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Original Research Article

PIERS calculator- predicting adverse maternal outcome in preeclampsia

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ABSTRACT

Background: Preeclampsia is a multisystem, highly variable disorder unique to pregnancy. For preeclampsia arising remote from term, supportive and temporizing measures are used to improve perinatal outcome. However, the magnitude of the maternal risks associated with expectant management is unclear. The PIER (preeclampsia integrated estimate of risk) score is a recently designed tool which assesses maternal signs, symptoms, and laboratory findings to generate a valid and reliable algorithm for predicting maternal and perinatal outcome in patients with preeclampsia.
Methods: The present study was a prospective hospital based observational study carried out in Department of Obstetrics and Gynecology, Sultania Zanana Hospital, Gandhi Medical College, Bhopal. A total of 125 women with preeclampsia who fulfilled the inclusion criteria were included in the study. Along with history and examination, all relevant and required investigations were done. The fullPIERS calculator was used to calculate the risk of adverse maternal outcome.
Results: In the present study, 82(65.6%) women were in the low risk category and only 4 (4.87%) had adverse maternal outcome. High risk patients were 6 (4.8%) and amongst them 5 (83.33%) women had adverse maternal outcome (p-value <0.00001). The result was statistically significant in identifying high risk cases in our study.
Conclusions: The fullPIERS calculator gave good results in prediction of adverse maternal outcome according to risk score in women with preeclampsia in our study. It will help the clinicians better manage the patients with preeclampsia specially remote from term and also help health workers in primary and secondary care centres to identify women who are or may become severely ill and who need specialist care and prevent delays in transporting these women to facilities where they can receive appropriate care.

Keywords: Maternal outcome, PIERS calculator, Preeclampsia

INTRODUCTION

Preeclampsia is a multisystem, highly variable disorder unique to pregnancy. Preeclampsia and other hypertensive disorders of pregnancy complicate up to 10% of pregnancies worldwide, constituting one of the greatest causes of maternal and perinatal morbidity and mortality.[1] An estimated 50,000 to 60,000 preeclampsia related deaths occur every year worldwide.[2,3] For every preeclampsia death that occurs, there are many more women who experience near miss maternal morbidity.

Maternal illness may vary from mild asymptomatic hypertension to neurological, renal, and cardiopulmonary compromise. Favorable maternal and perinatal outcomes for women with preeclampsia/eclampsia depend on how soon the condition is identified and how quickly the woman has access to treatment.

Outcomes are less favorable in women living in developing countries, regardless of gestation or severity of clinical presentation.[4] Management of preeclampsia may include increased maternal and fetal surveillance,

blood pressure control, and seizure prophylaxis, but ultimately delivery of the fetus is the only definitive treatment.[5] For preeclampsia arising remote from term, supportive and temporizing measures (expectant management) are used to improve perinatal outcome. However, the magnitude of the maternal risks associated with expectant management is unclear. Concerns around maternal risk have caused experts to hesitate in recommending expectant management either remote from or close to term.

The challenge to clinicians lies in identifying patients who will suffer subsequent adverse outcomes from preeclampsia in order to intervene appropriately while minimizing unnecessary and potentially harmful interventions in patients who do not require them.

The PIER (preeclampsia integrated estimate of risk) score is a recently designed tool which assesses maternal signs, symptoms, and laboratory findings to generate a valid and reliable algorithm for predicting maternal and perinatal outcome in patients with preeclampsia.[6] The fullPIERS calculator includes gestational age at diagnosis, the symptom complex of chest pain and/or dyspnea, oxygen saturation by pulse oximetry, and laboratory estimation of platelet count, serum creatinine, and aspartate transaminase (Figure 1).

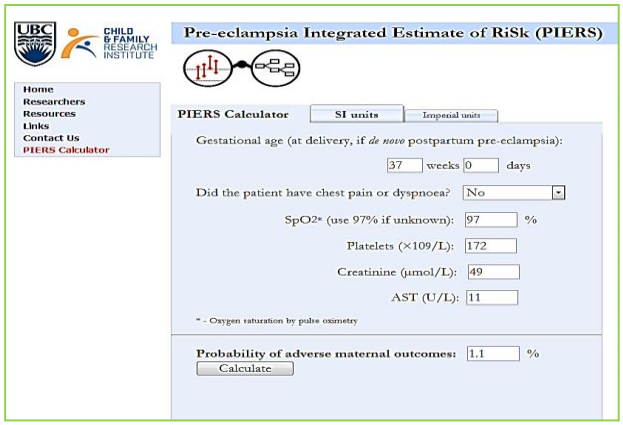

Figure 1: The fullPIERS calculator.

The final fullPIERS equation

$\text{logit}(\pi) = 2.8+(-5.1\times10^{-2;}\times\text{gestational age at eligibility})+1.23\ (\text{chest pain or dyspnea})+(-2.71\times10^{-2}\times\text{creatinine})+(2.07\times10^{-1}\times\text{platelets})+(4.0\times10^{5}\times\text{platelets}^2)+(1.01\times10^{-2}\times\text{aspartate transaminase})+(-3.05\times10^{-6}\times\text{AST}^2)+(2.50\times10^{-4}\times\text{creatinine}\times\text{platelet})+(-6.99\times10^{-5}\times\text{platelet}\times\text{aspartate transaminase})+(-2.56\times10^{-3}\times\text{platelet}\times SpO_2)$.

This tool is meant to aid caregivers in determining maternal risk in the setting of preeclampsia, in order to guide decisions around triage, transport, and treatment, in combination with an assessment of neonatal risk based on gestational age at presentation. The purpose of this study was to evaluate the ability of fullPIERS calculator to predict complications and adverse maternal outcome in preeclampsia.

METHODS

The present study was a prospective hospital based observational study carried out in Department of Obstetrics & Gynecology, Sultania Zanana Hospital, Gandhi Medical College, Bhopal, Madhya Pradesh, India. The data was collected for six months and analysed. A total of 125 women were included in the study. The study was done after approval from the institutional ethical committee.

Inclusion criteria

- Blood pressure ≥140/90 (two readings more than 4 hours apart) after 20 weeks of gestation.
- Urine albumin ≥1+ (heat coagulation and dip stick method)
- Patient with HELLP syndrome even in absence of hypertension or proteinuria
- Superimposed preeclampsia (pre-existing hypertension with accelerated hypertension (systolic blood pressure ≥170 mmHg or diastolic blood pressure ≥120 mmHg) or new onset of proteinuria.

Exclusion criteria

- If the patient experienced an adverse outcome prior to fulfilling the PIERS eligibility criteria or prior to the collection of study predictor variables.
- If they were admitted to hospital in spontaneous labor.

All patients who fulfilled the inclusion criteria and gave consent were enrolled in the study. A detailed history and meticulous clinical examination including general, systemic and obstetric examination was done. The investigation performed included:

- Hematology: Complete blood count, blood sugar, platelet count, coagulation profile (INR, PT, APTT and fibrinogen).
- Hepatic Function Test: Serum bilirubin, SGPT, SGOT, Alkaline phosphatase, LDH, A:G ratio.
- Renal Function Test: Blood urea, serum creatinine, serum electrolytes, uric acid, urine albumin (dipstick as well as 24 hour urine protein).
- Oxygen saturation by pulse oximetry.

The fullPIERS calculator was used to calculate the risk of adverse feto-maternal outcome. Patients with gestation <34 weeks, received 2 doses of betamethasone, 12 mg each, 24 hours apart. Patients with imminent eclampsia received magnesium sulphate and were intensively monitored to prevent maternal and fetal complications.

Antihypertensive drugs like labetalol and nifedepine were used to control hypertension and dose adjusted accordingly to the severity.

Mode of termination of pregnancy depended on the period of gestation, favorability of cervix and urgency of termination. Cervical priming agents like PGE 2 gel or PGE 1 were used if the cervix was unfavorable. Caesarean section was performed for obstetric indications and when urgent termination was indicated as for fetal distress and failure of induction.

Adverse maternal outcome included maternal death, eclampsia (≥1), glasgow coma score <13, stroke or reversible ischemic neurological deficit, transient ischemic attack, cortical blindness or retinal detachment, posterior reversible encephalopathy, positive inotropic support, infusion of a third parenteral antihypertensive drug, myocardial ischemia or infarction, SPO_2 <90%, ≥50% FIO_2 for >1 h, intubation (other than for caesarean section), pulmonary edema, transfusion of any blood product, platelet count $<50\times10^9$ per l, with no transfusion, hepatic dysfunction, hematoma or rupture, acute renal insufficiency (creatinine >150 µmol/l; no pre-existing renal disease), acute renal failure (creatinine >200 µmol/l; pre-existing renal disease), dialysis, placental abruption, severe ascites, bell's palsy.

Adverse Fetal outcome included still birth, small for gestational age, NICU admission (Neonatal Intensive Care Unit) and neonatal death.

Statistical analysis

Statistical analysis was carried out by using χ^2 -test and p value of <0.05 was taken as statistically significant.

RESULTS

During the study period, a total of 383 patients were admitted with preeclampsia. Out of these 125 women fulfilled the study criteria and were included in the study.

Most of the patients (69.6%) were in the age group 20-29 years. 69 (55.2%) were primigravidas. Most women were from rural areas and belonged to low socioeconomic class (Table 1).

Table 1: Demographic profile of the patients.

Age	Number	Parity	Number	Socio-economic class	Number	Area of residence	Number
<20	08 (6.4%)	Primigravida	69 (55.2%)	1	04 (3.2%)	Rural	89 (71.2%)
20-29	87 (69.6%)	Multigravida	36 (28.8%)	2	16 (12.8%)	Urban	36 (28.8%)
30-39	27 (21.6%)	Grandmulti	20 (16%)	3	21 (16.8%)		
>40	03 (2.4%)			4	32 (25.6%)		
				5	52 (41.6%)		

The most common symptom was swelling, which was present in 61 (48.8%) patients. Chest pain and/or dyspnea was present in 24 (19.2%) patients and of these 13 (54.16%) patients had adverse maternal outcomes, forming the largest symptom group with adverse outcome.

Table 2: Maternal symptoms and adverse outcome.

Symptoms	Women with symptom n (%)	Women with adverse outcome n (%)
Swelling	61 (48.8%)	15 (24.59%)
Nausea and vomiting	23 (18.4%)	03 (13%)
Headache	35 (28%)	12 (34.2%)
Epigastric pain	21 (16.8%)	02 (9.5%)
Chest pain and/or dyspnea	24 (19.2%)	13 (54.16%)
Visual disturbance	18 (14.4%)	04 (22.22%)
No symptom	20 (16%)	01 (5.0%)

While some patients had combination of symptoms, 20 (16%) patients had no symptoms (Table 2).Amongst the 27 women with gestational age <34 weeks, 9 (33.33%) women had adverse maternal outcome. There were 98 women with gestational age ≥34 weeks and 12 (12.24%) women had adverse maternal outcome. Our study shows the heterogeneity of preeclampsia and the fact that the timing of disease onset is one important indicator of disease severity and maternal outcome (Table 3).

Table 3: Gestational age and adverse maternal outcome.

Gestational Age	Number of women	Number of women with adverse outcome
<34 week	27	09 (33.33%)
≥34week	98	12 (12.24%)

In our study, SpO_2 successfully predicted adverse maternal outcome. Adverse maternal outcome increased with the decrease in SpO_2 value. 5 of 6 (83.33%) patients with SpO_2 90-93% had adverse maternal outcome. In

patients with SpO_2 >97%, 7 (12.06%) had adverse maternal outcome (The *p*-value is <0 .00001, Table 4).

Table 4: SpO_2 and adverse maternal outcome.

SpO_2	Number of women	Number of women with adverse outcome
90-93%	06 (4.8%)	05 (83.33%)
94-97%	61 (48.8%)	9 (14.9%)
>97%	58 (46.4%)	7 (12.06%)

Table 5: Biochemical parameters and maternal outcome.

Biochemical parameters	Number of women	Number of women with Adverse outcome
Platelet count (lakh/cumm)		
<1.5	45 (36%)	16 (35.5%)
>1.5	80 (64%)	05 (6.2%)
Serum creatinine (mg/dl)		
<1	99 (79.2%)	29 (15.3%)
>1	26 (20.8%)	06 (23.07%)
Serum AST		
≤40U/L	68 (54.4%)	07 (10.2%)
>40U/L	57 (45.6%)	14 (24.56%)

In the study, 45 patients had platelet count <1.5 lakh/cumm. Of these, 16 (35.5%) had adverse maternal outcome while only 5 out of 80 (6.2%) patients with platelet count >1.5 lakh/cumm had adverse outcome. 6 (23.07%) women with serum creatinine >1mg/dl had adverse maternal outcome. 14 (24.56%) women with AST >40U/L had adverse maternal outcome whereas 7(10.2%) with AST ≤40U/L had adverse outcome (Table 5).

Table 6: Distribution of cases according the PIERS score.

Score	Number of women	Number of women with adverse outcome
Low risk (<2.5%)	82 (65.6%)	04 (4.87%)
High (≥30%)	06 (4.8%)	05 (83.33%)

Table 7: PIERS score and adverse maternal outcome in high risk patients.

	PIERS score ≥30%	PIERS score <30%	Total
Adverse outcome present	05 (83.33%)	16 (13.44%)	21
Adverse outcome absent	01(16.66%)	103 (86.5%)	104
Total	06	119	125

In the present study, 21 (16.8%) women experienced adverse maternal outcome. 82 (65.6%) patients were in the low risk category and amongst them only 4 (4.87%) showed adverse maternal outcome. There were 6 (4.8%) high risk patients according to PIERS score and 5 (83.33%) women showed adverse maternal outcome (Table 6 and 7). The rest of the patients had intermediate risk.

DISCUSSION

The present study was undertaken to evaluate the ability of fullPIERS calculator in predicting adverse maternal in patients of preeclampsia within 48 hours of admission. 125 women were included in the study. 21 (16.8%) women experienced adverse maternal outcome.

Of the 21 women with adverse outcome, 3 women required blood and blood products transfusion, 1 woman had pulmonary edema, 1 woman had acute renal failure and required dialysis, 2 women had cerebral vascular accident, 2 women had placental abruption, 2 patients had hepatic dysfunction and another 2 had platelet count <50,000/ml. 2 women required intubation and 1 required ionotropic support. 2 women had eclamptic seizures. There was 1 maternal death. Many patients had more than one adverse outcome parameter.

Maternal symptoms are markers of maternal end-organ damage and play a very important role in patient management. In our study we found 61(48.8%) patients having swelling, making the most common presenting symptom. Adverse maternal outcome was most frequently associated with chest pain/dyspnea. 13 (54.16%) women with dyspnea had adverse outcome. This was followed by headache (34.2%) and blurring of vision (22.22%). Martin et al. in their study found that nausea, vomiting and epigastric pain were predictive of increased maternal morbidity.[7] Cavkaytar et al in their study found that the symptoms of headache, visual changes, epigastric pain and vomiting in a cohort of patients with HELLP were more predictive of adverse maternal outcome than laboratory values.[8] Yen et al analysed data from the PIERS study to predict adverse maternal outcome using clinical symptoms. They found that maternal symptoms of preeclampsia are not independently valid predictors of adverse maternal outcome and caution should be used when making clinical decisions on the basis of symptoms alone in these patients.[9]

There were 27 women in our cohort with gestational age <34weeks of pregnancy. 9 (33.33%) of these had adverse outcome. In contrast 12 of 98 (12.24%) women with gestational age >34weeks had adverse outcome. Gaugler-Senden et al in their study on maternal and perinatal outcome in early onset preeclampsia, found that with an onset before 24 weeks of gestation, there is considerable maternal and perinatal morbidity and mortality. Therefore, expectant management should not be

considered as a routine treatment option in these patients.[10] Ni Y and Cheng W in their study on early and late onset preeclampsia found that early onset preeclampsia is a distinct and more severe clinical entity with earlier gestational age onset and delivery.[11]

In our study 5 out of 6 (83.33%) patients with SpO_2 90-93% had adverse maternal outcome. In a study by Millman et al using the data from the PIERS multicenter study found that $SpO_2 \leq 93\%$ confers a particular risk and successfully predicts adverse maternal outcome.[12]

In our study serum creatinine levels did not differ significantly in patients with and without adverse outcomes. In a study on fullPIERS by Agrawal and Mitra, serum creatinine was found to be an independent predictor of adverse maternal outcome.[13] Serum AST levels of >40U/L were not significantly associated with adverse maternal outcome in our study. In a systematic review of PIERS data, Thangaratinum et al found that the presence of increased liver enzymes was associated with an increased probability of maternal and fetal complications, but normal liver enzyme levels did not rule out disease, as specificity was often higher than sensitivity.[14] Platelet count of <1.5 lakh/cumm was significantly associated with adverse maternal outcome. Similar results were seen in the study by Agrawal and Mitra.[13]

In our study 21 patients in all had adverse maternal outcome. 6 patients belonged to the high risk group according to fullPIERS calculator and 5 of these women had adverse outcome (p-value <0.00001). The result was statistically significant in identifying high risk cases in our study. According to the authors of the fullPIERS, only 1% of women in low risk category and 59% patients in the high risk category had adverse outcome in the study.[15]

There are some limitations to the fullPIERS calculator. Some of these are that the presence of individual symptoms is recorded as yes or no, with no quantification of symptom severity, fetal parameters such as intrauterine growth restriction are not included. Nevertheless the fullPIERS model identifies women at increased risk of adverse outcomes even up to 7 days before complications arise and can thereby modify direct patient care (eg, timing of delivery, place of care), improve the design of clinical trials, and inform biomedical investigations related to pre-eclampsia.

CONCLUSION

The fullPIERS calculator gave good results in prediction of adverse maternal outcome according to risk score in women with preeclampsia in our study. It may be very useful in our country where women are more likely to develop complications of preeclampsia than women in high-income countries and even die of it. It will help the clinicians better manage the patients with preeclampsia specially remote from term and also help health workers in primary and secondary care centers to identify women who are or may become severely ill and who need specialist care and prevent delays in transporting these women to facilities where they can receive appropriate care.

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