Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 01, 2023

Original research article

Neonatal deaths in a tertiary neonatal intensive care unit: A retrospective descriptive audit

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Abstract

Background: Perinatal Mortality rate is an important indicator of quality of health care facility which is a major concern in both developing and developed country. A decrease in neonatal mortality is the single most important measure of quality of any neonatal intensive care unit. Audits of cause and strata specific (gestation/weight) analysis and comparing with benchmark will give directions to improve the quality of neonatal care.

Objective: To audit the major causes of deaths in a tertiary Indian NICU over 10 years.

Method: A retrospective data analysis of 248 neonatal deaths (inborn and out-born) in a tertiary NICU over a period of one decade, information was obtained from electronic medical records and medical record registers after obtaining the institutional ethical clearance.

Results: 129/248 (52%) of neonatal deaths over the decade had expected/unpreventable causes with majority being extreme prematurity, complex heart diseases, hydrops or IEM. After excluding these deaths, 119 (48%) were analyzed using SPSS ver 22.

Conclusion: Hypoxic respiratory failure and sepsis are the most common cause accounting for 45.4% and 44.5% respectively.

Keywords: Neonates, neonatal deaths, sepsis, asphyxia, prematurity

Introduction

Neonatal period being the most vulnerable period which has its influence on a survival and well-being of an individual. About one fourth of global neonatal mortality is contributed by India. India's neonatal mortality rate was 24.9 per 1000 live births as per National Family Health Survey (NFHS)-5 survey which contributes to three fourth of India's infant mortality rate (IMR) and half of under-five mortality rate [1]. Neonatal sepsis is the major cause of neonatal mortality worldwide followed by prematurity and birth asphyxia. Quality of newborn care in the NICU determines its survival. Most of the neonatal deaths in developed countries is due to unpreventable causes such as congenital malformations where as preventable causes such as sepsis, birth asphyxia and prematurity is more common in developing countries. There has been variation in the newborn death rates across different states and regions in India [2-4]. This study was conducted in a tertiary level III teaching neonatal intensive care.

Objective

To identify the most common causes of neonatal death in neonatal intensive care unit

Methodology

Sample size: 248.

Type of study: Retrospective descriptive study.

Sampling: Purposive sampling.

Duration: Retrospective neonatal deaths over a period of 10 years.

Inclusion criteria

All legally viable babies requiring NICU care as per unit policy are admitted and treated as per national and international guidelines. Parents were regularly counseled about condition of the child and required treatment decisions. All the deaths of newborns in neonatal intensive care unit during the study period shall be included in the study.

Exclusion criteria

Incomplete records

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Statistics
Data is entered in Microsoft excel and analyzed using SPSS software ver. 22. Study variables are described by percentages.

Method
Study was started after obtaining permission from institutional ethical committee. Data were collected using internally validated, predetermined proforma by review of electronic medical records and medical record registers. Operational definitions used in the study are explained below.

Assigning cause of death (as per unit policy)
1. **Sepsis:** All babies with culture positive or CRP > 6 mg/dL associated proximate to death was labeled as death due to sepsis.
2. **Asphyxia:** Babies requiring extensive resuscitation at birth (chest compressions or more) and having multi-organ injury with or without HIE.
3. **Hypoxic respiratory failure:** Babies requiring 100% oxygen, HFOV, nitric oxide and dying due to hypoxia that can't be corrected.
4. **Extreme prematurity:** Babies <26 weeks and <800 grams (unless they survived > 2 days of life).
5. **Expected deaths/unpreventable causes:** Multiple major congenital malformations, complex congenital heart disease, inborn errors of metabolism, hydrops fetalis, extreme prematurity.

Borderline viability
All legally viable babies (>23 weeks and >400 grams) are resuscitated as per standard guidelines, babies are admitted to NICU. If gestation is unclear, and baby demonstrates signs of life at birth, babies are resuscitated and admitted to NICU. Only MTP with confirmed gestation <20 weeks are not admitted.
These babies received ventilator support, IVF, medications like vitamin K, antibiotics and warmth as a part of human care, even if parents have expressed unwillingness to intensive care in antenatal counseling. Then repeated communication over 1-2 days helps parents to take decisions in case of borderline viability. In case of parents unwilling, intensive care treatment was continued without escalation of treatment.

Results
Total number of neonatal deaths in the 10 years period 248 (100%).
Adjusted Number of Deaths (excluding unpreventable deaths) (Table 1) 119 (48%).
Deaths due to unpreventable cause, expected deaths (Table 3).
Malformations, IEM, critical CHD, extreme prematurity etc. 129(52%).

Discussion
This study was conducted in a level III neonatal intensive care unit, aimed at auditing the major causes of death over a period 10 year period. Neonatal mortality rates in an intensive care is an indicator of the quality of perinatal care.
By reviewing the case records of 248 deaths during the 10 years, this study had 129 (52%) neonatal deaths which had expected/unpreventable causes with majority being extreme prematurity, complex heart diseases, hydrops or IEM. After excluding these deaths, 119 (48%) were analyzed. Hypoxic respiratory failure and sepsis are the most common cause accounting for 45.4% and 44.5% respectively (Table 1). Majority of death due to infections is surely preventable by judicious monitoring and antibiotic usage. Though in this study we had only 10% of neonatal deaths due to birth asphyxia which is preventable by proper antenatal monitoring. Neonatal intensive care unit has dedicated neonatal ventilators including HFOV and surfactant, but, nitric oxide was not available until 2014 January and ECMO is not available. This study had more deaths in the outborn cohort which may be accounted to the severity of the disease, the condition of neonate at arrival, transportation problems etc. (Table 2). The sex specific, gestation specific and weight specific distribution of deaths is depicted (Table 3). Published audits have recognized major cases of mortality as infections, difficulty in access to equipments, non-availability of staff, inability to recognize of danger signs, improper processes (delay in care) etc. [5-9].
Tujare *et al*. conducted a retrospective cohort study on predictors of neonatal mortality in Neonatal intensive care unit, from 2015 to 2017, found that there were 159 neonatal deaths. They found that male deaths accounted for 11.6% and female deaths accounted for 4.9% of total admissions in NICU. Hyaline membrane disease accounted for majority of deaths followed by perinatal asphyxia whereas congenital malformations was found to be least. The study concluded that deaths were more in neonates born to mother with multiple gestation, unbooked gestation and neonates who were not breast feed in 1st hour of life [10].
Tanja AJ *et al*. conducted a prospective study by collecting data from surveillance sites in rural Nepal, Bangladesh, rural states of Odisha, Jharkand and urban slum settlements in Mumbai11. They found that prematurity, low birth weight, birth asphyxia, sepsis and hyaline membrane disease as the important

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 01, 2023

predictors of neonatal mortality [11].
In a similar study done by Uttam Sakpal and Rekha Sakpal found that 67% of the still births were of low birth weight and nearly half of neonates admitted to NICU were of low birth weight. About 26% of neonates admitted to NICU had severe congenital malformation not compatible with life. Birth asphyxia accounted for 37% and hyaline membrane disease accounted for 15% of NICU deaths [12].
A study done by Srijana and Laxman found prematurity, asphyxia and septicemia as the major causes of deaths, perinatal asphyxia accounting for about half of the early neonatal deaths and hyaline membrane disease accounting one fourth of deaths [13]. A prospective study done in Ethiopia also found prematurity as the major cause of preventable death in neonates admitted to NICU which was followed by birth asphyxia and sepsis [14].
Another study from Libya also found that prematurity, birth asphyxia and sepsis being the most common cause of neonates admitted in NICU. In their study congenital malformation is the second most common cause of death accounting for nearly one fourth of neonatal deaths [15].
This study had 248 neonatal deaths over a period of 10 years. Nearly half of the deaths accounted for unpreventable deaths while 129 deaths accounted for preventable causes hypoxic respiratory failure (45%), sepsis (45%) and birth asphyxia (10%). Extreme prematurity, inborn error of metabolism, complex congenital heart disease and congenital malformations being the major causes of unpreventable deaths. Neonatal prognosis depends not only on birth weight and gestational age, but also on other perinatal factors and physiological conditions of the individual infants, in particular, disease severity in the first hours of life. Neonates born to high risk mothers and those having complications during birth have a higher chance of death which is preventable by timely intervention and follow-up of high risk pregnancies. Neonatal sepsis being the most common predictor of neonatal outcome, hence measures should be taken to prevent neonatal sepsis and aggressive management of neonatal sepsis. This study highlights that prematurity being one of the most common cause of preventable neonatal deaths, early identification of high risk mothers, regular follow up and aggressive management of preterm neonates in a tertiary NICU helps in preventing neonatal deaths. Birth asphyxia accounted only for about 10% of preventable neonatal deaths due to aggressive antenatal monitoring and appropriate perinatal management. We have to improve care and survival of these extreme preterm babies.
Example of one such strategy is use of magnesium sulphate antenatally is being evaluated to decrease mortality and morbidity of extremely preterm babies.
The results of the present study suggest that surveillance programs for neonatal death should include preventive actions and interventions for the delivery period. Focused initiatives for quality improvement may also be necessary. Development of strategies aimed at addressing these issues is a key to further reduction of NICU deaths.

Conclusions
Hypoxic respiratory failure and sepsis account for most deaths after adjusting for malformations, IEM and extreme prematurity. Further improvements in survival require control of sepsis and improved care of extremely preterm babies.

Limitations of the study
As the retrospective data was huge, data collection was dependent on records readily available EMR and registers. Some death files couldn't studied as death summaries relevant details like gestation, weight weren't recorded.
This study does not include the babies discharged against medical advice/referred out to other hospitals. Many of these were sick babies and may have died after leaving our hospital.

Acknowledgments
I am are grateful to all staff in the neonatal unit and medical record department staff of the hospital for their help with data collection.

Declaration of conflicting interest
The author declare that there is no conflict of interest.

Funding
The author(s) received no financial support for the research, authorship, and/or publication of this article.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 01, 2023

Abbreviations

NICU	`Neonatal Intensive Care Unit
NFHS	National Family Health Survey
IEM	Inborn error of metabolism
IMR	Infant Mortality Rate
HIE	Hypoxic Ischemic Encephalopathy
CRP	C Reactive Protein
IVF	*In vitro* Fertilization
SPSS	Statistical Package for the Social Sciences
MTP	Medical Termination of Pregnancy
CHD	Congenital Heart Disease

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