Study of microalbuminuria and urinary calcium-creatinine ratio as predictive indicators of hypertensive disorders of pregnancy

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Abstract: Background: Hypertensive disorders of pregnancy have been a great challenge to obstetric practice causing considerable perinatal and maternal morbidity. Methods to predict the development of these conditions have been extensively studied. The present study investigated the predictive power of urinary microalbumin and calcium-creatinine ratio to the development of hypertensive disorders of pregnancy.

Methods: A prospective observational study has been conducted over six months recruiting 120 subjects considering inclusion and exclusion criteria. Urinary microalbumin and calcium-creatinine ratio were measured initially for all recruited patients and follow-up was done until delivery for the development of hypertensive disorders. Considering cut-off level of $\geq 30$ mg/L for urinary microalbumin and $\leq 0.04$ for urinary calcium-creatinine ratio, analysis was done using Medcalc and SPSS software.

Results: The outcome measured was the development of hypertensive disorders of pregnancy. Considering the upper cut-off of $30$ mg/L for urinary microalbumin, the odds for the development of hypertensive disorders was $0.706$ (95\% confidence interval [CI], $0.333–1.497$, $p = 0.443$). Similarly, considering the lower cut-off of $0.04$ for urinary spot calcium-creatinine ratio, the odds of developing hypertensive disorders was $1.356$ (95\% CI, $0.444–1.439$, $p = 0.775$).

Conclusion: Urinary microalbumin at the upper cut-off level of $30$ mg/L and urinary calcium-creatinine ratio at the lower cut-off value of $0.04$ were unable to significantly predict the development of hypertensive disorders of pregnancy.

Key words: Hypertensive disorders of pregnancy, preeclampsia, eclampsia, microalbuminuria, urinary calcium-creatinine ratio, predictive indicators.

I. Introduction

Background
Hypertensive disorders of pregnancy (HDP) complicate 10.08\% of all pregnancies according to the National Eclampsia Registry (FOGSI-ICOG NER) resulting in significant perinatal loss (30–40\%), maternal morbidity and mortality (4–6\%). The clinical manifestations of HDP can appear anytime from the second trimester to the first few weeks after delivery; however, the initial pathological changes begin in the period around late first trimester and involve abnormal remodeling of the spiral arteries. At the most severe end of the spectrum, HDP can result in pulmonary edema, cerebral hemorrhage, renal failure, hepatic failure, seizures (eclampsia), disseminated intravascular coagulation (primarily with a\hspace{0.01in}\hspace{0.01in}\hspace{0.01in}\hspace{0.01in}bruption), and maternal death. Fetal or neonatal adverse outcomes include preterm birth, stillbirth and growth retardation. Prediction and early diagnosis help in identifying the women at risk and treatment accordingly can reduce the adverse effects to a minimum.

Justification and proposed research work
The feasibility to predict the development of HDP appears to be appropriate especially since the antenatal care services have gained importance in many parts of the country. It would be logical at these antenatal care visits to actively look for and screen for HDP amongst the pregnant population. Currently, it is being done by basic methods such as regular and routine estimation of blood pressure and examination of the urine, in an attempt to detect these diseases as early as possible. These methods have their drawback in that they detect HDP only when they have already set in. Hence, a good test for predicting women who will develop HDP should be rapid, simple, noninvasive, inexpensive, easy to perform\textsuperscript{(1)}, should not expose the patient to discomfort or risk, widely applicable and usable; and the results should be reproducible and reliable having good sensitivity and specificity.
Ideally, it should provide a window for intervention to prevent the development of the disease, or at least result in better maternal and/or fetal outcome.

II. Brief account of present knowledge

Markers in the blood are always the easiest to study in terms of risk stratification and prediction of disease. In the field of HDP as well, multiple molecules have been targeted and studied, for example, vascular endothelial growth factor (VEGF) and placental growth factor (PIGF), as well as two anti-angiogenic proteins, soluble endoglin (sEng) and the truncated form of the full-length VEGF receptor type-1 (Flt1), known as soluble fms-like tyrosine kinase 1 (sFlt-1). Ischemic trophoblast has been shown to increase production of anti-angiogenic proteins (sEng, sFlt1) and reduce production of angiogenic proteins (VEGF, PIGF). Alterations in absolute levels of VEGF(2), PIGF(3), sFlt-1(4), and sEng(5) in maternal blood and urine antedate the onset of clinical preeclampsia by weeks to months, correlate with disease severity, and normalize after delivery. However, whether blood and urine levels of these substances will actually conclusively predict the development of these disorders is not certain. One systematic review evaluated 22 case-control and 12 cohort studies that tested VEGF, PIGF, sFlt-1, or sEng, alone or in combination, in the serum/plasma of pregnant women before clinical and biochemical onset of preeclampsia and before 30 weeks of gestation.(6) The concentrations of PIGF (studied in 27 studies) and VEGF (studied in 3 studies) were lower in women who developed preeclampsia and the concentrations of sFlt-1 (studied in 19 studies) and sEng (studied in 10 studies) were higher in women who went on to develop some form or the other of HDP. However, the test performances of the markers were not significant enough to recommend them for routine testing. Moreover, most of these markers discriminated better when they were used late during pregnancy (around 30 weeks of gestation) as opposed to being used earlier. The sensitivities of all these markers to screen for HDP were less than 30%. Although hyperuricemia is commonly seen in women with preeclampsia, a systematic review of five studies concluded that measurement of serum uric acid concentration was not useful for predicting which patients would develop preeclampsia.(7) One study used a rise in serum uric acid concentration above baseline level as the criterion for predicting the development of HDP, while the other four studies used threshold values above 3.5 to 4 mg/dL (0.21 to 0.24 mmol/L) as the cut-off for a positive test. Sensitivities ranged from 0 to 56 percent and specificities ranged from 77 to 95 percent. Overall, no clear cut benefit was demonstrated with testing for uric acid levels. Some of the above markers have also been used in the urine. Between 8 and 21 weeks of gestation there were no significant differences between the urinary levels of PIGF between the women who remained normotensive as opposed to the women who went on to develop HDP.(8) Urinary PIGF gradually increased during the first two trimesters, peaked at 29 to 32 weeks, and decreased thereafter in both groups. sEng is present and elevated in the urine of women who develop preterm preeclampsia – however, it does not appear to be useful in predicting HDP.(9) Markers like placental protein 13, pregnancy-associated plasma protein A, and a disintegrin and metalloproteinase-12 (ADAM12) have also been studied with no definite benefit.

III. Aims and objectives

The broad aims and objectives of this study were to recruit normal pregnant women between 20 and 36 weeks of a singleton gestation, and estimate urinary calcium-creatinine ratio and urinary microalbumin, and subsequently follow up these patients till delivery in the hospital, to test whether abnormal values of these urinary parameters were able to envisage the development of HDP.

IV. Review of literature

The American College of Obstetrics and Gynecology (ACOG) in their task force statement (10) has noted four diagnostic categories in the spectrum of hypertensive disorders in pregnancy viz, chronic hypertension, gestational hypertension, chronic hypertension with superimposed preeclampsia and preeclampsia–eclampsia. The diagnosis of preeclampsia is made on the basis of hypertension in a pregnant lady beyond 20 weeks of gestation, who has proteinuria as defined by either of the following:
1. Proteinuria ≥0.3 grams in a 24-hour urine specimen.
2. Urine protein (mg/dL)/creatinine (mg/dL) ratio ≥0.3.
3. Dipstick urine protein 1+ or more, if a quantitative measurement is unavailable.

Recently in the ACOG task force statement in 2013 (10), the above definition of preeclampsia was slightly modified. In recognition of the syndromic nature of preeclampsia, the guidelines have eliminated the heavy dependence of the diagnosis on proteinuria. Hence, currently a diagnosis of preeclampsia is possible even without the finding of proteinuria, provided any one or more of the following is present:
1. Thrombocytopenia with a platelet count less than 1,00,000 per microliter.
2. New development of renal insufficiency (elevated serum creatinine of more than 1.1mg/dL or, a doubling of serum creatinine in the absence of other renal disease).
3. Impaired liver function (elevated blood levels of liver transaminases to twice the normal concentration).
4. Pulmonary edema.
5. New onset of cerebral or visual disturbances. Preeclampsia as defined by the above parameters may occur alone or superimposed on an underlying disease of chronic hypertension. The risk of a woman in a developing country dying from a pregnancy-related cause during her lifetime is about 25 times higher compared to a woman living in a developed country. (11) Hypertensive disorders of pregnancy are responsible for over 60,000 maternal deaths worldwide annually. (12) Overall, hypertensive disorders of pregnancy are noted in about 6-8% of all pregnancies. (13,14) Preeclampsia is estimated to occur in 4.6 percent (95% CI 2.7-8.2) of pregnancies worldwide. (13,15) Variations in prevalence reflect, at least in part, differences in the maternal age distribution and proportion of primigravid women among populations. (16) Late onset disease (≥34 weeks) is more prevalent than early onset disease (<34 weeks) (in one population-based study: 2.7 versus 0.3%, respectively). (17) Women with preeclampsia have a 7-15% chance of developing preeclampsia in a subsequent pregnancy, compared with a 1% chance for women with no preeclampsia in their first pregnancy. (18) The risk of preeclampsia in a third pregnancy increases to 30%, if a woman’s first two pregnancies were complicated by preeclampsia, whereas the risk remains at 1% for women with no history of preeclampsia. (18) The risk of recurrence is influenced by gestational age at onset and plurality of the index pregnancy. Studies have reported both decreased and increased risks of cancer after preeclampsia, with a meta-analysis reporting a null effect. The overall increased mortality risk after preeclampsia (relative risk 1.49, 95 % CI 1.1-2.1) is largely driven by increased risk of death due to cardiovascular disease. (19)

Several researchers (20) have reported that hypocaliuria was associated with preeclampsia and could be considered a risk factor for the development of preeclampsia in pregnancy. Rodriguez et al (21) evaluated the role of decreasing calcium-creatinine ratio and microalbuminuria in prediction of preeclampsia as early as in 1998 and have concluded that these tests may be useful screening tools in prediction of preeclampsia. Since then, several researchers have demonstrated the efficacy of decreasing urinary calcium to creatinine ratio and microalbuminuria in the prediction of preeclampsia, whereas others have not found it as useful. (22–25) As early as from 1990, hypocaliuria has been studied in hypertensive disorders of pregnancy. Huikeshoven et al (26) studied 24 hour urinary calcium excretion in 41 pregnant ladies in the third trimester of pregnancy. There were two significant findings of this small study: (i) The 24 hour urinary calcium excretion was significantly reduced in patients with hypertensive disorders and (ii) The 24 hour urinary calcium excretion correlated with the calcium to creatinine ratio of a single voided urinary sample. Urinary calcium-creatinine ratio and microalbuminuria were determined in a spot urine sample in 200 asymptomatic pregnant women between 20-24 weeks of gestation, who attended the antenatal OPD at St John’s Medical College and Hospital (27). The results were analyzed by Chi square test and Fisher Exact test to test for significant association of findings of preeclampsia and urinary spot calcium-creatinine ratio as well as microalbuminuria. Area under Receiver Operator Curve (ROC) was used to find the predictive values of urinary spot calcium-creatinine ratio at less than or equal to 0.04 and microalbuminuria for preeclampsia. It was found that urinary spot calcium-creatinine ratio had a sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of 69.2%, 98.2%, 85.7% and 95.8% respectively with a statistical accuracy of 87% and p value of <0.001 (strongly significant). It was found to be a good test for prediction of preeclampsia. Microalbuminuria had sensitivity, specificity, PPV and NPV of 53.6%, 86%, 36% and 95% and was found to be only a fair test for prediction of preeclampsia. Hence, the authors concluded that urinary spot calcium-creatinine ratio at 0.04 could possibly be used for prediction of preeclampsia as a screening test in all asymptomatic pregnant women.

V. Materials and methods
After obtaining clearance from the institutional ethical committee and informed consent from the patients, this prospective observational study was conducted in R. G. Kar Medical College & Hospital, Kolkata, West Bengal, India, between April 2014 to September 2014 involving 120 subjects attending the G&O outpatient department by simple random sampling as per stipulated inclusion and exclusion criteria as follows:

Inclusion criteria:
1. Normotensive pregnant women, between 20-36 weeks gestation.
2. Singleton pregnancy.

Exclusion criteria:
1. Pregnant women with history of chronic hypertension or using any anti-hypertensive drugs.
2. Patients with other chronic medical illness (i.e. diabetes, thyroid disorders, antiphospholipid antibody syndrome, thrombophilia etc.).
3. Patients with renal diseases or using any diuretics.

Multiple pregnancy:
Urine sample was collected in sterile urine-collecting container at the time of enrolment into the study for analysis of microalbumin and calcium-creatinine ratio. As per literature review with strong statistical correlation, ≥ 30 mg/L (equivalent to ≥30 µgm/mL) for urinary microalbumin and ≤ 0.04 for urinary calcium-creatinine ratio were considered as cut-off levels to significantly predict the development of hypertensive
disorders of pregnancy. The pre-designed proforma was used to collect clinical data. Cases were followed up as per standard antenatal protocol till delivery. Development of hypertensive disorder was considered using standard hypertensive criteria i.e. systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg, measured on two occasions four hours apart in the antenatal outpatient clinic.

**Statistical analysis:**
Statistical analysis was done to detect the association between urinary microalbumin and urinary calcium-creatinine ratio and development of HDP. Continuous variables were analyzed by the independent student t-test in situations where data were normally distributed and the Mann Whitney test in cases of skewed data. Categorical variables were analyzed with Chi-square tests and odds ratios. For bivariate correlations, the Pearson’s correlation coefficient was calculated. p value of <0.05 has been considered to be statistically significant. Data were analyzed by the use of the MEDCALC software version 12.3.0 (Mariakerke, Belgium: Medcalc software 2012) and the SPSS software version 17.

### VI. Results and analysis

#### Table 1: Baseline characteristics of the study population

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Median</th>
<th>Mean</th>
<th>Range</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>26</td>
<td>25.25</td>
<td>18-30</td>
<td>3.5</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>154</td>
<td>153.27</td>
<td>147-160</td>
<td>3.35</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>51</td>
<td>51.88</td>
<td>43-74</td>
<td>5.33</td>
</tr>
<tr>
<td>Body mass index (ratio)</td>
<td>21.65</td>
<td>22.08</td>
<td>17-31</td>
<td>2.59</td>
</tr>
<tr>
<td>Haemoglobin (gm/dL)</td>
<td>10.4</td>
<td>10.17</td>
<td>7.6-12.5</td>
<td>1.09</td>
</tr>
</tbody>
</table>

#### Table 2: Proportion of the population with hypertensive disorders

<table>
<thead>
<tr>
<th>Prior pregnancies</th>
<th>Current pregnancy at delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>Normotensive</td>
<td>90</td>
</tr>
<tr>
<td>Gestational hypertension</td>
<td>24</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>5</td>
</tr>
<tr>
<td>Eclampsia</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 3: Odds ratio of urinary microalbumin to predict hypertensive disorders of pregnancy**

<table>
<thead>
<tr>
<th>Hypertensive disorder of pregnancy</th>
<th>Present</th>
<th>Absent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary microalbumin</td>
<td>Less than 30 mg/L</td>
<td>31</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>More than 30 mg/L</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>52</td>
<td>68</td>
<td>120</td>
</tr>
</tbody>
</table>

Odds ratio 0.706 (95% confidence intervals 0.333 – 1.497), p=0.443

**Table 4: Odds ratio of urinary calcium-creatinine ratio to predict hypertensive disorders of pregnancy**

<table>
<thead>
<tr>
<th>Hypertensive disorder of pregnancy</th>
<th>Present</th>
<th>Absent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary calcium creatinine ratio</td>
<td>Less than 0.04</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>More than 0.04</td>
<td>45</td>
<td>61</td>
</tr>
<tr>
<td>Total</td>
<td>52</td>
<td>68</td>
<td>120</td>
</tr>
</tbody>
</table>

Odds ratio 1.356 (95% confidence intervals 0.444 – 4.139), p=0.775

#### Table 5: Gestational age and key biochemical parameters in the population

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Median</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational age at enrolment (weeks)</td>
<td>30</td>
<td>30.3</td>
<td>23-36</td>
</tr>
<tr>
<td>Serum urea (mg/dL)</td>
<td>26</td>
<td>28.27</td>
<td>18-46</td>
</tr>
<tr>
<td>Serum creatinine (mg/dL)</td>
<td>1.1</td>
<td>1.05</td>
<td>0.6-1.6</td>
</tr>
<tr>
<td>Urinary microalbumin (µgm/mL)</td>
<td>26.5</td>
<td>29.8</td>
<td>6.5-109</td>
</tr>
<tr>
<td>Urinary calcium creatinine ratio</td>
<td>0.21</td>
<td>0.215</td>
<td>0.02-0.9</td>
</tr>
</tbody>
</table>

**Correlations:**
In our cohort of patients, we tested for bivariate correlations between some of the parameters of renal function to see if any of the experimentally tested parameters correlated with conventional parameters of renal function. There were some significant results.

In one such analysis, the experimentally tested parameter urinary calcium-creatinine ratio was correlated with the conventional renal parameter serum creatinine. We found that there was a statistically significant negative correlation of the urinary calcium-creatinine ratio with respect to serum creatinine. The Pearson’s correlation coefficient was found to be -0.301, with a p value of 0.001.
In another such analysis, the experimentally tested parameter urinary calcium-creatinine ratio was correlated with the conventional renal parameter urinary microalbumin. We found that there was a statistically significant negative correlation of the urinary calcium-creatinine ratio with respect to urinary microalbumin. The Pearson’s correlation coefficient was found to be -0.263, with a p value of 0.004.

VI. Discussion

The patients had an average age of 25.25 years. They were mainly from middle and lower socioeconomic status. Most patients were of small to moderate build as evidenced by their height, weight and body mass indices. There were only a small proportion of people who were overweight or obese. Majority of the patients were anemic. These characteristics are in keeping with the usual trend of patients as representative of the general population of the state of West Bengal, India. Most of the patients were second gravida. Most patients had antenatal care both in their current pregnancy and in their past pregnancy. This is also in keeping with the general trend in the state, where most patients are able to access basic antenatal care routinely during pregnancy. There were very few people with bad obstetric history. A significant proportion of the recruited population went on to develop one of the various forms of hypertensive disorders of pregnancy. This proportion appeared to be a fairly considerable fraction (43%). This may be due to referral bias considering our centre to be a tertiary referral centre. It could also be a bias due to sampling – however, as far as was possible, sampling bias was
minimized by systematic and serial recruitment of patients. Gestational hypertension was the most common form of hypertensive disorder of pregnancy in the cohort of population studied by us. Preeclampsia was the next most common form and frank eclampsia was the least common form. The low proportion of patients with eclampsia is probably due to good obstetric management at our centre. There were no patients with post-partum eclampsia in our cohort. There were no patients with HELLP syndrome (Haemolysis, Elevated Liver enzymes, Low Platelets). Most patients had favorable maternal and fetal outcome in our cohort of patients. Factors like prematurity, pre-term delivery, and post-partum hemorrhage were not studied owing to the fact that they had no direct bearing on the research question.

One of the principal research questions that this project set out to answer was whether a value of urinary spot microalbumin beyond a certain predetermined cut-off could actually predict the development of any form of hypertensive disorder of pregnancy. Some prior literature has raised the possibility that an elevated urinary spot microalbumin, beyond 30 mg/L, could significantly predict the development of hypertensive disorders of pregnancy. We sought to test whether the same cut-off value could predict the development of hypertensive disorders of pregnancy in our cohort of patients. It will be remembered, that at the time of recruitment, no patient had any form of hypertensive disorder, and the urinary spot microalbumin was tested right at the first point of enrolment of the patients. When we analyzed the data, we found that the mean value of urinary spot microalbumin was significantly, but only marginally more in the group of patients who developed any of the forms of hypertensive disorders as opposed to the group of patients that had normal or otherwise uneventful pregnancies. When we used a cut-off of 30 mg/L, we found that a value above that did not constitute significantly higher odds of developing hypertensive disorders as opposed to patients with a value of urinary spot microalbumin below 30 mg/L. Hence, we were unable to demonstrate a statistically significant predictive power of a spot urinary microalbumin value, for the development of any of the forms of hypertensive disorders. In contrast Sheela et al (27) in their report found that the same cut-off for urinary microalbumin positively predicted hypertensive disorders in pregnancy. They reported sensitivity, specificity, positive predictive value and a negative predictive value of 53.8%, 86%, 36% and 95% respectively for a urinary microalbumin cut-off of 30mg/L to predict hypertensive disorders of pregnancy. Similarly, Salako et al (28) also claimed a high sensitivity of 88.9% for urinary microalbumin to predict hypertensive disorders. The difference in our observations may be due to the fact that we used a spot sample to measure urinary microalbumin and a better result might have been arrived at by using a 24 hour urinary sample. However, this is cumbersome and typically may not be suitable for an initial screening test, which would finally be the appropriate use of urinary microalbumin in this setting. The other reason for this may be a large proportion of our patients with hypertensive disorders had gestational hypertension – the proportion of patients with preeclampsia or eclampsia were lesser – and the fact may be that urinary microalbumin may be a better predictor of such forms of hypertensive disorders as opposed to mere gestational hypertension. This could be answered by using similar research methodologies and analyses on patients only with preeclampsia or eclampsia.

When we analyzed our data, we found that the urinary spot calcium-creatinine ratio was significantly lower in patients who developed any form of the hypertensive disorders of pregnancies as opposed to normal pregnancies – the mean value was 0.168 in patients who subsequently developed hypertensive disorders as opposed to a mean value of 0.251 in patients with normal pregnancies (p=0.001). Thus, it appeared that there is a trend towards a lower value of urinary spot calcium-creatinine ratio in patients developing hypertensive disorders as opposed to patients with uneventful pregnancies, though the actual difference in the ratios was not numerically marked. Such small numerical differences may be of doubtful clinical value. Hence, in this situation, the proposed cut-off of 0.04 as suggested by prior literature was used in our analysis to check whether the application of such a cut-off could better the predictive power of this ratio with respect to the hypertensive disorders. From our analysis we found that the odds of developing hypertensive disorders in patients with a urinary spot calcium-creatinine ratio of less than 0.04 was not significantly higher than the group of patients with urinary spot calcium creatinine ratios higher than 0.04. When we calculated the sensitivity and the specificity from our study for a cut-off of 0.04 to predict the development of hypertensive disorders of pregnancy, we found that the values were 50% and 57.5% respectively, which were obviously far from ideal – the positive predictive value was 50%. Hence, our study was unable to demonstrate the predictive power of this ratio at a cut-off of 0.04. In contrast to the inability of our data to show positive correlation between spot urinary calcium-creatinine ratio and the development of hypertensive disorders of pregnancy, Sheela et al (27) in their report found that a urinary calcium-creatinine ratio of less than or equal to 0.04 in a spot sample of urine, had a sensitivity of 69% and a specificity of 98%, with a positive predictive value of 85.6% and negative predictive value of 95.5% for the prediction of hypertensive disorders of pregnancy. In some other similar reports Saudan et al (29) could report a sensitivity and specificity of only 68% and 70% respectively. Izumi et al (30) used a urinary calcium-creatinine ratio of 0.1 and found that it could not significantly predict hypertensive disorders of pregnancy. Hence, such conflicting reports exist in the literature with respect to this parameter. These observations may be due to the fact that the assay methods used by us to calculate these ratios may have been different from the assay methods used by the other studies in the literature demonstrating a significant benefit of
this ratio. Furthermore, there are wide physiological variations of both the components of this ratio, which may be the reason for inconsistent results and benefits of measuring and calculating this ratio. Finally, our population had a smaller proportion of patients with preeclampsia and eclampsia with most patients having gestational hypertension. Hence, that may also be a factor in the failure of this tool to show a significant predictive power for hypertensive disorders of pregnancy.

VII. Future scope of the study

In our cohort of patients, we tried to correlate the experimentally tested parameters of renal function with conventional parameters of renal function. In this process, we found that there was a statistically significant negative correlation between urinary spot calcium-creatinine ratio and serum creatinine. Similarly, there was a statistically significant negative correlation between urinary spot calcium-creatinine ratio and urinary microalbumin. Thus, this ratio appears to basically reflect renal function as well as calcium excretion which are in keeping with the established literature of renal abnormalities in hypertensive disorders of pregnancy. Hence, this ratio could also be used as a surrogate marker of renal function especially in pregnant ladies with hypertensive disorders. These observations have not hitherto been reported in the literature and will need larger and more extensive studies and validation prior to being accepted as accurate data.

VIII. Conclusions

1. Fairly high proportion of cases developed hypertensive disorders in our study cohort probably due to sampling bias.
2. Most patients had vaginal delivery with favorable feto-maternal outcome.
3. Urinary microalbumin was marginally higher in patients with hypertensive disorders of pregnancy – however, a cut off of 30 mg/L was unable to predict hypertensive disorders significantly.
4. Urinary calcium-creatinine ratio was marginally lower in the patients who developed hypertensive disorders of pregnancy – however, a cut-off of 0.04 was unable to predict hypertensive disorders significantly.
5. Statistically significant negative correlation was found between urinary calcium-creatinine ratio and conventional parameters of renal function tests.

References


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