

Calcium and Magnesium Urinary Excretion as Predictors of Preeclampsia

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Introduction

Preeclampsia (pure or superimposed) represents the greatest danger for fetus and is associated with life-threatening maternal syndromes. ¹Transient hypertension is a benign disorder characterized by mild to moderate elevations of blood pressure late in pregnancy that return to normal post partum. ¹Essential hypertension, also, is usually well tolerated if elevations remain (with or without therapy) below diastolic levels of 100 mm Hg, but complication such as midtrimester loss, growth retardation, and abruption of placenta may occur more frequently. ¹

The aims of this study were to investigate the potential usefulness of serum levels of calcium (SCa) and magnesium (SMg) and their urinary excretion as well as urinary metabolite of prostacycline, 6-KetoPGF₁α

(PGF₁α), tromboxan B2 (TxB2), urinary metabolite of tromboxan A2 and parathyroid hormone (PTH) as predictors of preeclampsia.

Design and Methods

A prospective, longitudinal study was conducted on four hundreds and eighty pregnant women. After termination of pregnancy five groups are formed if the criteria of classification¹ were fulfilled: 1-(NT)- normotensive pregnant women, 2-(HHTA)- pregnant women with chronic hypertension, 3-(SPE)- pregnant women with

superimposed preeclampsia, 4-(PE)- pregnant women with preeclampsia and 5- pregnant women with transient hypertension. They were observed at 8-13th, 18th, 23rd, 28th, 32nd and 36th gestational week (g.w.). Urinary excretion of calcium (Ca/L, Ca/dU), magnesium (Mg/L, Mg/dU), and serum levels of calcium, magnesium, were determined by standard laboratory tests. PGF₁α, TxB2, and aldosterone were measured in 24-hour urine samples and PTH in serum using RIA method.

Results

Mg/dU ≤ 3.3 mmol/L at 8-13th g.w. showed high sensitivity and specificity (Sen = 71%, Spec = 67%) in predicting PE, also CaS ≤ 2.2 mmol/L (Sen = 67%, Spec = 61%), Mg/L ≤ 2.8 mmol/L (Sen = 67%, Spec = 55%), PTH ≤ 13.5 pg/ml (Sen = 67%, Spec = 52%) and Ald ≤ 12 μg/ml (Sen = 56%, Spec = 58%) at 18th g.w. The best predictive values for SPE were: Mg/L ≤ 2.9 mmol/L (Sen = 75%, Spec = 75%), Ca/L ≤ 4.4 mmol/L (Sen = 71%, Spec = 57%) and Ald ≤ 15.5 μg/ml (Sen = 63%, Spec = 60%) at 8-13th g.w.; also Mg/L ≤ 2.5 mmol/L (Sen = 70%, Spec = 75%), Ca/L ≤ 4.2 mmol/L (Sen = 70%, Spec = 62%) and PTH ≤ 12 pg/ml (Sen = 67%, Spec = 54%) at 18th g.w.

Table 1: Sensitivity, specificity, positive predictive value, negative predictive value of different parameters in different gestational weeks in predicting of preeclampsia

Gestational weeks	PARAMETAR	SEN	SPEC	PPV	NPV
8-13 g.w.	MgD ≤ 3.3 mmol/L	71%	67%	38%	69%
18 g.w.	CaS ≤ 2.2 mmol/L	67%	61%	30%	86%
	Mg/L ≤ 2.8 mmol/L	67%	55%	29%	86%
	Mg/Kr ≤ 0.28	67%	76%	43%	89%
	PTH ≤ 13.5	67%	52%	27%	85%
	Ald < 12.0	56%	58%	21%	84%
8 to 13+18 g.w.	MgD ≤ 3.3 mmol/dU	69%	63%	34%	88%
	PgF1 ≤ 153	61%	59%	39%	77%
	Mg/L ≤ 3.20 mmol/L	69%	53%	29%	86%
	PTH ≤ 12	67%	54%	32%	84%
23 g.w.	D-DKP ≥ 75 mmHg	53%	60%	32%	79%
	N-DKP ≥ 59 mmHg	53%	70%	38%	81%
	Ald < 22.2	73%	62%	44%	85%
	PTH < 12	62%	73%	42%	86%
28 g.w.	Ca/L ≤ 3.9 mmol/L	70%	69%	47%	85%
	UCaE ≤ 0.56	60%	66%	46%	77%
	D-DKP ≥ 75 mmHg	60%	61%	38%	79%

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Table 2: Sensitivity, specificity, positive predictive value, negative predictive value of different parameters in different gestational weeks in predicting of superimposed preeclampsia

Gestational weeks	PARAMETAR	SEN (%)	SPEC (%)	PPV (%)	NPV (%)
8-13 g.w.	Mg/L \leq 2.9mmol/L	75	75	67	82
	Mg/Kr \leq 0.34	75	67	60	80
	Ca/L \leq 4.4 mmol/L	71	57	45	80
	Ca/D \leq 4.1 mmol/dU	71	57	45	80
	Ca/Kr \leq 0.37	57	79	57	79
	UCaE \leq 1.21	57	79	57	79
	Ald \leq 15.47	63	60	56	67
18 g.w.	Ca/L \leq 4.2 mmol/L	70	62	58	73
	Mg/L \leq 2.5 mmol/L	70	75	70	75
	Mg/D \leq 3.5 mmol/L	70	67	64	73
	PTH \leq 11.96	67	54	50	70
8 to 13 +18 g.w.	Mg/L \leq 2.9 mmol/L	83	75	71	86
	Mg/D \leq 3.7 mmol/L	67	71	63	74
	Mg/Kr \leq 0.36	56	63	53	65
	Ca/L \leq 4.4 mmol/L	67	59	52	73
	Ca/D \leq 4.9 mmol/dU	56	56	45	65
23 g.w.	D-DKP \geq 85 mmHg	70	69	64	75
	PTH $<$ 11.60	62%	73%	42%	86%

Discussion

Several reports have now indicated the presence of low intracellular free magnesium concentrations in subjects with essential hypertension or tip 2 diabetes.² Insulin resistance has been suggested to be a factor associated with hypertension, atherosclerotic cardiovascular disease, or both.³ Magnesium deficiency can lead to both an increases in angiotensin II - induced rise in blood pressure and aldosterone concentration. In addition magnesium deficiency is reflected by reduction in prostaglandin I₂ and an increase in vasoconstrictive prostaglandins.⁴

Same studies have linked hypocalcemia and high blood pressure.⁵ Pregnancy constitutes a major challenge for calcium homeostasis because calcium is actively transported from mother to fetus across the placenta, specially during the last trimester.⁶ Prada and al.⁷ have reported altered calcium concentrations during the last trimester of multiple ovine pregnancy may play a important role in the development of pregnancy induced hypertension.

Conclusions

We confirm marked reduction in magnesium excretion that is probably result of total magnesium deficiency, which is recently shown as important factor for development of hypertension and insulin resistance. We found inadequate low PTH secretion in PE and SPE in hypocalcemic

condition of pregnancy and that could be result of total magnesium deficiency and a factor for persisting hypocalcaemia.

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