ABSTRACT

Introduction
In preeclampsia, hypoxemia may result from a number of mechanisms. Preeclampsia remains a complex and poorly understood disease. Currently, there are no reliable predictors of preeclampsia for early diagnosis to avoid adverse maternal or perinatal outcomes.

Objective
The objective was to evaluate the efficacy of oxygen saturation ($SpO_2$) as a predictor of adverse maternal outcome in women with preeclampsia.

Methodology
We conducted the cross-sectional study on 182 preeclamptic women selected by random sampling technique. They were divided into two groups on the basis of oxygen saturation: 29 preeclamptic women (Group L) having oxygen saturation 95% or below and 153 women (Group H) having oxygen saturation 96% or above. The groups were statistically compared with respect to age, gestational age, proteinuria, severity of hypertension and developing different adverse effects of preeclampsia. Women with any medical disorders were excluded.

Results
After statistical analysis, it was seen that the women having $SpO_2 \leq 95\%$ (L-Group) had experienced more adverse outcomes. They were more hypertensive and more proteinuric, had higher liver enzyme levels, lower platelet counts, and were more likely to have experienced cardio-respiratory symptoms. Women with adverse outcomes were also more likely to have had therapeutic interventions, including corticosteroids, antihypertensives, and magnesium sulphate.

Conclusion
Women having $SpO_2 \leq 95\%$ (L-Group) had more adverse outcomes in comparison to $SpO_2 \geq 96\%$ (H-Group).

KEYWORDS
Pre-eclampsia, oxygen saturation, predictors
INTRODUCTION
Preeclampsia is a multi-organ syndrome that may be characterized by multiple symptoms, signs, and laboratory assessments. It is generally defined as the presence of hypertension (blood pressure ≥ 140/90 mmHg), proteinuria and may be associated with hyperuricemia, haemolysis, abnormal liver function test, and low platelet count. Preeclampsia remains the second leading global cause of maternal mortality. These deaths mainly result from eclampsia, uncontrolled hypertension or systemic inflammation. Pre-eclampsia and eclampsia are still among the most important causes of maternal mortality, both in high and low-income countries. The combined adverse maternal outcome is defined as the presence of one or more of the following morbidities: hepatic dysfunction, CNS dysfunction, renal dysfunction, cardiopulmonary dysfunction, haematological dysfunction or maternal death. Predictors of adverse maternal outcome included gestational age of onset of preeclampsia, chest pain or dyspnoea, oxygen saturation, platelet count, creatinine and aspartate transaminase concentrations. Measurement of oxygen saturation (SpO₂) by pulse oximetry has been widely used in different clinical situations. Preeclampsia is linked with serious maternal comorbidities, including pulmonary oedema and acute respiratory distress syndrome. Both of these complications may result in decreased blood gas exchange across the alveoli, with consequent hypoxemia. While maternal blood gas testing is important for the diagnosis of hypoxemia, it is expensive, invasive, painful, and slow, whereas SpO₂ is non-invasive, immediately available in rural and low-resource community settings. Respiratory rate, which is the other bedside method for evaluating possible respiratory distress, is poorly assessed and recorded and has many confounding factors. Therefore, SpO₂ may be a method for a screening tool in this patients. The aim of this study was to evaluate the predictive value of SpO₂ in pregnant women admitted to hospital with preeclampsia and to establish risk levels that are more clinically informative.

METHODOLOGY
It was a cross-sectional study performed in the obstetric ward and labour room of the Department of Obstetrics and Gynecology, North Bengal Medical College and Hospital after getting clearance from the institutional ethics committee, North Bengal Medical College from June 2012 to May 2013. Singleton pregnancy, more than 28 weeks of gestation, aged ≥19-35 years with preeclampsia (blood pressure ≥ 140/90 mmHg), and either proteinuria or superimposed preeclampsia (defined as sudden increase in proteinuria or blood pressure or platelet count < 1,00,000 mm⁻³ in women with hypertension and proteinuria before 20 weeks' gestation) were included for the study. Exclusion criteria were patient's refusal, chronic hypertension in pregnancy without any features of preeclampsia, mother admitted in active labour with any component of the combined adverse maternal outcome prior to data collection of predictors, multiple pregnancy, intrauterine fetal death and mother with pre-existing other medical complications such as heart diseases, renal diseases, infectious diseases etc. A total of 182 subjects were included with power of 0.9/90% at 5% significance level. The demographic data was tested by Independent-samples t test (continuous data) or by Pearson Chi-square test, Fisher’s exact test as appropriate (categorical data) and Mann-Whitney test. For descriptive purposes, p value <0.05 was considered statistically significant. All analysis was conducted using Epi-Info and SPSS for Windows (version 12).

Eligible patients were included in the study considering both inclusion and exclusion criteria with informed consent. After history taking and clinical examinations, oxygen saturation assessment by pulse oximetry was performed at admission for 3 minutes (average value) and then every day for monitoring. Data was retrieved daily from the day of admission to the day of delivery and day-1 of puerperium. The value for oxygen saturation used in this study was the lowest SpO₂ value recorded in each patient’s medical record within 48 hours after fulfilling the eligibility criteria or before the occurrence of an adverse outcome, which ever occurred first. The information collected from the study was tabulated and analyzed in details. The results were analysed.

RESULT

Table 1: Distribution of pregnant mothers Parameter.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>*Group L (n = 29)</th>
<th>*Group H (n = 153)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>24.13 ± 0.95</td>
<td>25.60 ± 0.28</td>
<td>0.060(NS)</td>
</tr>
<tr>
<td>Gestational age in weeks</td>
<td>37.65±0.37</td>
<td>37.83±0.13</td>
<td>0.610(NS)</td>
</tr>
<tr>
<td>Systolic blood pressure (mm Hg)</td>
<td>177.51±4.22</td>
<td>155.76±0.84</td>
<td>0.0001(S)</td>
</tr>
<tr>
<td>Diastolic blood pressure (mm Hg)</td>
<td>114.75±3.27</td>
<td>100.16±0.63</td>
<td>0.0003(S)</td>
</tr>
<tr>
<td>Mean arterial blood pressure</td>
<td>136.01±13.52</td>
<td>118.44±0.70</td>
<td>0.0001(S)</td>
</tr>
<tr>
<td>(mm Hg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prophylactic MgSO₄ therapy</td>
<td>22(75.86%)</td>
<td>12(7.84%)</td>
<td>0.001(S)</td>
</tr>
</tbody>
</table>

*Total 182 preeclamptic women were enrolled in the study applying the inclusion and exclusion criteria and were allocated into two groups, (Group L and Group H).

Test done: Mann-Whitney test. A value of p<0.05 are considered as significant.

The mean age was 24.13 ± 0.95 years in group L and 25.60 ± 0.28 years in group H. It was evident that there was no statistically significant difference between two groups (p=0.060). The mean Gestational age in weeks was 37.65±0.37 in group L while group H had a mean Gestational age in weeks of 37.83 ± 0.13. Group L and group H were comparable as per distribution of weight which was statistically not significant (p=0.61). The mean systolic blood pressure was 177.51 ± 4.22 mm of Hg in group L and 155.76 ± 0.84 in group H. It was evident that there was statistically significant difference between two groups (p<0.05). The mean diastolic blood pressure was 114.75±3.27 in group L while group H had a mean diastolic blood pressure of 100.16±0.63. Group L and group H were comparable as per distribution (p=0.0003) which was also significant. The mean
arterial pressure was 136.01 ± 3.52 mm of Hg in group L and 118.44 ± 0.70 in group H & this was also statistically significant difference between these two groups (p<0.05). It was also seen that Group L, SpO₂ is less than or equal to 95% maximum number of cases 22 (75.86%) received prophylactic Mgso₄ & least number of cases 7 (24.14%) not needed prophylactic Mgso₄. This is also significant (p=0.001).

Table 2: Distribution of pregnant mothers according to types of pre-eclampsia in Group L (n=29) and Group H. (n= 153 )

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group L (n = 29)</th>
<th>Group H (n = 153)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild pre-eclampsia</td>
<td>10(34.48%)</td>
<td>142(92.81%)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Severe pre-eclampsia</td>
<td>16(55.17%)</td>
<td>8(5.22%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Superimposed pre-eclampsia</td>
<td>3(10.35%)</td>
<td>3(1.96%)</td>
<td>0.0524</td>
</tr>
</tbody>
</table>

Test done: Fisher’s exact test. A value of p<0.05 are considered as significant.

The maximum numbers of cases 83.51% were of mild preeclampsia of which 142(92.81%) were having SpO₂ more than 95% (in group H) and the rest 10(7.19%) were in the group L which was statistically significant (p=0.0001). There were 24 cases of severe preeclampsia in which 16 were in group L (SpO₂ less than 95%) & 8 were in group H which was also statistically significant (p=0.001). In superimposed PE group there were only 6 cases of which were equally distributed in each group (L&H) which was not-significant statistically (p=0.0524).

Table 3: Distribution of pregnant mothers according to types of pre-eclampsia in Group L (n=29) and Group H. (n=153)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group L (n = 29)</th>
<th>Group H (n = 153)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest pain/Dyspnoea</td>
<td>4(13.79%)</td>
<td>0</td>
<td>0.0005</td>
</tr>
<tr>
<td>Transfusion of blood products</td>
<td>1(3.44%)</td>
<td>0</td>
<td>0.1593</td>
</tr>
<tr>
<td>Abnormal renal function tests</td>
<td>1(3.44%)</td>
<td>0</td>
<td>0.0524</td>
</tr>
<tr>
<td>Abnormal liver function tests</td>
<td>2 (6.89%)</td>
<td>1(0.65%)</td>
<td>0.060</td>
</tr>
<tr>
<td>Pulmonary oedema</td>
<td>2 (6.89%)</td>
<td>0</td>
<td>0.1593</td>
</tr>
<tr>
<td>Heart failure</td>
<td>1(3.44%)</td>
<td>0</td>
<td>0.0524</td>
</tr>
<tr>
<td>Development of eclampsia</td>
<td>1(3.44%)</td>
<td>1(0.65%)</td>
<td>0.2940</td>
</tr>
<tr>
<td>Glasgow coma scale&lt;13</td>
<td>1(3.44%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cerebrovascular accidents</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Retinal detachment</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Placental abruption</td>
<td>1(3.44%)</td>
<td>1(0.65%)</td>
<td>0.2940(NS)</td>
</tr>
<tr>
<td>Maternal death</td>
<td>1(3.44%)</td>
<td>0</td>
<td>0.1593(NS)</td>
</tr>
</tbody>
</table>

* Few women in both groups developed multiple complications simultaneously.

Table 3 shows the different adverse outcomes of pre-eclampsia (mild, severe and superimposed ) in Group L and Group H. It shows that chest pain/dyspnoea (13.79% in Group L vs. 0% in Group H) only this adverse outcome was statistically significant (p<0.05).

On the other hand transfusion of blood product (3.44% in Group L vs. 0% in Group H), abnormal R.F.T (3.44% in Group L vs. 0% in Group H), abnormal L.F.T (6.89% in Group L vs. 0.65% in Group H), pulmonary oedema (6.89% in Group L vs. 0% in Group H), heart failure (3.44% in Group L vs. 0% in Group H), eclampsia (3.44% in Group L vs. 0.65% in Group H), GCS<13 (3.44% in Group L vs. 0% in Group H) and in our study total 182 mothers diagnosed as pre-eclamptic were enrolled after admission in the obstetric ward or labour room of the Department of Obstetrics and Gynecology, North Bengal Medical College and Hospital. All patients were divided into two groups on the basis of oxygen saturation: 29 pre-eclamptic women (Group L) having oxygen saturation 95% or below and 153 women (Group H) having oxygen saturation 96% or above. In our study, maternal adverse outcomes were mainly seen in the L-group. 

DISCUSSION

In our study the mean and median maternal age was 24.13 ± 0.95 age and 23 years in group L while 25.60 ± 0.28 years and 26 years in group H. Here p value is 0.060, statistically insignificant. So, there was no difference in mean maternal age between group L and H. Similarly there was no difference in median maternal age in a study done by Alexandra L. Millman et al. in which median maternal age was 31 yrs in patients developing adverse outcome and median maternal age was 32 yrs in patients having normal outcome where the p value was 0.523 which was statistically insignificant.

The mean and median gestational age was 37.65±0.37 weeks, 38 weeks in group L while 37.83±0.13 weeks and 38 weeks in group H which was also statistically not significant (p=0.61). This finding contradict the result obtained from a study done by Alexandra L. Millman et al. where median gestational age was 34.1 weeks in patients developing adverse outcome and median gestational age was 36.3 weeks in patients having normal outcome which was statistically significant(p<0.001).

According to Peter von Dadelszen et. al gestational age at the time of admission to hospital for pre-eclampsia was found significantly lower and independently predictive, in women destined to develop complications. Disease onset at less than 32 weeks gestation was found to be associated with a 20-times increased risk of maternal mortality.

In our study proteinuria++ (mild to moderate) were seen in 41.37% and 90.19% women in Group L and Group H respectively. The incidence of proteinuria++ (mild to moderate) was significantly higher in Group H than in Group L (p<0.050). Also, Proteinuria+++ (severe) were seen in 31.03% and 9.15% women in Group L and Group H respectively. Proteinuria+++ (severe) were seen in 27.58% and 1%
In our study the mean and median of systolic blood pressure was 177.51 ± 4.22 mm Hg and 170 mm Hg in group L while 155.76 ± 0.84 and 156 in group H respectively which was statistically significant (p<0.05). The mean and median of diastolic blood pressure was 114.75 ± 3.27 and 120 mm Hg in group L while 100.16 ± 0.63 and 98 mm Hg in group H respectively which was statistically significant (p<0.05). The mean and median of mean arterial pressure was 136.01 ± 3.52 and 136.67 mm Hg in group L and 118.44 ± 0.70 and 117.30 mm Hg in group H which was also statistically significant (p<0.05).

In our study (13.79%) 4 patients developed chest pain/ dyspnoea in L group whereas none of the patients having normal outcome which was found to be statistically significant (p<0.001). Peter von Dadelszen also revealed dipstick proteinuria to be higher in women who developed adverse outcomes.

In our study (3.44%) each developed adverse outcome like dyspnoea in L group whereas none of the patients having normal outcome which was found to be statistically significant (p<0.05). One patient (3.44%) among H group and one (0.65%) among L group developed the same. Abnormal LFT were more in group L and these were statistically significant. Women having SpO 2 ≤ 95% (L-Group) were sicker overall and experienced more adverse outcomes in comparison to SpO 2 ≥96% (H-Group).

CONCLUSION
This cross sectional observation study concludes that there was no statistically significant variation in distribution of preeclamptic women regarding maternal age and gestational age between group L and H. The systolic, diastolic blood pressure was more in group L. The mean arterial pressure was also more in group L and these were statistically significant. Women having SpO 2 ≤ 95% (L-Group) were sicker overall and experienced more adverse outcomes.

LIMITATIONS OF THE STUDY
More sample size may be needed for betterment.

ACKNOWLEDGEMENTS
Principal, North Bengal Medical College, West Bengal

RECOMMENDATIONS
We recommend measurement of SpO 2 of all pregnant mothers with pre-eclampsia during admission to detect the mothers with low SpO 2 <95% as they are more prone to develop adverse outcome. They will need great care and monitoring to avert from life threatening complications.

CONFLICT OF INTEREST
None

FINANCIAL DISCLOSURE
None

REFERENCES
