

Acid-Base Disturbances in Sick Neonates - An Observational Study in a Tertiary Care Centre

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Abstract:

Introduction: The human organs and tissues function under a tightly controlled pH in the range of 7.35 to 7.45. Depending on the degree of deviation of pH outside this narrow range, several homeostatic responses are activated in an effort to restore normal acid base status.

Objective: To study the acid - base disturbances in sick neonates admitted in NICU of Niloufer hospital, Hyderabad.

Materials And Methods: Hundred neonates (from first hour to one month of age) attending pediatric emergency services with various ailments. Arterial blood gas (ABG) analysis was estimated in these neonates. Ethical committee approval was taken.

Results: Metabolic acidosis was the most common acid base disorder. 57 sick neonates had metabolic acidosis. Significant correlation was observed between metabolic acidosis and pathological conditions like birth asphyxia and sepsis.

Conclusion: Metabolic acidosis is the most common disorder in critically ill neonate. If we do early intervention in correction of acid base abnormality, the outcome is likely to get improved in sick neonates.

Key Words: Acid-base disorders, ABG analysis, birth asphyxia, metabolic acidosis, sepsis

I. Introduction

Understanding of acid-base dysfunction in various pathological conditions is an asset to a pediatrician in efficient treatment of critically ill children¹. Acid-base disorders reflect the seriousness of the underlying disease and are responsible for morbidity and mortality in sick children². Marked structural and functional differences occur in children in comparison to adults, for example children have narrow distal airways, so atelectasis develops quickly resulting in rapid-onset of hypercarbia and hypoxia. In addition, they have reactive vascular beds to maintain their blood pressure until late, so one cannot rely on hypotension to diagnose shock as in adults³. In children the respiratory center is immature and respiration is less efficient, therefore hypoxia and hypercarbia lead to decreased respiratory drive.

Disorders of acid-base balance can create complications in many disease states, and occasionally the abnormality maybe so severe so as to become a life-threatening risk factor⁴. Several factors impact the prognosis of patients with acid base disturbances like severity of acideamia, acuity and duration of the derangement, functional status of the major organs especially lungs and kidneys, and last but not the least the underlying cause. Initially reactions by chemical buffers will attempt to neutralize the derangement, followed by ventilator adjustments by the lungs and finally alterations in acid excretion by the kidneys. Hence a thorough understanding of acid-base balance is mandatory for any physician and intensivist⁴.

The utilization of an arterial blood gas (ABG) analysis becomes necessary in view of the following advantages:

- Aids in establishing diagnosis.
- Guides treatment plan.
- Aids in ventilator management
- Improvement in acid/base management which in turn allows for optimal function of medications
- Acid-base status may alter electrolyte levels that may be critical to a patient's status⁴

Identification of the underlying cause or causes of the acid base disorder at hand may be the final step in the management of the patients but it also plays an important role both in prevention of worsening of the derangement and other complications, as well as in the determination of the patient's overall prognosis⁵.

II. Aims And Objectives

AIM OF THE STUDY: The main objective of our study was to identify the Acid Base disturbances in sick Neonates admitted in our Neonatal Intensive Care Unit at our Niloufer Hospital. This hospital is a tertiary care centre for both pediatric and neonatal cases. The hospital also has a Level III neonatal care for high risk cases.

III. Materials And Methods

VOLUNTEERS: One Hundred neonates from birth to one month old, attending pediatric emergency services with various ailments were included in this study. Blood Gas analysis was estimated in these sick neonates who require ABG report as part of the management by pediatrician. Cases were selected unbiased in our study.

SOURCE OF RECRUITMENT: Neonatal intensive care unit of Niloufer Hospital, Hyderabad.

STUDY PERIOD: Three months MAY to AUGUST 2013.

EXCLUSION CRITERIA: Infants above 1 month of age.

CONTROLS: No control group was planned, as it will be unethical to procure arterial samples of healthy neonates.

METHOD: Detailed history was noted in every case. Detailed examination was done to see for gestational age, respiratory distress, cardiac disease, hypotension, pallor etc. Protocol was followed strictly in all the cases before the sample collection. Ideal artery for sampling in newborn is ulnar or radial artery. For most of the cases in our study either of these two arteries was punctured for ABG analysis. However in some cases arterial blood sample was drawn from the umbilical arterial line. It was ensured that there was a free flow of blood and no dead space was present during the sampling. Care was taken that there were no air bubbles in the sample collected. Samples are collected in pre-heparinised glass syringes only, as plastic syringes are permeable to air. Heparin that was used was of lower strength (1000units per ml) instead of higher strength (5000units per ml) because heparin in higher strengths can lead to changes in the ph of collected sample. The sample was processed as early as possible preferably within 30 minutes of collection. Even during this time the sample was stored in a cool container having slush of ice but not cubes of ice. The samples were thoroughly mixed by rotating the syringe between the hands and swirling it gently up and down before processing them in the analyzer machine. Other laboratory investigations like blood counts, blood cultures, metabolic profile, serum electrolytes, 2D-Echo etc were done.

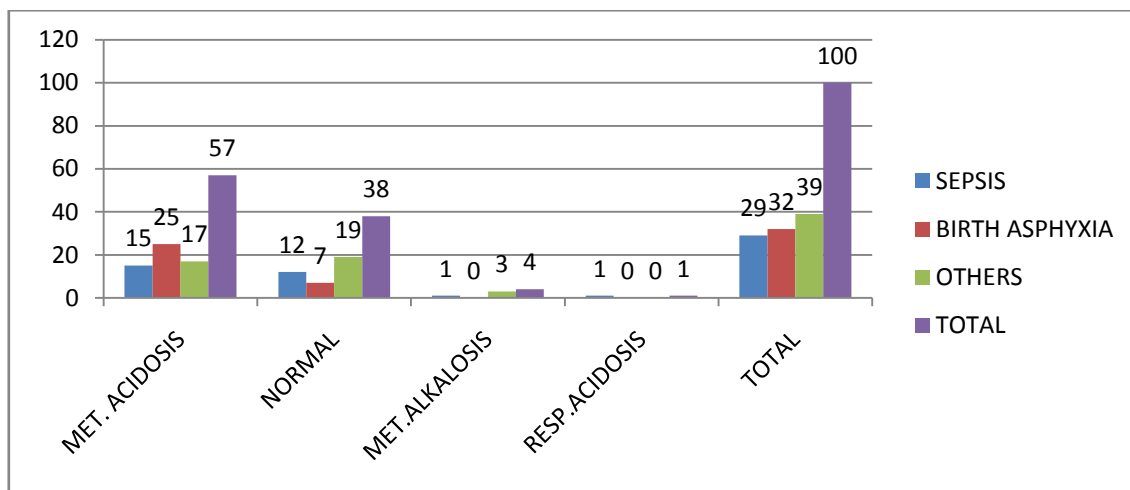
IV. Results

This study was carried out over a period of 3 months. The median age of patients was 2 days. The Male to Female ratio was 1.38:1 (58 males to 42 females). There was no correlation between either age or sex and severity of Acid Base disturbances in this study. Table no: 1 shows the gender wise distribution of the cases in our study.

TABLE NO: 1 GENDER WISE ACID BASE DISTURBANCES

	FREQUENCY	PERCENTAGE	CUMULATIVE PERCENT
FEMALE	42	42	42
MALE	58	58	100

CHART NO: 1



The above chart (chart no:1) and the Table no: 2 gives a comparative observation of acid base parameters and major diagnosed pathological conditions among neonates (birth asphyxia, sepsis etc). Table 3 shows that a significant correlation was found between outcome and various diagnosed pathological conditions where the P value was found to be less than 0.05. Metabolic acidosis was found in 57 sick neonates. Birth asphyxia (32cases) followed by sepsis (29 cases) were associated major pathologic conditions. Decrease in PH was observed in 40 of such cases.

38 neonates admitted in the emergency area had normal arterial blood gas parameters while 4 neonates had metabolic alkalosis. Only one case developed respiratory acidosis in this study.

TABLE NO: 2

	Preterm	Term	TOTAL
METABOLIC ACIDOSIS	10	47	57
NORMAL	8	30	38
METABOLIC ALKALOSIS	0	4	4
RESPIRATORY ACIDOSIS	0	1	1
TOTAL	18	82	100

TABLE NO: 3

	SEPSIS	BIRTH ASPHYXIA	OTHERS	TOTAL	CHI SQUARE VALUE (12.413)	P VALUE (0.030(<0.05))
METABOLIC ACIDOSIS	15	25	17	57		
NORMAL	12	7	19	38		
METABOLIC ALKALOSIS	1	0	3	4		
RESPIRATORY ACIDOSIS	1	0	0	1		
TOTAL	29	32	39	100		

The Table No 4 shows the number of cases admitted with different pathological conditions that were studied for the acid base disorders.

TABLE NO: 4

DIAGNOSIS	FREQUENCY	PERCENT	CUMULATIVE PERCENT
Amniotic fluid gastritis	4	4	4
Birth asphyxia	32	32	36
Diaphragmatic Hernia	3	3	39
DIC	3	3	42
HDN	11	11	53
I.U.PNEUMONIA	2	2	55
P.DUCTUS ARTERIOSUS	1	1	56
PARALYTIC ILEUS	1	1	57
RDS	13	13	70
SEPSIS	29	29	99
URTI	1	1	100
TOTAL	100	100	

V. Discussion

The study was done on neonates suffering with different pathological conditions, admitted in the neonatal emergency services. Male babies were more in our study though this gender difference had no significant correlation with the purpose of this study. However it only signified an epidemiological pattern in the region. Similar inference was made in Lekhwani et al study¹. The acid base status in major pathological disorders such as birth asphyxia, bronchopneumonia, sepsis, HDN, amniotic fluid gastritis etc occurring in infants and neonates is discussed as follows. In our study, Birth Asphyxia constituted major cause of admission among sick neonates. Sepsis is the second most common cause for admission in sick neonates. Metabolic acidosis is the predominant acid base abnormality which was established in this study.

In this study out of 32 neonatal cases admitted for birth asphyxia, 25 neonates had metabolic acidosis. Similarly 15 out of 29 neonates admitted for sepsis have shown a picture of metabolic acidosis on ABG analysis. Similar results were also seen in the studies made by Lekhwani et al¹.

17 neonates admitted with other conditions like bronchopneumonia, cardiac diseases and Hyaline membrane disease, etc were also reported to have metabolic acidosis. All the three cases of congenital diaphragmatic hernias had metabolic acidosis in this study. Among the 13 neonates which were admitted for respiratory distress syndrome, only 5 cases had metabolic acidosis and the remaining 8 neonates had normal ABG analysis. Out of the 4 neonates which developed metabolic alkalosis, 2 neonates had amniotic fluid gastritis, one neonate had paralytic ileus and one neonate suffered with sepsis. Only one case in our study which was admitted with sepsis had respiratory acidosis.

Thus in our study it was noted that the major acid base disorder was the metabolic acidosis which was statistically significant. The present study shows that ABG measurement may give important prognostic information and early warning signals.

VI. Conclusion

Acid base disorders need to be anticipated in all the critically ill neonates. Vigorous monitoring of the acid base status will help in early recognition of the underlying cause and also help in prevention of a life threatening state. Our study on the acid base disorders in sick neonates has given valuable information in relation to various pathological conditions especially with common conditions like birth asphyxia and sepsis. Metabolic acidosis was the most common acid base disorder in our study.

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