



STUDY OF ARTERIAL BLOOD GAS ANALYSIS IN PREECLAMPSIA AND ECLAMPSIA PATIENTS

Dr Preeti Kanal	MS, Assistant Professor, Department of Obstetrics and Gynaecology, Maharani Laxmi Bai Medical College, Jhansi,(U.P).
Dr Sanjaya Sharma	MD, Professor and Head, Department of Obstetrics and Gynaecology, Maharani Laxmi Bai Medical College, Jhansi,(U.P).
Dr Harshita Purwar*	Junior Resident, Department of Obstetrics and Gynaecology, Maharani Laxmi Bai Medical College, Jhansi,(U.P). *Corresponding Author
Dr Sippy Agarwal	MS, Associate Professor, Department of Obstetrics and Gynaecology, Maharani Laxmi Bai Medical College, Jhansi,(U.P).
Dr Rajni Gautam	MS, Assistant Professor, Department of Obstetrics and Gynaecology, Maharani Laxmi Bai Medical College, Jhansi,(U.P).
Dr Chavi Sehgal	MD, Assistant Professor, Department of Anaesthesiology and Critical Care Medicine, Maharani Laxmi Bai Medical College, Jhansi,(U.P).

ABSTRACT

Background: Studies evaluating acid-base imbalances in preeclamptic women are scarce, and to our knowledge no comprehensive analysis of independent factors determining acid/base status has been performed. So we have performed a study to find out the changes in acid base balance in preeclampsia and eclampsia patients.

Aim and Objectives: To analyse acid base balance in the preeclampsia and eclampsia patients. The role of arterial blood gas values and their implications in patient management. To assess whether ABG analysis alters the diagnosis or management or quality of patient care. To analyze the fetal outcome in antenatal preeclamptic and antepartum eclampsia patients through ABG analysis.

Material and Methods: The present study was conducted in the department of Obstetrics & Gynaecology in association with Department of Anesthesia in Maharani Laxmi Bai Medical College, Jhansi. It is a prospective observational cohort study conducted over a period of 18 months on 300 patients.

Result: Most common acid base disorder diagnosed by 0 hr ABG sampling at the time of admission was metabolic acidosis i.e. 21.18% and 73.08% in preeclampsia and eclampsia cases. In our study it was found that, non survivors showed a lower mean pH, bicarbonate, and a higher lactate and base excess than survivors. While in case of pre-eclampsia the incidence of still born and NICU admission was 7.65% and 17.06% respectively. the most common cause of NICU admission within 72 hours of delivery was prematurity i.e. 5.29% and 9.23% followed by IUGR i.e. 4.71% and 6.92% respectively in pre-eclampsia and eclampsia patients.

Conclusion: Regular monitoring of ABG, parameter and observing the changes in acid base parameter can help by providing early warning of deterioration and can judge the effectiveness of therapeutic intervention, thus can predict the good and poor maternal and fetal outcome and duration of stay in intensive care unit.

KEYWORDS : Blood gas analysis, Acid-base balance, neonatal asphyxia

INTRODUCTION

Eclampsia is the onset of seizures (convulsions) in a woman with pre-eclampsia. Pre-eclampsia is a disorder of pregnancy characterized by development of hypertension to the extent of 140/90mmHg or more with proteinuria after the 20th week in a previously normotensive and non proteinuric women. Onset may be before, during, or after delivery. Eclampsia remains a leading cause of maternal and perinatal morbidity and mortality^[1].

Approximately, 1 in 2000 deliveries is complicated by eclampsia in developed countries, whereas incidence in developing countries varies from 1 in 100 to 1 in 1700 cases. (Deley L,1992^[1]) Around 585,000 women die each year of pregnancy related causes, 98% of them in developing countries. (WHO,1998: Ghosh MK^[2], 2008). Preeclampsia is also associated with high rates of preterm delivery, prematurity, intrauterine growth restriction, respiratory distress syndrome, meconium aspiration syndrome, birth asphyxia and perinatal death. The incidence and mortality from eclampsia has fallen dramatically over the past several decades due to better antenatal care, early diagnosis and management; but the associated maternal and fetal morbidity and mortality is still significant.

AIM AND OBJECTIVES

- To analyse acid base balance in the preeclampsia and eclampsia patients.
- Role of arterial blood gas values and their implications to patient management.
- To assess whether ABG analysis alters the diagnosis or management or quality of patient care.
- To analyze the fetal outcome in antenatal preeclamptic and antepartum eclampsia patients through ABG analysis.

MATERIAL AND METHODS

The present study was conducted in the department of Obstetrics & Gynaecology in association with Department of Anesthesia of Maharani Laxmi Bai Medical College, Jhansi. It is a prospective observational cohort study conducted over a period of 18 months on 300 patients.

Selection Criteria:

- All the preeclamptic and eclamptic patients.

INCLUSION CRITERIA:

- All antenatal preeclampsia women
- All antepartum eclamptic women
- All intrapartum eclamptic women
- All postpartum eclamptic women

EXCLUSION CRITERIA

- Patients of known cardiac anomaly
- HIV infected
- Known case of renal disorder
- Chronic hypertensive disorder
- Known case of diabetes mellitus.

Ethical approval for the study was obtained from the ethical committee of the hospital and informed consent was taken from all the patients included in the study .

Analysis of ABG was done by ABG machine (Blood gas electrolyte analyser) model No 5700 (Gem Premier - 3000), S.No. 31551 and 76009.

Study Design- It is a prospective observational cohort study.

Sample Size – Over 300 patients (170 preeclamptic and 130 eclampsia patients) were studied over a period of 18 months

After taking detailed clinical history, clinical examination of the patients and relevant investigations, patients were assigned a case number, and their name, age, sex, occupation socio-economic status were noted.

The data was tabulated and analysed using SPSS (Statistical Package for 11.0 Social Sciences) statistical analysis software version 25.

RESULT

Table 1: Distribution of eclampsia cases according to Antepartum, Intrapartum and Postpartum

Eclampsia cases	N	%
Antepartum	92	70.77%
Intrapartum	05	3.85%
Postpartum	33	25.38%
Total	130	100%

Table 2: Effect on perinatal outcome

Perinatal outcome	Pre-eclampsia cases		Eclampsia cases	
	N	%	N	%
Still born	13	7.65%	20	15.38%
Live born	157	92.35%	77	59.23%
NICU admission within 72 hours of delivery	29	17.06%	35	26.92%

Out of the 97 antepartum and intrapartum eclampsia patients admitted, 15.38% had still born and out of the 77 live born, 26.92% required NICU admission within 72 hours of delivery. While in case of pre-eclampsia the incidence of still born and NICU admission was 7.65% and 17.06% respectively.

Table 5: Arterial blood gas (ABG) at 0 hours outcome

Acid base disorder	Improved conservatively				Ventilatory support							
	Pre-eclampsia cases		Eclampsia cases		Pre-eclampsia cases				Eclampsia cases			
	Survivors		Death		Survivors		Death		Survivors		Death	
	No	%	No	%	No	%	No	%	No	%	No	%
Compensated metabolic acidosis	29	17.06%	60	46.15%	1	0.59%	0	0.00%	13	10.00%	0	0.00%
Decompensated metabolic acidosis	1	0.59%	6	4.62%	5	2.94%	0	0.00%	13	10.00%	3	2.31%
Metabolic alkalosis	2	1.18%	2	1.54%	0	0.00%	0	0.00%	1	0.77%	0	0.00%
Respiratory acidosis	0	0.00%	06	4.625	1	0.59%	1	0.59%	3	2.31%	1	0.77%
Respiratory alkalosis	1	0.59%	04	3.08%	0	0.00%	1	0.59%	4	3.08%	2	1.54%

In our study, out of the total eclampsia patients admitted 60% eclampsia patients improved conservatively with proper ICU monitoring while 30.76% required mechanical ventilation support, out of which 26.15% survived while 4.6% succumbed to death.

Table 3: Cases of NICU admission within 72 hours of delivery

Causes	Pre-eclampsia cases		Eclampsia cases	
	N	%	N	%
Prematurity	09	5.29%	12	9.23%
Respiratory distress syndrome	04	2.35%	04	3.08%
IUGR	08	4.71%	09	6.92%
Birth asphyxia	03	1.76%	05	3.85%
Meconium aspiration syndrome	05	2.94%	06	4.62%

In our study, the most common cause of NICU admission within 72 hours of delivery was prematurity i.e. 5.29% and 9.23% followed by IUGR i.e. 4.71% and 6.92% respectively in pre-eclampsia and eclampsia patients.

Table 4: Type of acid base disorder diagnosed by 0 hours arterial blood gas (ABG)

Acid base disorder	Pre-eclampsia cases		Eclampsia cases	
	N	%	N	%
Metabolic acidosis	36	21.18%	95	73.08%
Compensated	30	17.65%	73	56.15%
Decompensated	06	3.59%	22	16.92%
Metabolic alkalosis	02	1.18%	03	2.31%
Respiratory alkalosis	02	1.18%	10	7.69%
Respiratory acidosis	02	1.18%	10	7.69%
Without any significant changes	128	75.29%	12	9.23%

Most common acid base disorder diagnosed by 0 hr ABG sampling at the time of admission was metabolic acidosis i.e. 21.18% and 73.08% in pre-eclampsia and eclampsia cases.

Out of 170 cases of pre-eclampsia, 42 patients had deranged ABG parameters at 0 hours. Out of these 42, 78.57% improved conservatively with proper ICU monitoring, while 21.42% required ventilatory support and amongst these 42, 2 patients with severe pre-eclampsia succumbed to death

Table 6: comparison of different arterial blood gas (ABG) parameters between survivors and non survivors at 0 hours and 24 hours

Acid base parameters	Survivors		p value	Non survivors		p value
	Pre-eclampsia cases	Eclampsia cases		Pre-eclampsia cases	Eclampsia cases	
	[Mean±SD]	[Mean±SD]		[Mean±SD]	[Mean±SD]	
Ph (0 hours)	7.28±0.075	7.25±0.090	0.0001 (S)	7.35±0.262	7.28±0.173	0.0088 (S)
Ph (24 hours)	7.31±0.061	7.32±0.068	0.1818 (NS)	7.28±0.375	7.22±0.238	0.1118 (NS)
PCO2 (0 hours)	30.33±8.885	29.91±8.868	0.6850 (NS)	46.00±25.456	30.83±13.33	0.0001 (S)
PCO2 (24 hours)	31.54±7.692	31.73±6.487	0.8209 (NS)	50.50±36.348	30.33±17.985	0.0001 (S)
HCO3 (0 hours)	14.84±4.347	11.82±2.598	0.0001 (S)	21.75±10.536	13.80±7.110	0.0001 (S)
HCO3 (24 hours)	16.18±4.981	17.37±3.472	0.0001(S)	20.70±13.453	12.15±8.776	0.0001 (S)
Lactate (0 hours)	4.52±2.077	5.78±1.979	0.0001 (S)	2.50±0.707	5.63±3.146	0.0001 (S)
Lactate (24 hours)	2.59±1.435	3.04±1.292	0.0001 (S)	4.00±1.697	9.03±4.229	0.0001 (S)
BE (0 hours)	-7.25±5.723	-10.06±6.163	0.0001 (S)	0.00±16.971	-10.17±9.453	0.0001 (S)
BE (24 hours)	-1.24±1.182	-3.72±4.150	0.0001 (S)	-4.00±28.284	-16.50±14.195	0.0001 (S)

In our study it was found that, non survivors showed a lower mean pH, bicarbonate, and a higher lactate and base excess than survivors.

Table 7: Comparison of different arterial blood gas (ABG) parameters at 0 hours and 24 hours in survivors requiring ICU care

Acid base parameters	Survivors		p value
	Pre-eclampsia cases	Eclampsia cases	
	Mean±SD	Mean±SD	
Ph (0 hours)	7.20±0.024	7.260±0.142	0.0001 (S)
Ph (24 hours)	7.23±0.034	7.29±0.110	0.0001 (S)
PCO2 (0 hours)	31.33±17.963	28.39±11.286	0.1031 (NS)
PCO2 (24 hours)	33.67±17.840	29.50±9.330	0.0160 (S)
HCO3 (0 hours)	12.85±7.722	12.20±5.323	0.4118 (NS)

HCO ₃ (24 hours)	17.37±7.197	15.41±4.345	0.0001 (S)
Lactate (0 hours)	6.93±2.090	8.45±2.171	0.0013 (NS)
Lactate (24 hours)	2.57±1.654	3.15±1.411	0.0001 (S)
BE (0 hours)	-10.50±9.711	-13.48±8.778	0.0064 (S)
BE (24 hours)	-5.45±11.657	-8.96±6.330	0.0021 (S)

Table 8: Maternal mortality

Mortality	Pre-eclampsia cases		Eclampsia cases	
	Number of patients	Percentage	Number of patients	Percentage
HELLP syndrome with DIC	00	0.00%	02	1.54%
Cerebrovascular accident	01	0.588%	01	0.77%
Acute renal failure	00	0.00%	01	0.77%
Pulmonary edema	01	0.588%	01	0.77%
Aspiration pneumonia	00	0.00%	01	0.77%
Total	02	1.176%	06	4.62%

In our study, amongst all the cases of PIH i.e. 170 (mild and severe pre-eclampsia included only in our study), maternal mortality was reported to be 1.17% (patients belonged to severe pre-eclampsia category). While, in eclampsia cases maternal mortality was 4.62%.

DISCUSSION

Critical care is a bonafide part of obstetric practice. A critically ill pre-eclamptic and eclamptic obstetric patient is the one who needs intensive monitoring, therapy or life support system.

There are different modalities and investigation for monitoring the critically ill patients in intensive care unit. One of the important investigation is arterial blood gas analysis.

Our study is aimed to identify changes in arterial blood gas values in pre-eclamptic and eclampsia patients for timely management and intervention which will help in decreasing both perinatal mortality and morbidity.

Obstetrics admission rate to maternal ICU was 0.9% and 3.4% in a study done by Mabie et al^[3] & lewinsohn et al^[4] respectively.

Distribution of eclampsia cases according to antepartum, intrapartum and postpartum status on admission-

In our study, out of the 130 eclampsia patients admitted, 70.77% were antepartum, followed by 25.38% postpartum and 3.85% developed fits during delivery (intrapartum).

Effect on perinatal outcome:

Fits before or during delivery put fetus at an increased risk fetal hypoxia, thereby, decreasing their survival. Out of the 97 antepartum and intrapartum eclampsia patients admitted, 15.38% had still born and out of the 77 live born, 26.92% required NICU admission within 72 hours of delivery. While in case of pre-eclampsia patients, due to early arrival at health care facility and better management the incidence of still born and NICU admission was less in comparison to eclampsia cases i.e. 7.65% and 17.06% respectively.

Causes of NICU admissions within 72 hours of delivery:

In our study, the most common cause of NICU admission within 72 hours of delivery was prematurity i.e. 5.29% and 9.23% followed by IUGR i.e. 4.71% and 6.92% respectively in pre-eclampsia and eclampsia patients.

Other notable causes were Respiratory Distress Syndrome (2.35%, 3.08%); Birth Asphyxia (1.76%, 3.85%) and Meconium Aspiration Syndrome (2.94%, 4.62%) respectively in pre-eclampsia and eclampsia groups.

Type of Acid Base disorder diagnosed by '0 hour' ABG:

Most common acid base disorder diagnosed by 0 hr ABG sampling at the time of admission was metabolic acidosis i.e. 21.18% and 73.08% in pre-eclampsia and eclampsia cases.

In these pre-eclampsia patients, 17.65% had decompensated metabolic acidosis while 3.59% were diagnosed with decompensated metabolic acidosis. While in eclampsia cases, numbers went higher, 56.15% and 16.92% were diagnosed with compensated and decompensated

metabolic acidosis respectively. Metabolic acidosis is mainly found in patients with hypertensive disorders, hypovolemic shock due to haemorrhages, septicemia.

Metabolic alkalosis was seen only in 1.18% and 2.31% pre-eclampsia and eclampsia patients respectively, seen mainly in those presenting with excessive vomiting (excess H⁺ loss), with inappropriate diuretic use, with multiple blood transfusions, or where renal bicarbonate excretion fails (as in cases of hypokalemia and hypochloremia)

Respiratory acidosis was seen in 1.18% and 7.69% of pre-eclampsia and eclampsia patients respectively. Respiratory acidosis was found at 0 hour ABG mainly in those patients complicated by development of ARDS, pulmonary edema, aspiration pneumonitis and pneumonitis (particularly due to extra complications put on by SARS-COV2).

Respiratory alkalosis was seen in 1.18% and 7.69% of pre-eclampsia and eclampsia patients respectively. Patients with cerebrovascular accident, neurological injury, in patients with severe anemia, with pulmonary embolism showed respiratory alkalosis at 0 hour ABG.

Out of 170 pre-eclampsia patients, 128 i.e. 75.29% and out of 130 eclampsia patients 12 i.e. 9.23% did not show any significant changes in arterial blood gas values.

Arterial blood gas at 0 hours outcome:

In our study, out of the total eclampsia patients admitted 60% eclampsia patients improved conservatively with proper ICU monitoring without any ventilatory support. While 30.76% of eclampsia patients required mechanical ventilation support, out of which 26.15% survived while 4.6% succumbed to death. Amongst the patients who died, 2.31% showed decompensated metabolic acidosis at 0 hour ABG, 1.54% were diagnosed with respiratory alkalosis and 0.77% with respiratory acidosis at 0 hour ABG.

Out of 170 cases of pre-eclampsia, 42 patients had deranged ABG parameters at 0 hours. Out of these 42, 78.57% improved conservatively with proper ICU monitoring, while 21.42% required ventilatory support and amongst these 42, 2 patients with severe pre-eclampsia succumbed to death.

Comparison of ABG at 0 hour and 24 hours between survivors and non survivors:

ABG analysis was done at '0' hour of admission and repeated after 24 hours while giving treatment and the results were compared between survivors and non survivors. The results were found statistically significant ($p < 0.001$) for most of the parameters. Non survivors showed a lower mean pH, bicarbonate, and a higher lactate and base excess than survivors.

Our study showed higher incidence of lactic acidosis among non survivors eclampsia cases with higher mean value and increase in lactate level in non survivors (from 5.63±3.146 to 9.03±4.229) whereas in survivors mean lactate level was found to be lower as compared to non survivor and it decreased from 5.78±1.979 to 3.04±1.292. As compared to study done by Gnnerson et al^[5] (2006) out of 851 patients, 64% had metabolic acidosis and 45% had mortality. The mortality rate was highest for lactic acidosis (56%) among all causes. Also when compared with Albright et al^[6] (201) USA studies showed lactic acidosis as a prognostic indicator for increase in maternal morbidity, admission to ICU ($p < 0.01$) or acute monitoring unit ($p < 0.01$) and longer hospital stay ($p < 0.01$). Thus indicating lactate may be a factor useful in prognostification.

Maternal Outcome:

In pre-eclampsia cases, maternal mortality was reported to be 1.17%, attributable to cerebrovascular accident and pulmonary oedema. These patients showed respiratory alkalosis and respiratory acidosis respectively at 0 hour ABG.

In eclampsia cases, maternal mortality was reported to be 4.61%. causes of maternal death in eclampsia cases were due to HELLP Syndrome with DIC (2 patients died), while 1 patient died each of Cerebrovascular Accident, Acute Renal Failure, Pulmonary edema and Aspiration Pneumonitis.

CONCLUSION

With present study, we concluded that Eclampsia is still one of the most important obstetric emergencies which has a significant role in maternal and perinatal outcome. ABG analysis is an important prognostic tool while monitoring critically ill pre-eclampsia and eclampsia obstetric patients in intensive care unit. ABG determination plays an important role in diagnosing derangement in acid base balance, oxygenation and ventilation. Patients with lower pH, higher lactate or lower bicarbonates at presentation are considered as high risk patients and should be shifted to ICU for intensive monitoring to avoid maternal mortality.

Regular monitoring of ABG, parameter and observing the changes in parameter can help by providing early warning of deterioration and can judge the effectiveness of therapeutic intervention, thus can predict the good and poor maternal and fetal outcome and duration of stay in intensive care unit.

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