Calcium-to-Creatinine Ratio in a Spot Sample of Urine, for Early Prediction of Hypertensive Disorders of Pregnancy

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Abstract: *Background - Hypertensive disorders complicate 5–10 % of all pregnancies. Various methods for screening have been studied to identify pregnant women at risk of development of preeclampsia, but no ideal screening test has been identified so far. The objective of this study was to determine the efficacy of urinary calcium-to-creatinine ratio, in a spot urine sample, for the prediction of preeclampsia in asymptomatic pregnant women between 18 and 24 weeks of gestation. Methods - This study was done on 106 patients presenting to the antenatal clinic in the Department of Obstetrics and Gynecology at VSS Medical College and Hospital. A random urinary calcium-to-creatinine ratio of all the patients was analyzed. The urinary calcium level and creatinine was analyzed by suitable method. A value of less than or equal to 0.04 was considered positive. Results - 106 patients were recruited in the study. 6 lost to follow up. Out of the 12 subjects with urinary CCR less than 0.04, 8 developed gestational hypertension, 2 developed preeclampsia, and 2 remained normotensive. In 88 patients with CCR>0.04, 4 developed gestational hypertension, none preeclampsia and 84 were normotensive. Interpretation and Conclusion - On statistical analysis, it was found that when CCR alone is taken as high-risk factor for prediction of preeclampsia, P<0.001 was statistically significant, sensitivity was 71.42%%, specificity 97.67%, PPV 83.33%, NPV 95.45 %, and diagnostic accuracy 94%. So this test was satisfactory as an early predictor for the development of preeclampsia.*

Keywords: Calcium-to-Creatinine Ratio, Urine, Hypertensive Disorders, Pregnancy

1. Introduction

- Hypertensive disorders occur in 5–10 % of all pregnancies [1]. They contribute to significant maternal and perinatal morbidity and mortality.
- In most cases, preeclampsia is diagnosed only after the pathological changes are already established. So, not many treatment options are left for the treating obstetrician.
- Calcium-to-creatinine ratio has been suggested by many to be a good screening test for preeclampsia [2].
- Creatinine clearance is an indicator of the renal damage in pregnancy hypertension.
- The lower the creatinine clearance, the severe is the renal disease. This has been shown to parallel the decline in urinary calcium in preeclampsia, even before the clinical appearance of signs and symptoms.

2. Materials and Methods

- Study Period: July 2021 – June 2022.
- Study Place: VSSIMSAR, BURLA, SAMBALPUR.
- Inclusion Criteria: All normotensive gravid women between 20-24 weeks of gestational age.
- Exclusion Criteria: Those with proteinuria and BP > 140/90mmHg at booking visit, preexisting hypertension, diabetes mellitus, chronic renal or vascular disease were excluded.
- Procedure: A spot urine sample was collected for the test. The urinary calcium level was analyzed by Arezano method, while creatinine was estimated by Jaffe's method.

- Calcium-to-creatinine ratio (CCR) was calculated, and those with a ratio of less than or equal to 0.04 were considered as test positive.
- At each visit, blood pressure was measured, and if found to be elevated, the patient was treated for the same according to the hospital protocol.
- All patients were followed up until delivery.

3. Results

- Total sample size – 106, 6 were lost to follow-up.
- Out of 100 women, 12 had CCR <0.04 from which 2 pre-eclampsia, 8 GHTN, 2 normotensive.
- Rest 88 had CCR >0.04. from which 4 GHTN, rest 84 were normotensive.

Parameters	PE group	Normotensive
Urinary creatinine [mg/dl]	111.2±18.0	76.3±10.9
Urinary calcium [mg/dl]	4.45±2.9	8.56 ±2.3
Calcium-creatinine ratio	0.04±0.16	0.11±0.21

Parameters	Number (%)
PE group (14)	
CCR ≤ 0.04 (TP)	10/14 (71.42 %)
CCR > 0.04 (FN)	4/14 (28.59%)
Normotensive non-PE group (86)	
CCR > 0.04 (TN)	84/86 (97.67%)
CCR ≤ 0.04 (FP)	2/86 (2.32%)
Sensitivity = TP ÷ (TP + FN) × 100	10/ (10+4) *100 = 71.42%
Specificity = TN ÷ (TN + FP) × 100	84/ (84+2) *100 = 97.67%
PPV = TP ÷ (TP + FP) × 100	10/ (10+2) *100 = 83.33%
NPV = TN ÷ (TN + FN) × 100	84/ (84+4) *100 = 95.45%
Accuracy = TP + TN ÷ (TP + TN + FP + FN) × 100	10+84/ (100) *100 = 94%

4. Discussion

- The effectiveness of spot urine calcium-to-creatinine ratio (CCR) in predicting preeclampsia was studied by many groups.

Name of the study	Sensitvity %	Specificity %
Ozcan et al. [4]	75	86
Kamra et al. [5]	71.4	95.5
Sheela et al. [2]	69.2	98.2
Rodriguezet al [6]	70	95
Sanchez-Ramos et al [7]	88	84
J Kar et al [8]	63.63	94.87
This study	71.42%	97.67%

- Most of the studies have used 0.04 as the upper limit for calcium-to-creatinine ratio in the prediction pregnancy hypertension [3].
- From this study, we can conclude that calcium-to-creatinine ratio is a good predictor for hypertensive disorders in pregnancy wth accuracy of 94% n ths study.
- A single urinary CCR may be an effective screening method for impending preeclampsia & may identify population at greater risk to be included in primary prevention programmes.
- It is noninvasive& convenient as a screening test.

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