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## Cause-Specific Neonatal Mortality at the Armed Forces Hospital, Southern Region Khamis Mushayt, Kingdom of Saudi Arabia

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### Abstract

**Objective:** To document the perinatal and neonatal characteristics in a single hospital setting, to identify the main causes of neonatal deaths and to review the trends in neonatal mortality over a 6-year period.

**Methodology:** This is a 6-year retrospective analysis of perinatal and neonatal data at the Armed Force Hospital, Southern Region, Saudi Arabia.

**Results:** During the study period, there were 37,384 births resulting in 4,352 (11%) admissions to the neonatal intensive care unit (NICU). The average stillbirths rate was 54/1000 of the total births, and perinatal mortality rate was 9.6/1000 live births. Of the total NICU admissions, 2,698 (62%) were preterm, low-birth-weight (LBW) babies and 234 (5.4%) were extreme low birth-weight neonates (ELBW<1000gm). Overall neonatal mortality was 5.3% of the total admissions. Mortality rate was highest among ELBW babies (n=85; 36%). Prematurity-related conditions and multiple congenital anomalies accounted for the majority of deaths in the unit (61% and 44%, respectively), followed by birth asphyxia (10%). In ELBW infants, respiratory failure (45%) and grade IV intraventricular hemorrhage (40%) were the leading causes of early deaths, while sepsis accounted for 50% of late neonatal deaths. The mortality rate was significantly lower for larger neonates (10% for 1000-1500gm birth weight infants and only 3.3% of near-term neonates above 1500gm). The major cause of death was respiratory failure in smaller babies (52%) and multiple congenital anomalies in near-term infants. The presence of multiple congenital anomalies and extreme prematurity were the major contributing factors to neonatal mortality.

**Conclusions:** There is a pressing need to study neonatal mortality to ascertain the cause of neonatal deaths in the Kingdom of Saudi Arabia.

**Key Words:** Neonatal mortality – Neonatal intensive care unit – Birth weight.

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### Introduction

THE infant mortality rate (IMR) is an important health indicator of the effectiveness of health services, environmental quality and overall welfare of the people [1]. A reduction in IMR is accepted as an indication of improvement in socioeconomic status and provision of health care in a community [2]. The IMR in the Kingdom of Saudi Arabia (KSA) had declined significantly over the last decade to 22 per 1000 livebirths [3]. Neonatal mortality, due to perinatal and post-natal conditions, was the leading cause of death for children under 5 years in 2001 [3]. Efforts to reduce infant mortality, therefore, must focus on the pattern and causes of neonatal deaths since neonatal mortality accounts for about 50-70% of deaths in infancy [4].

Neonatal mortality accounted for 65.6% of the infant mortality according to the findings of a regional study at North West Armed Forces Hospital, in Tabouk, KSA [5]. These results raised concern since many of the causes in this report such as prematurity, birth asphyxia, and sepsis are preventable with available low-cost interventions.

With improvement in antenatal and prenatal health care delivery, however, the overall neonatal mortality rate in KSA has dropped significantly from 14 to 5.6/1000 live births [6] over the last 15 years. In a recent hospital based study in KSA-Abha, of the 277 newborns admitted to the neonatal intensive care unit (NICU) of a maternity hospital, the mortality rate among these neonates was 22.4%. The three most common causes of death were prematurity (31%), respiratory distress syndrome (27%) and perinatal asphyxia (7.6%) [7].

Although hospital-based studies may not be helpful in estimating the actual burden in the community because of the selection bias, it is important

for health-planners and policy makers to acquire the accurate causes of death and also to establish an audit system assessing the quality and outcome of prenatal and neonatal services in that hospital.

The objectives of this study were to document the perinatal and neonatal characteristics in a single hospital setting, to identify the main causes of neonatal deaths (ND) and to review the trends in neonatal mortality over a 6-year period. The results could be used to plan for the future direction of perinatal and neonatal care at our hospitals.

### Material and Methods

This is a retrospective study, carried out at the Armed Forces Hospital, Southern Region (AFH-SR), in Khamis Mushayt, KSA. This hospital is a 40-bedded well-equipped tertiary referral hospital which provides level III neonatal intensive care services in the Southern Region of KSA. The hospital performs 5000-7000 deliveries per year. The hospital receives both normal and complicated deliveries, in addition to prenatally diagnosed malformations. A trained pediatrician attends all high-risk deliveries and the delivery unit is covered by four full-time consultants, who have long experience in the management of sick neonates.

The records of all infants born at AFHSR who survived the delivery room resuscitation and were admitted and died in neonatal intensive care unit during the period from 1<sup>st</sup> January 2001 to 31<sup>st</sup> of December 2006 were included in this study. We did not include the delivery room neonatal deaths because the records of these deaths were not available.

All perinatal and neonatal data were collected from the maternal and neonatal medical records, including maternal age, parity, presence of antenatal care, mode of delivery, APGAR score, sex of the baby, birth weight and the best gestational age assessment. All deaths were certified by a medical doctor.

The "underlying cause of death" was derived from the diagnosis listed on each death certificate according to International Classification of Diseases, Ninth Revision, Clinical Modification [8]. In cases where the cause of death was not conclusive, case notes were reviewed with the doctor who certified the death of the neonate to arrive at a consensus regarding the direct cause of death. All neonates had their weight measured in the labor room using a digital scale.

Gestational age was estimated from the mother's expected date of delivery and the assessment of the attending pediatrician using maturity assessment charts posted on the wall of the delivery room and NICU. For this period, data were available on total births, stillbirths, NICU admissions and total neonatal deaths.

According to Moutquin [9], the birth weights of all the babies over the study period were grouped into the following 3 categories:

- 1- Extremely low birth weight (ELBW) infants: Below 1000gm.
- 2- Very low birth weight (VLBW) infants: 1000-1499gm.
- 3- Near term infant: More than or equal to 1500gm.

*Definitions* [10]:

- Stillbirth: The complete expulsion from the mother of a foetus weighing  $\geq 500$ g and/or with gestational age  $>22$  weeks that shows no sign of life at or after birth.
- Early neonatal death (ENND): The delivery of a live baby weighing  $\geq 500$ g at birth who dies during the first 7 completed days of life.
- Preterm delivery: Gestation at birth  $<37$  completed weeks.
- Perinatal mortality rate: The number of stillbirths and early neonatal deaths per 1000 total births.

The obtained data from the hospital records were carefully scrutinized for accuracy and entered into a database program. Statistical analysis was done using Epi-Info (version 6.3).

### Results

During the whole 6-year study period, there were 37,384 births, with mean still-birth rate of 53.7/1000, and mean perinatal mortality rate of 9.1/1000. The annual admissions to NICU constituted 10-13% of total births (Table 1).

Among the 4352 NICU admissions, the majority were in the third group near term infants (i.e., with a birth weight more than or equal to 1500gm). Their case fatality rate was 3.3% (Table 2). There were 247 (5.7%) deaths of total admissions; 81% of the deaths occurred in infants with preterm delivery, and 19% in term infants (Table 3).

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causes of death were prematurity-related conditions (61 %), multiple congenital anomalies (44%), followed by perinatal asphyxia and congenital cardiac diseases (Fig. 1).

When looking to the subgroups, the early causes of death in ELBW infants (i.e., <1000gm) were respiratory failure (45%), intra-ventricular hemorrhage (IVH) (40%) followed by sepsis (4.5%). However, in late neonatal death group, sepsis was the major cause of death (50%), followed by respiratory complications, mainly broncho-pulmonary dysplasia and air leak syndrome (29%) (Fig. 2).

Among the 1000-1500gm birth-weight babies, the mortality rate was 10% of 405 neonates, 71% of deaths occurred in the first week of life. The major causes for deaths were prematurity-related conditions in 63%, (respiratory failure in 52%, sepsis in 36%, NEC in 8% and IVH in 4%), followed by multiple congenital anomalies in 37.5% (Fig. 3).

Furthermore, in the near-term infants, mortality was significantly lower than other birth weight categories (122 of 3713 admissions, 3.3%). The distribution of deaths among different birth weights is shown in Fig. (4). Among the infants whose birth weights were >2500gm, there were 35 infants with lethal anomalies labelled as “do not resuscitate” (DNR) and died in the first 7 days of life. The major causes for death in the >2500gm birth weight category were multiple congenital anomalies (36%) followed by birth asphyxia (30%), as shown in Table (4).

Table (1): General biostatistics in the study period.

Year	Birth	PMR	Still Birth Rate	Admissions to NICU
2001	5599	12.0	67	594 (10.6%)
2002	5708	7.0	42	686 (12%)
2003	6265	5.7	41	833 (13.3%)
2004	6322	9.4	52	780 (12.3%)
2005	6567	8.5	48	675 (10.3%)
2006	6923	12.0	72	784 (11.3%)
Total (Average)	37384	9.1	53.7	4352 (11.6%)

PMR : Perinatal mortality rate.

NICU: Neonatal Intensive Care Unit.

Table (2): Distribution of admissions according to their birth weights and mortality rates.

Birth weight	total admissions	Deaths	Mortality rate (%)
<1000gm	234 (5.4%)	85	36.3
1000-1499	405 (9.3%)	40	9.9
≥1500gm	3713 (85.3%)	122	3.3
Total	4352	247	5.7

Table (3): Distribution of neonatal deaths according to their gestational age.

Gestational age	Deaths	Mortality rate (%)
- Term deliveries	47	19.0
- Preterm deliveries:	200	81.0
<25 weeks	47	19.0
26-28 weeks	47	19.0
29-31 weeks	39	15.7
32-34 weeks	35	14.2
35-37 weeks	32	13.0

Table (4): Main causes of neonatal death in near term infants (≥1500gm).

Causes	No. (%)
Multiple congenital anomalies*	45 (37)
Birth asphyxia + Persistent pulmonary hypertension	37 (30)
Inborn error of metabolism	13 (10.5)
Isolated CDH	9 (7.5)
Isolated CHD	9 (7.5)
Hydrops fetalis	4 (3)
Sepsis	4 (3)
Abdominal wall defect	1 (1.5)
Total	122

\* 35 Infants with lethal anomalies.

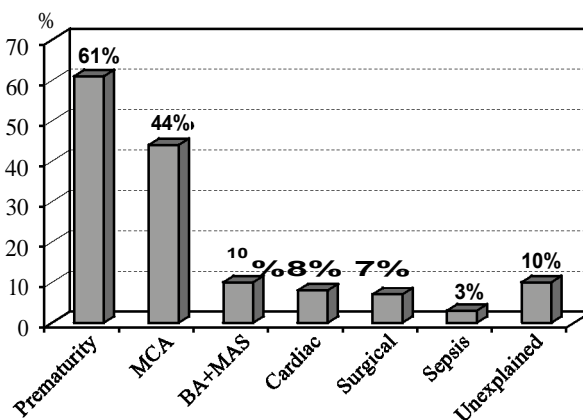


Fig. (1): Main causes of neonatal deaths in all admissions.

MCA : Multiple congenital anomalies.  
 BA : Birth asphyxia.  
 MAS : Meconium aspiration syndrome.

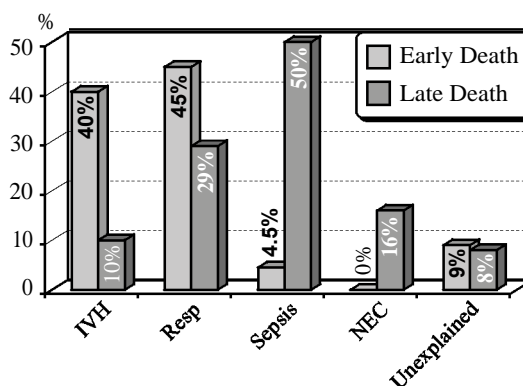


Fig. (2): Causes of deaths in ELBW infants.

IVH : Intraventricular hemorrhage.  
 Resp: Respiratory complications.  
 NEC: Necrotizing enterocolitis.

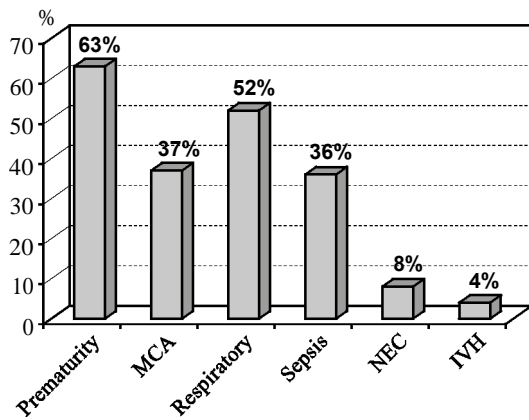


Fig. (3): Main Causes of Death in VLBW infants.  
 MCA: Multiple congenital anomalies.  
 NEC: Necrotizing enterocolitis.  
 IVH: Intraventricular hemorrhage.

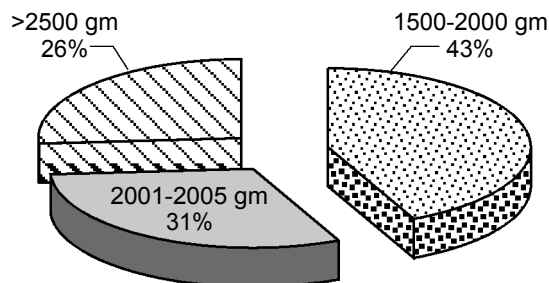


Fig. (4): Birth weight mortality in near term infants.

### Discussion

Comprehensive statistical information regarding neonatal deaths is the basis for developing a sound program for the early detection of perinatal and neonatal mortality, along with the ability to audit treatment and outcome. Reliable statistics should ideally be based on community surveillance, but so far, much of the reliance has been placed on hospital-based statistics, which are bound to be skewed. In spite of these limitations, hospital-based data can be useful in demonstrating the pattern of neonatal morbidity and mortality in a given population.

The data emanating from this survey shows annual increment of birth rate and total admissions to NICU. By the year 2006, there were a total of almost 7,000 deliveries which indicates the demand on prenatal services in KSA. The average stillbirth rate of 53.7/1000 and perinatal mortality rate of 9.1/1000 live births in this study are comparable to the results of other hospital-based studies in KSA and other developing countries [11,12]. The overall case fatality rate in the unit was 5.7%, in which 62% occurred in preterm infants. Regional and international studies have observed wide variations in neonatal intensive care mortality; in developed countries. It has been reported as low

as 4% [13] and as high as 27% in developing countries [14]. This variability is probably related to differences in admission categories, especially among borderline viability and out-born neonates.

The major causes for death were prematurity-related complications, multiple congenital anomalies, followed by perinatal asphyxia and cardiac anomalies. Similar results were reported by Lawn et al., who reported an estimated distribution of the causes of 4 million neonatal deaths in the year 2000 to be: Prematurity (40.5%), followed by congenital anomalies (29.8%) and asphyxia (13.8%) [15]. The same authors reported that the major direct causes for neonatal deaths at global level were; infections (35%), preterm birth (28%), and birth asphyxia (23%) with geographic variation in the proportionate causes of death [16]. The strong association between NICU mortality on one hand and preterm delivery on the other hand, indicates the importance of antenatal care, identifying the high risk group and prevention of preterm delivery [7].

Analysis of the data after stratification according to birth weight groups revealed that 62% of deaths occurred in preterm infants (less than 37 weeks), respiratory failure secondary to pulmonary hemorrhage and air leak syndrome was the leading cause of early deaths in ELBW infants, followed by grade 4 IVH, whereas sepsis with or without NEC was the leading cause of late neonatal deaths. Despite the significant improvement in respiratory status of these infants after surfactant administration, significant death still occurred because of complicated spontaneous pulmonary hemorrhage, which was the leading cause of respiratory failure (37%). Pandit, et al. reported that approximately 50% of infants who experience pulmonary hemorrhage die [17]. We failed to identify any direct cause for this hemorrhage, as we could not examine the association between patent ductus arteriosus and pulmonary hemorrhage in these deaths. A meta-analysis of the results of the randomized clinical trials of surfactant therapy indicates a 47% increased risk of pulmonary hemorrhage for infants who received surfactant therapy. However, no association with patent ductus arteriosus was demonstrated [18].

A major cause for late deaths was neonatal sepsis, which contributed to 50% of deaths in ELBW infants and 36% in VLBW infants. Data from the National Institute of Child Health and Human Development-sponsored "Neonatal Network" indicated that 29% of infants born at 25-28 weeks' gestation and 46% of infants born at less than 25 weeks' gestation experience a serious

nosocomial infection during hospitalization in the NICU. This infection is responsible for almost 50% of the deaths that occur beyond 2 weeks of age [19].

Looking at the near-term infants, multiple congenital anomalies contributed to 37% of deaths, followed by birth asphyxia in 30%. In KSA, as well as in other Arab countries, consanguinity rate is very high, which may explain this high rate of genetic and multiple congenital anomalies [20]. In KSA, Abu Srair also reported similar rate for case fatalities caused by congenital anomalies (26.7%) in Qatif area [21]. One of the major contributing factors is the lethality of these congenital anomalies, where these neonates will be labelled with "do not resuscitate" order (DNR). Another preventable cause for death in near-term infants is birth asphyxia (30%), which indicates the urgent demand to improve our neonatal and prenatal services.

There is still a pressing need to study neonatal mortality in the various regions of KSA to ascertain the cause of neonatal deaths in the Kingdom. Thus, the policies can be designed to lower the perinatal mortality in general, prenatal mortality in particular and to improve neonatal health care delivery in KSA.

### References

- CARVER J.D., MCDERMOTT R.J., JACOBSON N.H., et al.: Infant mortality statistics do not adequately reflect the impact of short gestation. *Pediatr.*, 92: 229-32, 1993.
- Development of indicators for monitoring progress towards health for all by the year Geneva, World Health Organization, 2000.
- EL-MAZROU Y., AL-SHEHRI S.N., EL-HASSAN S. and KHALIL M.: Levels, trends and differentials of infant and child mortality in Saudi Arabia. A Ministry of Health Project supported by UNICEF, 2005.
- WHO. Perinatal mortality: A listing of available information. Geneva, World Health Organization, 2001.
- JELLY A., WARNASURIYA N. and PEJAVER R.: Study of infant deaths in a Regional Hospital in Saudi Arabia. *Saudi Medical Journal*, 19 (2): 136-140, 1998.
- DAWODU A.H., AL UMRAN K. and AL FARAIDY A.: Neonatal vital statistics: A 5-year review in Saudi Arabia. *Ann. Trop. Paediatr.*, 8 (3): 187-92, 1988.
- ARAF A.M. and AL SHEHRI M.: Predictors of neonatal mortality in the intensive care unit in Abha, Saudi Arabia; *Saudi Medical Journal*, 24 (12): 1374-1376, 2003.
- PUCKETT C.D.: International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), 4<sup>th</sup> edition, Volume 1,2,3 Channel Publishing Ltd, 2008.
- MOUTQUIN J.M.: Classification and heterogeneity of preterm birth. *BJOG*.110 Suppl., 20: 30-33, 2003.
- Perinatal Statistics Report: By Health Research and Information Division, ESRI published report on perinatal statistics Appendix A. December 2008, pp. 82-84, 2006.
- ASINDI A., ARCHINBONG E., FATINNI Y. and MANNAN N.: Perinatal and neonatal deaths. *Saudi Medical Journal*, 19 (6): 693-697, 1998.
- KUMAR M.R., BHAT B.V. and OUMACHIGUI A.: Perinatal mortality trends in a referral hospital. *Indian J. Pediatr.*, 63 (3): 357-361, 1996.
- SANKARAN K., CHIEN L.Y., WALKER R., SESHIA M., OHLSSON A. and LEE S.K.: Variation in mortality rates among Canadian neonatal intensive care units. *Canadian Med. Assoc. J.*, 166: 173-178, 2002.
- KASIRYE-BAINDA E. and MUSOKE F.N.: Neonatal morbidity and mortality at Kenyatta National Hospital newborn unit. *East. Afr. Med. J.*, 69: 360-365, 1992.
- LAWN J.E., COUSENS S. and ZUPAN J.: 4 million neonatal deaths: When? Where? Why? *Lancet*, 365: 891-900, 2005.
- LAWN J.E., WILCZYNSKA-KETENDE and COUSENS S.: Estimating the cause of 4 million neonatal deaths in the 2000. *International Journal of Epidemiology*, 35: 706-718, 2006.
- PANDIT P., O'BRIEN K., DUNN M., ASZTALOS E. and COLUCCI E.: Outcome following pulmonary hemorrhage (PH) in very low birth-weight neonates treated with surfactant *Pediatr. Res.*, 41: 208A, 1997.
- RAJU T. and LANGENBERG P.: Pulmonary hemorrhage and exogenous surfactant therapy: A meta-analysis. *J. Pediatr.*, 123: 603-610, 1993.
- Brodie S.B., Sands K.E., Gray J.E. et al.: Occurrence of nosocomial bloodstream infections in six neonatal intensive care units. *Pediatr. Infect. Dis. J.*, 19: 56-65, 2000.
- EL-BADRAMANY M.H., FARAG T.I., ALWADI S.A. and TEEBI A. S.: Genetic disorders among Arab population. Oxford, UK: Oxford University Press. P474-486.
- ABU SRAIR H. and JOSHUA A.: Owa, Hussain Ahmed Aman. Cause-Specific infant mortality rate in Qatif area, Eastern province, Saudi Arabia. *Ann. Saudi. Med.*, 15 (2): 156-158, 1995.