 (95% CI 52.26; 79.65) % vs. 85.1

(95%CI 74.82; 95.40) %. In the DM2 group, the incidence of AH in its diagnosis according to the ACC/AHA criteria (2017) [9] was significantly (p <0.001) higher than the incidence of AH when using the ESC/ESH diagnostic criteria (2018) [10]: 84.2 (95% CI 80.85; 87.59) % vs. 56.4 (95%CI 51.86; 61.03) %.

Conclusion. Thus, in people with NCM, PD and DM2, the application of the ACC/AHA diagnostic criteria (2017) led to a statistically significantly higher incidence of AH than when using the ESC/ESH diagnostic criteria (2018).

### Prospects for further research

The development of criteria used for the diagnosis of "Arterial hypertension" should be thoroughly considered before the beginning of pharmacotherapy. The state of carbohydrate metabolism (the presence of Prediabetes, type 2 diabetes mellitus or their absence) should be taken into account when deciding which criteria for the diagnosis of "Arterial hypertension" should be applied.

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### Реферат

ПОРІВНЯЛЬНИЙ АНАЛІЗ ЗУСТРІЧАЄМОСТІ НОРМОТЕНЗІЇ ТА ГІПЕРТЕНЗІЇ ПРИ ДІАГНОСТИЦІ АРТЕРІАЛЬНОЇ ГІПЕРТЕНЗІЇ У ВІДПОВІДНОСТІ З КРИТЕРІЯМИ ESC/ESH (2018) І КРИТЕРІЯМИ АСС/АНА (2017) У ЛЮДЕЙ З НОРМАЛЬНИМ ОБМІНОМ ГЛЮКОЗИ, ПРЕДІАБЕТОМ І ЦУКРОВИМ ДІАБЕТОМ 2 ТИПУ

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Ключові слова: артеріальна гіпертензія, нормальний вуглеводний обмін, предіабет, цукровий діабет 2 типу.

**Мета.** Визначення впливу критеріїв діагностики артеріальної гіпертензії, запропонованих АСС/АНА (2017) та ESC/ESH (2018) на виявлення цього захворювання у людей з нормальним вуглеводним обміном, предіабетом та цукровим діабетом типу 2. Матеріали та методи. Проведено ретроспективний аналіз бази даних Азербайджанської Асоціації Ендокринології, Діабетології та Терапевтичного Навчання. Проаналізовано дані 596 обстежених, з яких були сформовані три основні групи: група з нормальним вуглеводним обміном (n=99), група з предіабетом (n=47), група з цукровим діабетом типу 2 (n=450). Був проведений розподіл хворих, включених у популяцію, на 2 вибірки: обстежені з наявним цукровим діабетом 2 типу; обстежені без цукрового діабету 2 типу. Підставою для включення пацієнта до групи хворих з цукровим діабетом 2 типу була анамнестична інформація про наявність цукрового діабету 2 типу та/або прийом цукрознижувальних препаратів. Результати. При застосуванні критеріїв АСС/АНА (2017) нормотензія (систоличний артеріальний тиск <130 мм рт.ст. та діастолічний артеріальний тиск <80 мм рт.ст.) мала місце у 40.4% (95% СІ 30.69%; 50.12) представників контрольної групи, тоді як у 59.6% (95% СІ 49.88; 69.31) була артеріальна гіпертензія. У 14.9% групи предіабету (95% СІ 4.60%; 25.18) % відповідно до тих же критеріїв мала місце нормотензія, тоді як у більшої частини учасників цієї групи - 85.1 (95% СІ 74.82; 95.40) % - була артеріальна гіпертензія. В групі пацієнтів з цукровим діабетом 2 типу нормотензія була у 15.8 (95% СІ 12.41%; 19.15) %, а артеріальна гіпертензія – у 84.2 (95% СІ 80.85; 87.59) %. Тобто, артеріальна гіпертензія статистично значно рідше зустрічалася в контрольній групі, ніж при предіабеті (p <0.01) і цукровому діабеті 2 типу (p <0.001). Висновки. Встановлено, що у людей з нормальним вуглеводним обміном, при предіабеті та цукровому діабеті 2 типу застосування критеріїв діагностики АСС/АНА (2017) призводило до статистично значуще більшої частоти зустрічаємості артеріальної гіпертензії, ніж при застосуванні критеріїв діагностики артеріальної гіпертензії за ESC/ESH (2018).