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RESEARCH ARTICLE

ARTERIAL BLOOD GAS ANALYSIS PROFILE IN EXTREMELY PREMATURE NEONATES ADMITTED IN A TERTIARY CARE NEONATAL INTENSIVE CARE UNIT

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Abstract

Early studies suggest an association of abnormal carbon dioxide (PCO_2) or oxygen (PO_2) levels with adverse inpatient outcomes in very preterm babies. Recent resuscitation practice changes, such as targeted oxygen therapy, end-expiratory pressure, and rescue surfactant may influence these associations. The aim of this study is to assess the range of the initial partial pressures of PCO_2 and PO_2 in extremely preterm neonates (<1 kg) after birth and their correlation to inpatient neonatal outcomes.

Introduction:-

Arterial blood gases (ABG's) is a blood test which is used to give an indication of ventilation, gas exchange and acid-base status and is taken from an arterial blood supply[1.] It gives us information about the activity in both the respiratory system and the 'metabolic' system.

They are commonly used to identify acid/base disorders, identify gas exchange problems, and monitor the effects of oxygen therapy [2]. The purpose of obtaining blood gases in a neonate is to determine if the baby is adequately ventilating and/or perfusing.

Blood gas measurements are as important for ill newborns as for other critically ill patients, but rapidly changing physiology, difficult access to arterial and mixed venous sampling sites and small blood volumes present unique challenges. This paper discusses considerations for interpretation of blood gases in the new-born period.

Premature neonates frequently have inadequate respiratory function and require oxygen therapy during the weeks after birth. Since they are also exquisitely vulnerable to oxygen toxicity, careful monitoring of oxygen status is an essential component of neonatal intensive care[3] . Neonatal respiratory distress syndrome (RDS) also known as hyaline membrane disease occurs almost exclusively occurs in premature infants is a breathing disorder due to deficiency of surfactant in immature lungs leading cause of mortality among preterm infants.

Newborn respiratory distress occurs in about 7% of deliveries. The wide variation of reported RDS rates (1.2–76%), with RDS-related mortality rates up to 52%, hampers efforts to determine which interventions would improve outcomes[4] .In addition; surfactant replacement reduced the incidence of pneumothorax, pulmonary interstitial emphysema, and the combined outcome of death or BPD, compared with no surfactant[5].

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But the study regarding the arterial blood gas analysis and correlation with the surfactant use is not done prior, so this study aims at finding the correlation of ABG analysis with the surfactant use and outcome of the ELBW babies in tertiary care hospital.

Aims and objectives of the study:-

Research question?

1. What is the early blood gas profile of extremely low birth weight neonate?
2. What is the correlation of hypoxemia on arterial blood gas with surfactant uses in ELBW infants?

Materials and Methods:-

Arterial blood collection in extremely low birth weight neonate is done under all aseptic precautions, 1 ml sample in heparinised syringe by 24-gauge needle in radial artery after performing Allen test to ensure collateral blood supply. Sample processed in ABG analyser machine.

After analyzing ABG and clinical condition of the patient decision regarding surfactant therapy taken.

Surfactant given by INSURE/ LISA technique, Days of mechanical ventilation and outcome observed for ELBW baby admitted in tertiary care hospital.

Regarding these reports of ABG, surfactant therapy, and days of mechanical intubation and outcome are collected retrospectively from record section patients' files after ethical committee consent.

All the data analysed for withdrawing statistical analysis.

Results:-

The mean gestational age from the descriptive statistics of demographic parameters was mean 29 weeks with standard deviation of 2 weeks.

Table 1:- Descriptive Statistics of Demographic Parameters.

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Gestational Age(weeks)	42	12.00	25.00	37.00	29.0714	2.68140
Weight (Grams)	42	340.00	660.00	1000.00	877.619	113.06828

Average gestational age was 29.1±2.7. Most preterm case enrolled was of 25 weeks gestation.
The mean weight of the cohort was 877 grams with minimum weight recorded of 660 grams with the standard deviation of 113 grams.
Descriptive statistics of arterial blood gas parameter of the cohort was recorded and these were as in table no 2.

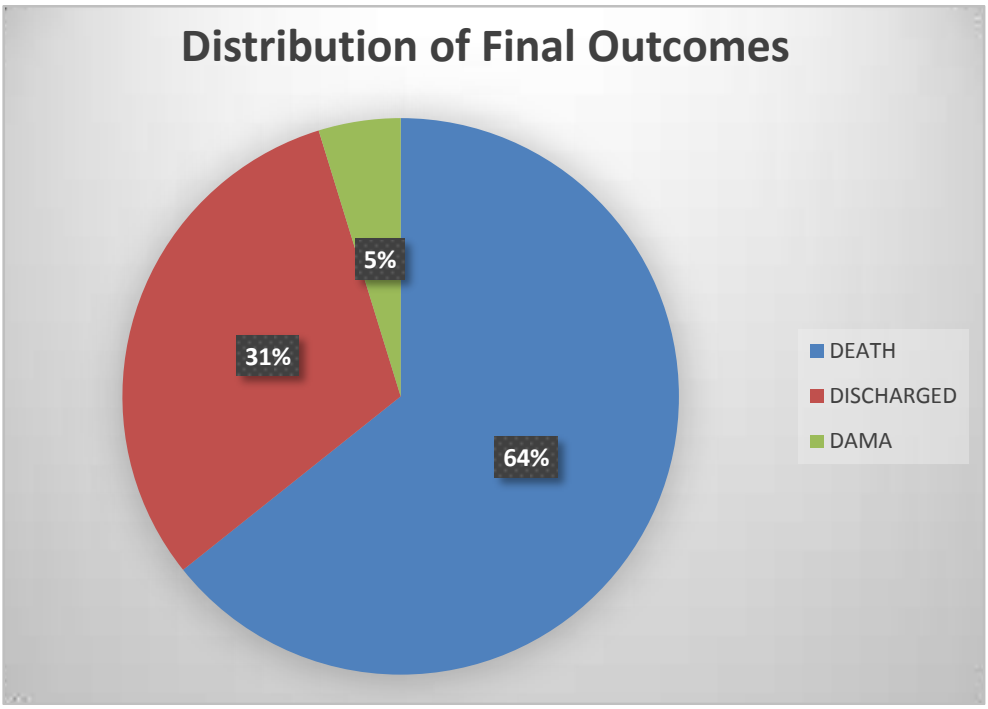
Table 2:- Descriptive Statistics of Electrolyte parameters.

Parameters	N	Range	Minimum	Maximum	Mean	Std. Deviation
PH	42	.43	7.01	7.44	7.2628	.10039
PO2	42	125.70	.00	125.70	58.1619	26.82029
PCO2	42	80.10	.00	80.10	33.9429	11.80162
BE	42	15.10	-18.00	-2.90	-9.4524	3.29340
HCO3	42	22.40	11.60	34.00	18.8262	4.53001

Average PH was 7. 26±0.1 with maximum value recorded of 7.44. Average PO2 was 58.2 ±26.8 whereas average PCO2 was 33.9 ±11.8. Average BE was -9.45 ±3.3 while average HCO3 value was 18.8 ±4.5.

The mean PH recorded in cohort was 7.26 mean PaO2 58 mm Hg , PCO2 was 33 mm Hg, BE was -9, and HCO3 of 18.8.The minimum PH recorded was 7.01, with standard deviation 0.1 amongst the cohort. Our cohort the hospital stay distribution was analysed 64% babies was discharged or died within first two weeks.

We have analysed the evaluated risk factor, mortality was outcome ofr ELBW babies with gestational age, weight and arterial blood gas parameters there was significant ass of PH recorded on admission with mortality, base excess and bicarbonate was add on correlation risk factors with mortality in our cohort of ELBW study.



Distribution of final outcome: The PH, base excess and bicarbonate value in ABG had highly significant mean difference by independent sample t test.

Table 6:- Correlation of various Risk factors with Mortality.

Outcomes		N	Mean	Std. Deviation	Std. Error Mean	P
Gestational Age(weeks)	Death	27	29.1	2.4	0.5	0.909
	Survival	15	29.0	3.3	0.8	
Weight (Grams)	Death	27	860.4	119.0	22.9	0.188
	Survival	15	908.7	97.7	25.2	
PH	Death	27	7.2	0.1	0.0	0.001**
	Survival	15	7.3	0.1	0.0	
PO2	Death	27	62.9	21.0	4.0	0.127
	Survival	15	49.7	34.2	8.8	
PCO2	Death	27	35.1	11.5	2.2	0.395
	Survival	15	31.8	12.5	3.2	
BE	Death	27	-10.6	3.4	0.6	0.001**
	Survival	15	-7.3	1.8	0.5	
HCO3	Death	27	17.2	3.6	0.7	0.001**
	Survival	15	21.7	4.7	1.2	

Average PH in patients who survived was (7.2±0.1) significantly lower compared to average PH in mortality group. (7.3±0.1). The mean difference was highly significant. (p=0.001).

Average BE in patients who survived was (-7.3±1.8) was significantly higher in value compared to average PH in mortality group. (-10.6 ±3.4). The mean difference was highly significant. (p=0.001).

Average PH in patients who survived was (7.2±0.1) significantly higher compared to average PH in mortality group. (7.3±0.1). The mean difference was highly significant. (p=0.001)

The average saturation before and after instillation of surfactant therapy was recorded and the saturation of babies improved dramatically after INSURE\LISA technique with the p value of <.0001.

Average PO2 was significantly lower among the patient group who received surfactants (n=36) (54.8±25.8) when compared to average PO2 in patients group who did not receive surfactants (n=6) (78.3±25.6) (p=0.04).

The mean values of rest of the electrolyte parameters were comparable between groups based on surfactant use.

Table 9:- Distribution of outcomes stratified by Surfactant use.

Surfactant * Outcomes Cross tabulation:						P
			Outcomes		Total	
			Survival	Death		
Surfactant	Not received	Number	2	4	6	0.639
		%	13.3%	14.8%	14.3%	
	Received	Number	13	23	36	
		%	86.7%	85.2%	85.7%	
Total		Number	15	27	42	
		%	100.0%	100.0%	100.0%	

Difference is not significant using Chi square test.

The final outcomes i.e. death and survival were distributed comparably between children who received surfactants and those who did not. (p>0.05)

Statistical analysis:
This study was retrospective in nature and data was retrieved from Medical records of NICU admitted children from the period of September to march. The data was entered in Microsoft Excel 2016. Statistical analysis was done on IBM SPSS STATISTICS VERSION 20.

Categorical variables were taken in the form of frequencies and percentages. Distribution was represented by pie charts or bar graphs. Continuous variables were expressed in the descriptive statistics tables as means, standard deviation and range.

The ccategorical variables in the two groups were compared using cross tabulation design and Chi square T test. The continuous variables were compared by considering mean and standard deviation and using independent sample T test.

Bivariate Correlations between variables were calculated using Pearson's correlation coefficient value < 0.05 was considered significant and p value < 0.01 was considered highly significant.

Discussion:-

Our study observed arterial blood gases in cohort of very preterm baby during the first 24 hrs after birth. By using current resuscitation and stabilization technique that monitor the and control oxygen in mechanical ventilation we found a low values of oxygen in ABG and high pco2 values both of which is implicated in respiratory tissue injury.

Respiratory distress syndrome in ELBW babies is implicated with favorable outcomes due to the advancement in lab technique and easy accessibility to ABG technique[6]. We were unable to demonstrate association of abnormal blood gas with impatient morbidity or death

These are limited data on hypoxia and hypercarbia values in preterm infants during first 24 hours. In a study of Tracy MB it was reported that 26 % of preterm infants with less than 34 weeks gestation had hypocarbia 73 % had normocarbia 22% and none has hypercarbia at NICU admission[7].

In extreme preterm, 38 % hypoxia and 20 % were both hypocarbia and hyperoxia in a study by Kong et al. Median cord pCO2 values were 15 mm hg with wide range of pCO2 values after NICU admission. The optimal pCO2 goal in ELBW preterm infants has documented both hypocarbia and hyper carbia which had been associated with

respiratory distress syndrome and severe intraventricular hemorrhage, periventricular leukomalacia, and bronchopulmonary dysplasia[8].

Arterial blood gas abnormalities cause changes in cerebral perfusion, perfusion which are associated with brain injury however this mechanism may be arrested during first postnatal day with cerebral blood flow reactivity to pCO2 being re-established by 2 or 3 rd. post-natal day after surfactant use in mechanical ventilation[9].

In particular infants with low PH were significantly more likely to be intubated and received surfactant compared to those with normal PH hence we speculate that significant reduction in hospital stay and severity of respiratory distress can be avoided with increased use of surfactant followed by CPAP or elective intubation after surfactant administration.

We observed hyperoxia in standard deviation of 58.2 %-+_26.8 and normoxia in 42.8%.This is of clinical relevance because oxygen administration at birth increased in oxidative stress markers[10]. The guidelines on the use of oxygen during neonatal resuscitation included early weaning after surfactant administration recommending room air as initial gas.

Many centres like our initiated resuscitation with 30 % o2 to avoid hyperoxia and the need of mechanical ventilation. inspired O2 concentration is currently titrated to normalize the PH to target normal oxygen saturation ranges during neonatal resuscitation and stabilization.

Preterm infants are at increased risk of oxidative stress and related injury due to the immaturity of antioxidative defence mechanism.

The term oxidative disease of neonatology coined by Saugstad was to refer to several free radical related morbidity in preterm infants including intraventricular hemorrhage, periventricular leukomalacia, necrotizing enterocolitis, retinopathy of prematurity and chronic lung disease. Our multiple regression analysis did not find any significant differences in the outcome in infants with hypoxia vs normoxia.

Other clinical practices such as delayed cord clamping permissive hypercapnia and developmentally sensitive care may influence the changes in SPO2 and pCO2 in the first minutes after birth hence arterial blood gas parameters should be considered when establishing standard approaches for resuscitation of preterm infants.

In addition to the changes in neonatal resuscitation practices factor such as early surfactant use and weaning of to room air will inevitably influence rates of hypoxia, low PH and hypercarbia after birth. It is important that these strength and their potential impact on neonatal outcomes are understood while managing ELBW babies with respiratory distress syndrome.

We believed that our study provided interesting and valuable insights into the impact of current practices in our NICU for ELBW babies.

There is no comprehensive study comparing or correlating the ABG Values in ELBW babies in the available data hence this study was done.

In addition accepting this variability supports the outcome measures of respiratory distress syndrome in ELBW infants.

Conclusion:-

Our retrospective study has established that reduced PH, reduced bbicarbonates and large negative base excess values in ABG estimation pose high risk of mortality in extremely low birth weight preterm neonates. Surfactant use is more advisable in lesser gestation and neonates with reduced PaO2, hypoxemia with PaO2 less than 50mmHg.

There was very high mortality among prematurely delivered extremely low birth weight babies and the use of surfactant did not improve survival rate significantly, therefore arterial blood gas profile was analysed.

Conflict of Interest:-
None.

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