

Comparing Finger-stick β -Hydroxybutyrate with Dipstick Urine Tests in the Detection of Ketone Bodies

Keton Cisimciklerinin Tespitinde Parmakucu β -Hidroksibütirat ile İdrar Daldırma Testlerinin Karşılaştırılması

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SUMMARY

Objectives

Blood ketone (beta-hydroxybutyrate) measurements are suggested instead of urine ketone (acetoacetate) measurements in the diagnosis of diabetic ketoacidosis. Urine ketone examination is difficult and time consuming, and may result in an incorrect interpretation. Studies performed in emergency departments on blood ketones are limited. Our objective is to compare urine ketones and capillary blood ketones in patients whose serum glucose levels were ≥ 150 mg/dl.

Methods

In our cross-sectional prospective study, finger-stick blood beta-hydroxybutyrate, arterial blood gas and urine ketone measurements of patients whose serum glucose levels were 150 mg/dL and higher were performed in the emergency department.

Results

A total of 265 patients were included in the study. The mean age of the patients was 62.4 ± 14.9 years, and 65.7% of them were female. The mean of the capillary blood ketone levels of the patients was determined to be 0.524 ± 0.9 mmol/L (min: 0 mmol/L, max: 6.7 mmol/L). In 29 (13.1%) of the 221 patients whose urine ketone levels were negative, the finger-stick blood ketone levels were positive. Three of these patients were severely ketonemic, six were moderately ketonemic, and 20 were mildly ketonemic.

Conclusions

In patients admitted to the emergency department with a blood glucose level of 150 mg/dL or higher, performing a capillary blood ketone measurement instead of a urine ketone measurement was a better predictor of ketonemia.

Key words: Diabetic ketoacidosis; hydroxybutyrates; ketosis.

ÖZET

Amaç

Diyabetik keto asidoz tanısında idrar ketonu (asetoasetat) yerine kan ketonu (beta-hidroksibütirat) ölçümü önerilmektedir. İdrar ketonu bakılması zahmetli, zaman alıcı ve yanlış yorumlara yol açabilen bir testtir. Acil servislerde kan ketonu ile ilgili yapılan çalışmalar sınırlıdır. Bu çalışmadaki amacımız serum glikoz düzeyi ≥ 150 mg/dl tespit edilen hastalarda idrar ketonu ile kapiller kanda keton varlığını karşılaştırmaktır.

Gereç ve Yöntem

İleriye yönelik kesitsel çalışmada, acil serviste serum glikoz düzeyi 150 mg/dL ve üzerinde olan hastaların parmak ucu kan beta-hidroksibütirat, venöz kan gazı ve idrar ketonu ölçümü yapıldı.

Bulgular

Bu çalışmaya toplam 265 hasta dâhil edildi. Hastaların yaş ortalaması 62.4 ± 14.9 yıl, %65.7'si kadındı. İdrar ketonu negatif olan 221 hastanın 29'unda (%13.1) parmak ucundan kan ketonu pozitif olarak saptandı. Bu hastaların üçü ağır, altısı orta düzeyli, 20'si hafif düzeyli ketonemikti. Olguların kapiller kan keton düzeyleri ortalaması 0.524 ± 0.9 mmol/L (min.: 0 mmol/L, maks.: 6.7 mmol/L) tespit edildi.

Sonuç

Acil servise başvuran ve kan glikoz değeri 150 mg/dL üzerindeki hastalar içinde, idrar keton ölçümü yerine kapiller kan keton ölçümünün kullanılması hastaların yönetiminde önemli değişikliğe yol açabilir.

Anahtar sözcükler: Diyabetik ketoasidoz; hidroksibütirat; ketozis.

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Introduction

It has been reported that 25% of patients who are admitted to the emergency department (ED) are diabetic, and the routine glycemic control results of nearly half of these patients were negative. In emergency medicine practice, diabetic ketoacidosis (DKA) should be considered in patients whose blood glucose level is ≥ 250 mg/dL, regardless of symptoms.

^[1] DKA is a severe complication of diabetes that is characterized by hyperglycemia, ketone body production and metabolic acidosis.^[2-4] Early diagnosis of DKA patients is critical because of the high mortality rate (2-5%).^[5]

In current emergency medicine practice, ketonemia is frequently tested using a urine dipstick that measures acetoacetate (AA) concentrations.^[1] A urine dipstick does not measure the concentration of β -hydroxybutyrate (β -OHB), a major ketone body that plays an important role in DKA pathogenesis.^[2-4]

Studies of blood ketone concentrations in ED patients are limited.^[1,6-9] Detection of ketone bodies in capillary blood provides analytical, technical, and clinical advantages compared to a urine dipstick test.^[3] The objective of our study was to compare urine ketone (AA) and capillary blood ketone (β -OHB) levels in ED patients whose serum glucose levels were ≥ 150 mg/dl.

Materials and Methods

Our cross-sectional prospective study was performed over a period of three months in the Department of Emergency Medicine of Izmir Tepecik Training and Research Hospital, a tertiary training clinic. Ethics committee approval was obtained before the study. All the patients included in the study gave consent.

Patient Selection

All the patients admitted to our ED who were older than 14 years and whose serum glucose level was 150 mg/dL or

higher were consecutively enrolled in the study. The criteria of the American Diabetes Association (ADA) were used for the definition of DKA as follows: blood glucose levels higher than 250 mg/dl, the existence of an anion gap greater than 10, bicarbonate levels lower than 18 mEq/L, and 3 mmol/L ketonemia or significant ketonuria (" $\geq 3+$ " by standard urine dipstick) with blood pH lower than 7.3.^[1,4,10,11]

Patients who declined to participate in the study as well as any patients whose blood biochemical tests, blood gas analysis, or urine or capillary ketone measurements could not be performed for any reason were excluded from the study.

Study Protocol

Patients whose finger-stick blood glucose level was measured to be 150 mg/dL and higher for any reason were identified. Serum glucose levels, serum electrolyte (Na⁺, K⁺, Cl⁻; to calculate the anion gap) measurements, complete urine tests, arterial blood gases (pH, lactate, HCO₃⁻, base excess), and capillary blood ketone measurements were performed.

Serum electrolytes and glucose levels were measured with an Olympus AU640 auto-analyzer. Arterial blood gas parameters were evaluated with a GEM Premier 3000 S/N 17839 blood gas analyzer[®]. To avoid observer bias, complete urine tests were evaluated using DIRUI H10-800 urine dipsticks with a DIRUI H800 Urine Analyzer[®] device with a spectrophotometric measurement technique. Urine ketone levels were grouped as no ketonemia, "trace quantity", "1+", "2+", or "3+".

Capillary blood glucose levels were measured with a Glucometer[®] (HMD Biomedical Inc., Hsinchu, Taiwan) in mg/dL at the bedside using a finger-stick test. Measurement of capillary blood ketone levels was performed at the bedside using β -ketone test strips (Optium-meter, Optium TM Xceed TM/Abbott[®]). Capillary blood ketone levels were grouped as follows: no ketonemia (0-0.5 mmol/L), mild ketonemia (0.6-

Table 1. Comparison of capillary blood ketone levels with dipstick urine ketone levels

Blood ketone levels	Urine ketone levels										Total	
	-		Trace		1+		2+		3+		n	%
	n	%	n	%	n	%	n	%	n	%		
No	192	72.4	18	6.8	1	0.4	0	0	0	0	211	79.6
Mild	20	7.5	7	2.6	5	1.9	0	0	2	0.8	34	12.8
Moderate	6	2.3	1	0.4	5	1.9	0	0	0	0	12	4.5
Severe	3	1.1	2	0.8	1	0.4	1	0.4	1	0.4	8	3
Total	221	83.4	28	10.6	12	4.5	1	0.4	3	1.1	265	100

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