Hematocrit level effect on diastolic blood pressure more than systolic blood pressure

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مستوى مِكْدَاسُ الدَّم يؤثرعلى ضغط الدم الانبساطي اكثر من تاثيره على ضغط الدم الانقباضي

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المستخلص

الهدف من الدراسة: دراسة مستوى مِكْدَاسُ الدَّم (PCV) وتاثيره على ضغط الدم الانبساطي وضغط الدم الانقباضي.

تصميم الدراسة:وهي دراسة عرضية لمجموعتين من المرضى،المجموعة الاولى مرضى مصابون بارتفاع ضغط الدم الانبساطي و المجموعة الاخرى مرضى مصابون بارتفاع ضغط الدم الانقباضي ومجموعة السيطرة للمقارنة.

مكان الدراسة:مستشفى الكرامة التعليمي قسم الامراض الباطنية في قضاء الكوت في محافظة واسط .وقد استمرت الدراسة للمدة من شهر شباط 2013 الى شهر كانون الاول من نفس السنة.

طريقة الدراسة : تم العمل في هذا البحث لتقيم مستوى مكداس الدم (PCV) من عينات تم الحصول عليها من ثلاثة مجاميع. المجموعة الاولى خمسون مصابا بارتفاع ضغط الدم الانبساطي والمجموعة الثانية خمسون مصابا بارتفاع ضغط الدم الانقباضي وخمسون متطوعا اعتيادي (كمجموعه السيطرة). وقد شملت الدراسه العلامات الاتيه (PCV) و ضغط الدم الانبساطي وضغط الدم الانقباضي. بعد جمع النتائج الخاصه بالمتغيرات المذكوره أعلاه تم تحليلها احصائيا لغرض مقارنتها مع النتائج المستحصله من مجموعة السيطرة.

النتائج :وجود زيادة معنوية في مستوى مِكْدَاسُ الدَّم PCV في المرضى المصابين بضغط الدم الانبساطي مقارنة مع نتائج مجموعة التحكم (P<0.0005) حيث كانت نسبة التكرار (frequency) لقيمة مِكْدَاسُ الدَّم العالية (PCV> 51%) هي كانت 28%.

وكذالك وجود زيادة معنوية في مستوى مِكْدَاسُ الدَّم PCV في المرضى المصابين بضغط الدم الانقباضي مقارنة مع الاصحاء (P<0.0005) حيث كانت نسبة التكرار(frequency) لقيمة مِكْدَاسُ الدَّم العالية(PCV> 51%) هي كانت 16% .

وان معدل مستوى مِكْدَاسُ الدَّم PCV للمرضى المصابين بضغط الدم الانبساطي (Mean 48.04) وهو اعلى من معدل مستوى مِكْدَاسُ الدَّم PCV للمرضى المصابين بضغط الدم الانقباضي (mean 45.70).

الاستنتاجات

ارتفاع مستوى مِكْدَاسُ الدَّم PCV هو احد العوامل التي تؤثر على مستوى ضغط الدم وخاصة ضغط الدم الانبساطي مقارنة مع ضغط الدم الانقباضي .

Abstract

The objective of the study: is to study the effect of hematocrit (PCV) on diastolic and systolic blood pressure and assert the effect of PCV on blood pressure especially on isolated diastolic blood pressure.

Design: cross-sectional study of two groups of patients with isolated diastolic and isolated systolic hypertension and normal healthy controls.

Setting: Al- Karama teaching Hospital Department of medicine in Al- Kut city, Iraq. Patients and Method:-This cross-sectional study included inpatients and outpatients with hypertension from (February 2013 to December 2013) in Al- karama Teaching Hospital Department of medicine. The samples were divided into three groups, group 1 (normal healthy controls), group 2(patients with isolated diastolic hypertension) and group 3(patients with isolated systolic hypertension). The level of PCV was measured in each group.

Results: Patients with isolated diastolic hypertension have positive relation with increased level of PCV, frequency of patients with PCV>51% is 28% (mean 48.04), more than that in individuals with isolated systolic hypertension, frequency of PCV>51% is 16% (mean 45.70), and normal healthy controls frequency of PCV>51% is 6% (mean PCV 41.34).

Hematocrit level remained as statistical significance for patients with isolated diastolic hypertension (P<0.0005), and also in patients with isolated systolic hypertension (Mean PCV 45.70) in compare to normal individuals (P<0.0005)

Conclusions: increased level of PCV is a risk factor or marker that affect blood pressure specially patients with isolated diastolic hypertension more than patients with isolated systolic hypertension

Introduction

Hypertension (high blood pressure) is defined as that level of blood pressure at which the institution of therapy reduces blood pressure–related morbidity and mortality, Current clinical criteria for defining hypertension are generally based on the average of two or more seated blood pressure readings during each of two or more outpatient visits. (1,2,3)

A recent classification recommends blood pressure criteria for defining normal blood pressure, prehypertension, hypertension (stages I and II) and isolated systolic hypertension, which is a common occurrence among the elderly as showed in (Table 1).(1,2) In children and adolescents, hypertension is generally defined as systolic and/or diastolic blood pressure consistently >95th percentile for age, gender, and height. Blood pressures between the 90th and 95th percentiles are considered prehypertensive and are an indication for lifestyle interventions.(1,2).

Table (1): Definition of hypertension : (1,2)

Category	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)
Blood pressure		
Optimal	< 120	< 80
Normal	< 130	< 85
High normal	130-139	85-89
Hypertension		
Grade 1 (mild)	140-159	90-99
Grade 2 (moderate)	160-179	100-109
Grade 3 (severe)	≥180	≥110
Isolated systolic hypertension		
Grade 1	140-159	< 90
Grade 2	≥160	< 90

Systemic BP rises with age, and the incidence of cardiovascular disease (particularly stroke and coronary artery disease) is closely related to average BP in all ages even when BP readings are within the so-called 'normal range'. (1, 4)

Although the exact cause of high blood pressure is unknown, there are several factors and conditions that may increase risk. (1, 3,5)

- Smoking.
- Diabetes. (6)
- Obesity or being overweight.(7,8,9)
- Being obese/overweight as a child - a research team at the Indiana University School of Medicine found that obese/overweight children are much more likely to suffer from hypertension during adulthood.
- Lack of physical activity.
- High levels of salt intake (sodium sensitivity).
- Insufficient calcium, potassium, and magnesium consumption.
- Vitamin D deficiency.
- High levels of alcohol consumption.
- Stress.
- Aging. (10)
- Medicines such as birth control pills.
- Genetics and a family history of hypertension.
- Chronic kidney disease.
- Adrenal and thyroid problems or tumors.

- Dyslipidemia may also associate with the development of hypertension, and is independent of obesity. (11,12)
- Personality and Sedentary lifestyle. (13)

Hematocrit

The term comes from Greek roots hemat- (blood) and krites (judge).(14,15) It is the proportion of blood volume that is occupied by erythrocytes (the ratio of red blood cells to the whole blood volume), it is usually expressed either as a percentage or as a decimal fraction (e.g. 41% or 0.41) and it is considered an integral part of a person's complete blood count results, along with hemoglobin concentration, white blood cell count and platelet count, the hematocrit may also be referred to as Packed Cell Volume (PCV).(16)
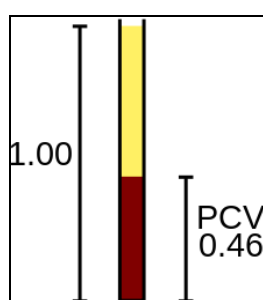
Packed cell volume diagram

Materials and methods

One hundred fifty (150) human formed the samples for this study, the age range from 18-70 year. Arranged into three groups, group 1 (50 normal healthy individuals control), group 2(50 patients with isolated diastolic hypertension) and group 3 (50 patient with isolated systolic hypertension and those with following condition excluded from this study

- Malignant disease
- Hematological diseases
- Secondary causes of polycythemia

Statistical analysis

The Student's t-test was used to determine if the mean value for PCV tests were significantly different in the normal healthy control and isolated diastolic hypertension and also for the normal healthy control and isolated systolic hypertension, $p< 0.05$ were considered significant.

Procedure

Step1- **(** Manual blood pressure measurement) we used:

a.Stethoscope and blood pressure measurement instrument such as an aneroid or mercury column sphygmomanometer

b.Prepare the patient: We made sure that the patient is relax by allowing 5 minutes to relax before the first reading. The patient should sit upright with their upper arm positioned, so its level with their heart and feet flat on the floor and remove excess clothing that might interfere with the BP cuff or constrict blood flow in the arm.

We choose the suitable BP cuff size for arm circumference and place the BP cuff on the patient's arm after Palpate/locate the brachial artery and position the BP cuff so that the artery marker points to the brachial artery and wrap the BP cuff snugly around the arm, then position the stethoscope on the same arm that we placed the BP cuff, palpate the arm at the antecubical fossa (crease of the arm) to locate the strongest pulse sounds and place the diaphragm of the stethoscope over the brachial artery at this location, than we Inflate the BP cuff begin pumping the cuff bulb as we listen to the pulse sounds. When the BP cuff has inflated enough to stop blood flow we should hear no sounds through the stethoscope. The gauge should read 30 to 40 mmHg above the person's normal BP reading. If this value is unknown we can inflate the cuff to 160 - 180 mmHg. (If pulse sounds are heard right away, we inflate to a higher pressure.), than slowly deflate the BP cuff and the pressure should fall at 2 - 3 mmHg per second, because rapid deflation may likely result in an inaccurated measurement. The first occurrence of rhythmic sounds heard as blood begins to flow through the artery which is the patient's systolic pressure; this may resemble a tapping noise at first and after that we listen for the diastolic reading; where we continued to listen as the BP cuff pressure drops and the sounds disappear, this will be the diastolic reading.

Step 2 (Hematocrit Measurement)
a. We punctured the skin of the finger and collect blood from the capillary directly into heparinized microhaematocrit tube; fill 2/3 of the tube.
b. Then sealed one end of the tube with clay or a sealant. We avoid trapping air between the blood and plug.
c. Then placed the tube into a calibrated microhaematocrit centrifuged and sealed ends out against a rubber ring. Place firmly the lid over the centrifuge head, closed the cover, set the timer (most instruments require 3 to 5 minutes centrifugation time). Centrifuged the tube (usually at 10,000 RPM).
d. The tube then removed and read within a minute or two after the centrifuge has stopped to avoid re-dispersion of cells. Hemolysis noted, since this may lower the hematocrit results in relation to the hemoglobin (the hematocrit is 3 times the value of the hemoglobin, if the cells are normocytic).
e. We determined the Hematocrit value by measuring the height of the total blood column and the height of the red cell layer.

Plasma (55%)

White blood cells and platelets (<1%)

Red blood cells (45%)
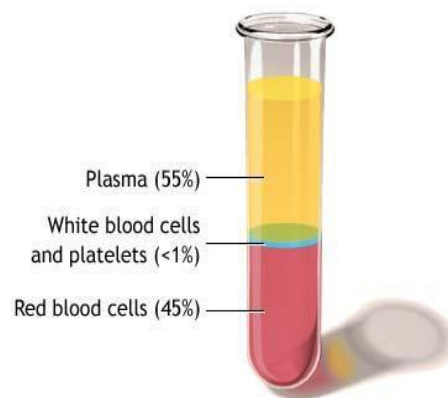
Results

The level of PCV was measured in patients with isolated diastolic hypertension, and the results revealed that the PCV was increased as a comparison to normal healthy controls P<0.0005, as showing in table (2) and figure (1)

Table (2): Bio-statistical calculations, student t-test for PCV of normal healthy control and patient with isolated diastolic hypertension

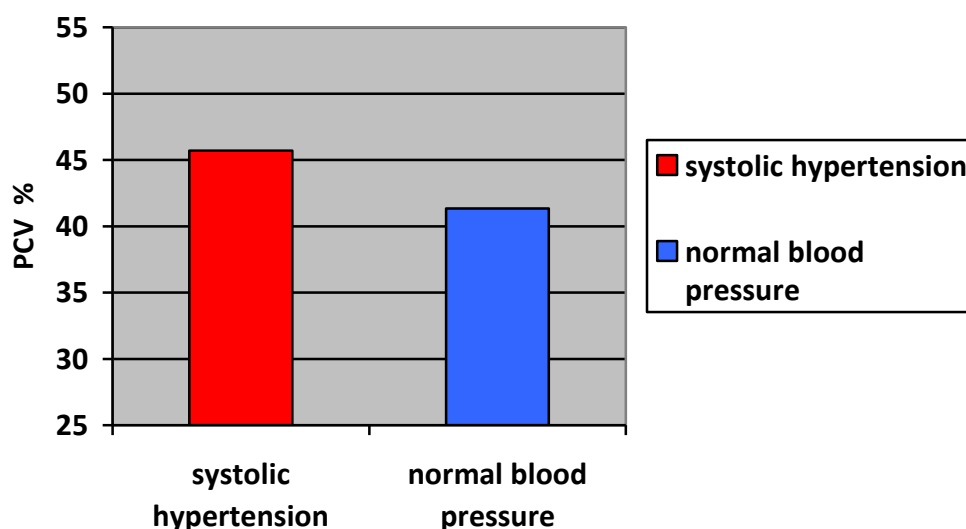| PCV	Normal healthy control	diastolic hypertension
Sample size	N1=50	N2=50
Means	X1=41.34	X2=48.04
Standard deviation	SD1=4.89735	SD2=3.61381
Standard error of the mean	Sx1=0.693	Sx2=0.511
Frequency PCV>51%	6%	28%
t-test	7.78	
Probability	P<0.0005	
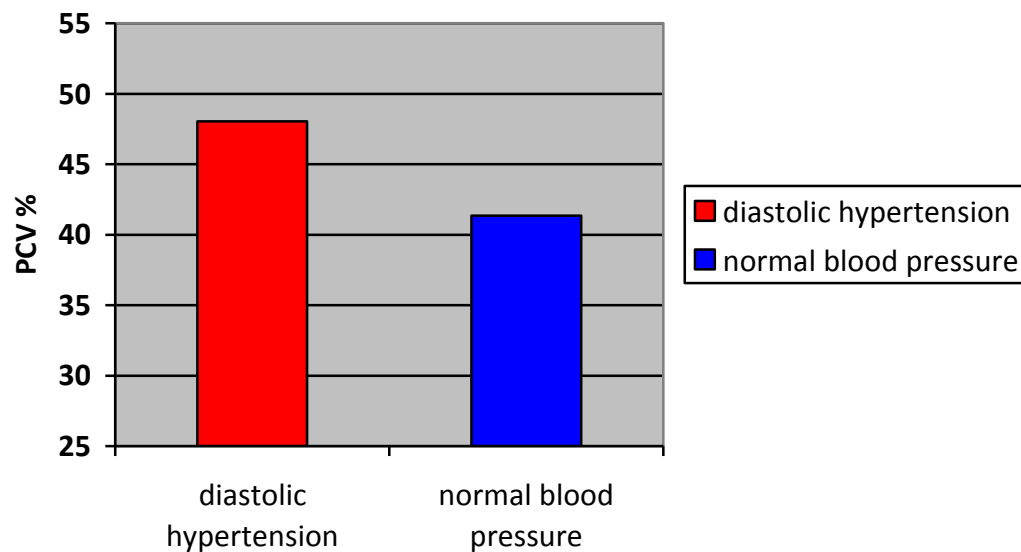
Figure (1): The level of the PCV in patients with isolated diastolic hypertension and normal healthy control.

When we studied the level of PCV in patients with isolated systolic hypertension it's also increased in a comparison with normal healthy controls individuals P<0.0005 as showing in Table (3) and figure (2):

Table (3): Bio statistical calculations, student t-test for PCV normal healthy control and patient with isolated systolic hypertension

PCV	Normal healthy control	systolic hypertension
Sample size	N1=50	N2=50
Means	X1=41.34	X2=45.70
Standard deviation	SD1=4.89	SD2=5.07
Standard error of the mean	Sx1=0.69	Sx2=0.71
Frequency PCV>51%	6%	16%
t-test	4.369	
Probability	P<0.0005	

Figure (2): The level of the PCV in patients with isolated systolic hypertension and normal healthy controls.

Discussion

Many previous studies mentioned that there is important effect of hematocrit (PCV) level on hypertension like M Cirillo, et al. (17) study, where they found that prevalence of hypertension was at least two times greater for persons whose hematocrit levels were higher by 10 units.

Letcher RL, et al. (18) also found that elevations in arterial pressure are associated with increased blood viscosity is a consequence of increased hematocrit, plasma viscosity, and red cell aggregation. (18) Also the effect of hematocrit level on blood pressure confirmed in other studies. (19, 20, 21 and 22)

In this cross sectional study, we studied the effect of hematocrit level on patients with high blood pressure especially those with diastolic hypertension and the results revealed that the PCV increased more in patients with diastolic hypertension in comparison to normal healthy control (P<0.0005), and also when we made comparison for patients with systolic hypertension we found the effect of hematocrit on diastolic blood pressure is more than its effect on systolic blood pressure.

So there is a clear similarity with other studies that was done outside Iraq regarding the effect of PCV on blood pressure in general, but in our study we found the effect is more on diastolic blood pressure and this fact not mentioned or discussed separately in previous studies especially in Iraq.

Conclusion

The level of hematocrit rises in patients with hypertension especially those with isolated diastolic hypertension, so it represented one of important risk or parameter that it need to be checked for any patient with hypertension at least for those with diastolic hypertension in order to help controlling this risk and the conditions that lead to rise PCV which in turn rise blood pressure.

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