Morbidity and Mortality Profile of Neonates Admitted in Neonatal Intensive Care Unit

Pradip Kumar Paudel,[1] Prakreeti Bhandari,[1] Nawaraj KC,[1] Bibek Devkota[2]

[1]Department of Pediatrics, Province Hospital, Karnali,[2]Department of Anesthesia, Province Hospital, Karnali.

ABSTRACT

Background: The neonatal period faces the greatest risk of death as they are vulnerable to sepsis, birth asphyxia, hypoxic injuries etc. A substantial disparity exists in NMR between Nepal and other developed countries and among different provinces of Nepal as well. This study was conducted to describe the pattern of neonatal admission, and immediate hospital outcomes from NICU located in a remote part of Nepal.

Methods: This prospective study was conducted in The Province Hospital, Karnali, Nepal over a period of six months (June 2021 to Dec 2021 AD). The variables used were neonatal age, sex, gestation, birth weight, maternal age, mode and place of delivery. Neonatal morbidities and final outcomes at discharge were recorded in a predesigned proforma.

Results: A total of 396 neonates included, the majority were inborn 283(71%), male 241(61%), term 301(76%) and had normal birth weight 279 (70.4%). Neonatal sepsis 188(37.2%), prematurity 95(24%), and birth asphyxia 55(15.2%) were main indications for hospitalization. The majority 337(85%) improved after treatment, while 33(8.3%) died, 12 (3%) left against medical advice and 14(3.5%) cases were referred. Preterm neonates had thrice the risk of mortality than term neonates (OR =3.27). Low birth weight (< 2500 grams) had higher odds of poor outcomes (OR =3.5). Low maternal age (<20 years), prematurity, LBW, mechanical ventilation and inotrope use were predictors of poor outcomes.

Conclusions: Neonatal sepsis, prematurity and perinatal asphyxia were the most common causes of NICU admissions. Mechanical ventilation, inotropes use, extreme prematurity, low birth weight and younger age of the mother were predictors of poor outcome.

Keywords: Karnali; morbidity; mortality; neonates.

INTRODUCTION

The first 28 days of life, the neonatal period, is highly susceptible to mortality and morbidity. The neonatal period faces the greatest risk of death as globally, 2.4 million newborns died in 2020.[1] In 2020, 47% of all under-5 deaths occurred in the first 28 days of life thus signifying the importance of newborn care. There is a substantial disparity in the rate of decline in neonatal mortality rate (NMR) between developing countries like Nepal and other developed countries.[1,2] The disparity also exists among different provinces of Nepal.[3] The NMR of Nepal has moved from 33 per 1,000 live births to 21 per 1000.[3] The Karnali Province had the second-highest NMR of 29 after Sudurpaschim (41), least in Gandaki (15).[3] As per the researcher's knowledge, there is limited information on neonatal outcomes from Karnali. The present study aimed to find out neonatal disease patterns of admissions and outcomes in a tertiary care centre from Karnali province.

METHODS

The present prospective observational study was conducted in the Neonatal Intensive Care Unit (NICU) of a tertiary care centre, Province Hospital, Karnali. The Hospital offers comprehensive emergency obstetric and neonatal care services along with others. This NICU is currently running 8 bedded units with 4 neonatal ventilators, 5 continuous positive airway pressure (CPAP) machines, 2 incubators, and 6 phototherapy

Correspondence: **Pradip Kumar Paudel, Province Hospital, Karnali, Nepal. Email: drpradippaudel@gmail.com, Phone: +9779807320679.**

units. Inborn neonates and outborn cases referred from within the Surkhet district as well as from other nearby districts in the Karnali province are admitted. This NICU has a government-run free NICU package program.

The data was collected from June 15, 2021, to Dec 15, 2021. Data were collected daily. Ethical clearance was obtained from Nepal Health Research Council(NHRC) reference number 3364.

All the admitted neonates (less than 28 days) to NICU, were included in the study.

Those neonates whose parents were not giving consent were excluded. A predesigned, semi-structured questionnaire was used to collect data by interview method and daily patient notes. Neonatal variables used were data on age at admission, gender, gestational age, birth weight, initial presenting symptoms at admission, final diagnosis, type of therapy received, and outcome in regards to whether the newborn was discharged or transferred to the ward after improvement, left against medical advice, referred to other centres for a various reason or expired during hospital stay were collected. The diagnosis was mainly clinical supported by specific laboratory or radiological findings. Sepsis was diagnosed on clinical criteria used by the World Health Organization(WHO) in Integrated Management of Neonate and Childhood Illness (IMNCI) along with C-reactive protein (CRP), complete blood count (CBC) only as blood culture facility was not available at the centre. Diagnosis of perinatal asphyxia was based on the criteria set by WHO.[4] Hypoxic-ischemic encephalopathy was classified based on Sarnat and Sarnat staging.[5] Mortality data were collected, in the form of the cause of death, therapy received, and duration between the time of admission and death. Data was entered and analyzed using SPSS 20.0. Results were expressed as percentage and p value and Risk of mortality was calculated using odds ratio and 95% confidence interval.

RESULTS

There was a total of 403 admissions during the study period of 6 months of which 7 were excluded due to age more than 28 days at the time of admission. Out of 396 cases included in the study, the majority were inborn neonates than outborn (71% vs 29%). Male admissions were more than female (60.9% vs 39.1%) and the majority were delivered vaginally (73.4%). Most admitted neonates were term gestation (72.9%) and had normal birth weight (67.42%). The majority of neonates were admitted when their age was less than 3 days (61.8%). Most of the neonates were admitted for less than 7 days' duration (76%). (Table 1).

Table 1. Various characteristics of admission to NICU.

Characteristics		Frequency(n)	Percentage(%)
Birthplace	Inborn	281	71
	Outborn	115	29
Gender	Male	241	60.9
	Female	155	39.1
Gestation	Preterm	98	24.7
	Term	289	72.9
	Post-term	9	2.2
Birth weight	Normal	279	70.4
	LBW	92	23.2
	VLBW	21	5.3
	ELBW	3	0.75
	LGA	13	3.2
Duration of NICU stay	<1 day	24	6.06
	1-3 days	100	25.2
	4-7 days	178	44.9
	7 - 14 days	66	16.6
	>14 days	28	7.07
Mode of delivery	Vaginal	291	73.4
	Em LSCS	83	20.9
	El LSCS	10	2.5
	Instrumental	12	3.03
Age of mother	16-19	60	12
	20-25	208	41.9
	26-30	92	18.5
	31-40	36	7.2

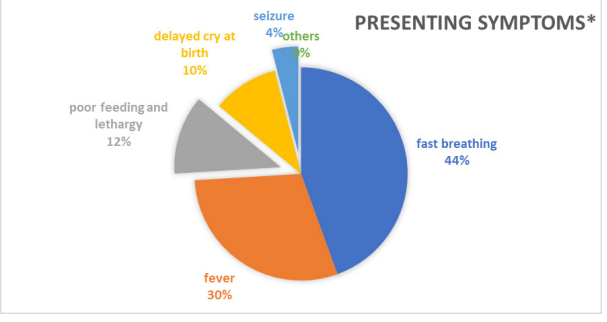

Figure 1. Presenting symptoms to NICU.

*not mutually exclusive

Fast breathing was the most common presentation followed by fever ((44% & 30%) (fig -1). Most admitted neonates were from Surkhet (72%) followed by Dailekh (20%).

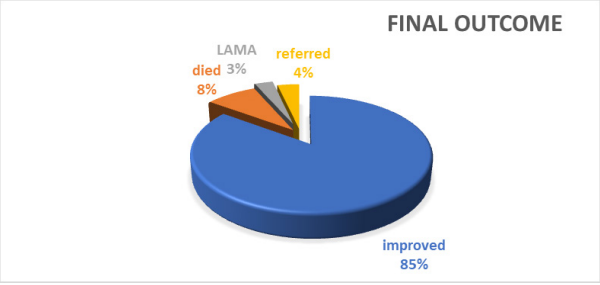

Figure 2. The outcome of the admitted neonate.

More than two-thirds of the admitted neonate was discharged after medical treatment (85%), while 33(8%) died,12 (3%) left against medical advice(LAMA) and only 14(3.5%) cases were referred to other centers(Fig-4).

The most common indication for NICU admission was neonatal sepsis in 188 (37.2%), prematurity and complications e.g. respiratory distress syndrome(RDS), necrotizing enterocolitis (NEC) etc. in 74(18.4%), and birth asphyxia in 55(15.2%) (Table 2). The commonest cause of death was due to prematurity with complications like RDS in 13(39.3%), birth asphyxia with or without HIE in 8(24.2%), and neonatal sepsis in 7(21.3%). The remaining 3(9%) neonates died due to major congenital malformation including CHD and 2(6%) due to MAS (Table 2). Out of 33 deaths, 12(36.3%) died within 24 hours of admission.

As most of the LAMA cases in our study were terminally ill and unlikely to survive we included it into the poor outcome category along with death. The poor outcome rate (died +LAMA) among inborn was slightly higher than outborn (57.1% vs 42.86%), also males had slightly higher poor outcomes than females (53.17% vs 46.83%). Both findings were not statistically significant (P – 0.76 and P- 0.84) (Table 3). There were 42% premature and 51% low birth weight neonates among total NICU poor outcomes. There was a significant relationship between the younger age of the mother (< 20 years) and negative outcome (chi-square- 10.52, p-value of 0.001). Preterm babies had a significantly higher poor outcome rate than the term (Chi square-15.2, OR-3.27). Likewise, birth weight less than 2500 gm had a significantly poor outcome (chi -16.3, p = 0.000). There was no significant difference regarding poor outcomes between the place of birth (chi-0.09), gender (chi-0.04) and mode of delivery (chi-1.41) (Table-3).

Neonates who were ventilated mechanically had poor outcomes (36 out of 46 i.e. 78.2%). Neonate requiring inotropes and CPAP were also having higher rates of poor outcomes respectively (OR-23 & OR-6.6). Neonates presenting within 72 hours of birth to NICU were more likely to die than later presentation (OR-6, p<0.000). (Table 3).

Table 2. Morbidity pattern of neonates with the outcome (*not mutually exclusive).

Morbidity		Frequency(%)*	Outcome			
			improved	died	LAMA	refer
Neonatal Sepsis	Total	188(37.20)	176	7	1	4
	Early-onset	66(14.1)				
	Late-onset	122(23.1)				
Prematurity with complications		95(18.4)	53	13	6	2
MAS		20(6.9)	18	2	-	-
Birth asphyxia	Total	55(15.2)				
	No HIE	30	42	8	3	2
	HIE I/II/ III	5/14/ 6				
TTN		20(5.4)	20			
Dehydration fever		15(2.9)	15			
Congenital malformation & CHD		15(4)	4	3	2	6
NNJ		35(5.1)				
Neonatal seizure		20(1.4)				
LBW		10(2.2)				
Others		16(1.4)				
Total		396(100)	337	33	12	14

Table-3 Neonates who were ventilated mechanically had poor outcomes						
Characteristics	Total patients N(%)		Poor outcome (Died+ LAMA)	Chi square	OR (95%CI)	P value
Birthplace	Inborn	283(71)	33(11.6)	0.09	0.9(0.45-1.8)	0.764
	Outborn	113(29)	12(10.6)			
Gender	Male	241(60.9)	28(13.1)	0.04	1.06(0.5-2.2)	0.84
	Female	155(39.1)	17(12.3)			
Gestation	>37wk	301(76)	26(7.9)	14.3	3.27(1.7-6.2)	<0.000
	<37wk	95(24)	19(20)			
Birth weight	>2.5 kg	279(70.4)	22(7.8)	16.3	3.51(1.86-6.6)	<0.000
	<2.5 kg	117(29.6)	23(19.6)			
Maternal age	<19 year	59(14.8)	14(23.7)	10.524	2.58(1.4-4.5)	<0.001
	>20 year	337(85.2	31(9.1)			
MV	Yes	46(11.6)	36(78.2)	231.6	136.3(52-357.3)	<0.000
	No	350(88.4)	9(2.5)			
CPAP	Yes	75(18.9)	24(32)	39.1	6.6(3.6-12.9)	<0.000
	No	321(61.1)	21(6.5)			
Inotropes	Yes	38(9.5)	22(57.8)	100.6	23.4(10.7-51.1)	<0.000
	No	358(90.5)	23(6.4)			
Age of presentation	<72 hour	245(61.8)	41(16.7)	18.4	6.3(2.3-17.5)	<0.000
	>72 hour	151(38.2)	4(2.6)			
Mode of delivery	LSCS	87(21.9)	13(14.9)	1.41	1.44(0.79-2.7)	0.234
	Vaginal	309(78.1)	32(10.3)			

DISCUSSION

In the present study, the authors tried to acknowledge neonatal morbidity patterns and outcome parameters from tertiary care neonatal centres located in a remote part of a developing country. Existing data suggests huge inequalities in child mortality across and within the same country and Karnali Province having the second highest NMR of 29.[3,21] As compared to developed countries, neonatal mortality is still high in developing countries.[4] The neonatal health SDG goal can be achieved by 2030 only when we uniformly improve our neonatal health status in all provinces. As the study site is the provincial hospital of Karnali, it is a referral centre for many districts of this province.

The most common morbidity was neonatal sepsis (37.2%) followed by prematurity with complication (18.4%) and perinatal asphyxia with or without hypoxic-ischemic encephalopathy (15.2%) being second and third respectively. A higher percentage of 57% of NNS was found in a study done in a tertiary care centre in the central region.[9] Adhikari et al. found neonatal hyperbilirubinemia at 37.1%, neonatal sepsis at 31.2%, prematurity at 18.4% and perinatal asphyxia at 6.6% as main indications for hospitalization.[21] Studies from other parts of the country also had shown similar results with the notable exception of neonatal hyperbilirubinemia, which was only 5 % in our study. Neonatal hyperbilirubinemia was among the top 3 morbidities in previous studies.[6,7,9,12,14,15] The lower percentage in our study may be explained by the bilirubin estimation technique used in our lab that showed a lower level of bilirubin than the phototherapy range and the high threshold in part of the clinician to start phototherapy. We should be more vigilant and flexible to find more hyperbilirubinemia cases. The perinatal asphyxia of 15% in our study was similar to 5 to 24 % from other studies.[7,9,10,12,13,15] There is still room for improvement to decrease perinatal asphyxia by ANC coverage, timely referral and improving obstetric care in our hospital. Mothers are referred late from the birthing centre in the periphery or arrive late due to geographical conditions resulting in long travel hours. The low socioeconomic status, the bad condition of roads and inefficient

ambulance services have contributed to a higher percentage of perinatal asphyxia.

In our study, preterm admission 15 % was similar to other studies from various parts of the country 18 -23%.[7,9,10,12,13,15] Prematurity and low birth weight were major prognostic factors for NICU outcomes. Our study found gestation of lesser than 37 weeks(preterm) had 3.5 fold more risk of poor outcome compared with the term neonates (OR =3.27). Adhikane et al. found a similar result 21 % with 4 fold increased risk (OR 3.9).[17] Adhikari et al. found two fold increased risk (OR-2.16). The higher percentage of LBW was found in other studies 40 to 60% than in our study 29.6%.[12] We found birth weight of lesser than 2500 grams had three and half times more risk of neonatal poor outcome compared with normal birth weight (OR =3.5). Adhikari et al. found similar risk (OR =3.0783).[12] Adhikari et al. found even higher risk (OR- 6.9).[17] Future projects directed to improve neonatal care should address problems of preterm and LBW in addition to continuing care for term and normal birth weight neonates.

In our study, a good outcome was observed in 85% cases, whereas only 11.3% cases were having a poor outcome. The mortality rate of 8 percent after excluding LAMA was seen, this finding was lower than Nepal et al study 18 % from central Nepal but similar to Paudel et al. have found from western Nepal 6.7%, Shrestha et al. have found from Jumla 6%, and Kanodia et al. found from the eastern region 4.7%, Roma et al. found from Midwestern region 7.4%.[7,9,12,14,15] Most cases 36.3% died during the first day of admission indicating serious conditions at arrival and biological vulnerability of first day of life. Some cases were resuscitated at ER at arrival and died within 4 hours. The mortality depends upon the stage of the disease and facilities available in a particular Neonatal unit. As neonates were already critical at arrival, timely referral and increasing awareness among health worker and parents can lower the mortality further. The long travel hour due to poor road condition as well as difficult geography and poorly equipped ambulances has complicated the matter further. Prematurity and complication like RDS was the leading cause of poor outcome followed by birth asphyxia and sepsis. A similar trend was seen in other studies from different part of country.[7,9,12,14,15] Cases were referred to higher centers mostly due to surgical causes like intestinal obstruction, duodenal atresia, trachea-esophageal fistula, and congenital heart disease. Few cases were referred on patient interest.

Male babies being predominant in both hospital admissions 60.9% as well as in poor outcomes, 13.1% raise the issues of biological vulnerability of male neonates, as similar findings were observed in previous studies.[6,7,9,10,11,12,13] Neonates born to young mothers who were less than 20 years had the highest mortality rate which was statistically significant (p-value 0.001, OR 2.28). The finding is similar from other studies .[9,11,19,20] This might be due to poor nutritional status of mother due to young age, biological immaturity and more tendency to give preterm and LBW babies. The issue is further complicated by low maternal education, less concern or knowledge regarding care of newborn baby and low socioeconomic status prevalent in Karnali province .[18,19,20]

Out of mechanically ventilated cases, 80 percent had a poor outcome. The need for mechanical ventilation and inotropes were predictors of poor outcomes (OR=136.3 and OR= 33). Other workers reported a lower mortality rate in their studies.[9,12,16] Banstola et al. from the western region of our country, showed an even higher (87.5%) mortality rate.[10] The higher poor outcome of the ventilated neonate in our study may be explained by the critical condition at the time of ventilation commencement, late arrival to the hospital, overburdened NICU, lack of skilled staffs to monitor ventilated baby and unavailability of measures like surfactant in preterm RDS cases.

This was a single centered hospital-based prospective study. The findings of the current study should be deduced keeping in view the subsequent limitations. Neonates, who were referred to other centers due to non-availability of NICU beds, left against medical advice and in need of surgical intervention could modify the outcome. As it was a government hospital-based study and as most of the patients had a low socio-economic status, the results of this study may not give representativeness of the true disease burden in the province.

CONCLUSIONS

Neonatal sepsis, prematurity and perinatal asphyxia were the leading causes of NICU admissions. Mechanical ventilation, inotropes use, extreme prematurity, low birth weight, neonate admitted to NICU within 72 hours of birth and younger age of mother were predictors of poor outcome. Enforcing strict aseptic protocols and hand hygiene techniques can help in the prevention of neonatal sepsis. Community programs providing health education for antenatal care and proper newborn care can be done. Immediate care and management

of preterm neonates in referring centres should be strengthened. The higher incidence of birth asphyxia and significant mortality associated with it in this study warrant that strategies to prevent birth asphyxia need to be strongly implemented.

ACKNOWLEDGEMENTS

We would like to thank all the parents of neonates for participating in the study. We are also thankful to all the nursing staff of the NICU, on-duty medical officers and consultant Pediatricians of Province Hospital who helped during the data collection of the study. We would like to thank province hospital director Dr Damber Khadka and the administration for allowing us to conduct the study.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. orld Health Organization. Fact sheets 2020; Newborns: improving survival and well-being.

2. Chow S, Chow R, Popovic M, Lam M, Popovic M, Merrick J, et al. A selected review of the mortality rates of neonatal intensive care units. Front Public Health. 2015;3:225.doi: https://doi.org/10.3389/fpubh.2015.00225

3. Ministry of Health - MOH/Nepal, New ERA/Nepal, ICF. Nepal Demographic and Health Survey 2016. Kathmandu, Nepal: MOH/Nepal, New ERA, and ICF, 2017

4. World Health Organisation. Fact sheet 2014. Geneva: WHO; 2014. Available from: www.who.int/en.

5. Sarnat HB, Sarnat MS. Neonatal encephalopathy following fetal distress: a clinical and electroencephalographic study. Arch Neurol. 1976; 33(10):696-705. doi: 10.1001/archneur.1976.00500100030012.

6. Chapagain RH, Basaula YN, Kayastha M, Adhikari K, Shrestha SM. Disease Profile and Hospital Outcome of Newborn Admitted to Neonatal Intermediate Care Unit at Tertiary Care Center in Nepal Kathmandu Univ Med J 2017;58(2):126-9. PMID: 34547843

7. Shrestha S, Sindan N, Kayastha N, Karki D, Jha K, Thapa S, Acharya B, Gurung D. Clinical profile and outcome of neonates admitted to the Neonatal Care Unit in a rural teaching hospital. Journal of Karnali Academy of Health Sciences 2018;1(02):23-7. doi: https://doi.org/10.3126/jkahs.v1i2.24130 [Article]

8. Phibbs CS, Baker LC, Caughey AB, Danielsen B, Schmitt SK, Phibbs RH. Level and volume of neonatal intensive care and mortality in very-low-birth-weight infants. N Engl J Med. 2007;356:2165-75. doi: 10.1056/NEJMsa065029

9. Nepal D, Agrawal SP, Shrestha SM, Rayamajhi A. Morbidity Pattern and Hospital Outcome of Neonates Admitted in Tertiary Care Hospital, Nepal. Journal of Nepal Paediatric Society. 2020;40:107-13.doi: https://doi.org/10.3126/jnps.v40i2.29469

10. Banstola RC, Shrestha SK, Ghimire JJ, Gurung R, Sigdel YR. Disease Pattern and Outcome of Neonates at Special Care Neonatal Unit of Pokhara Academy of Medical Science, Nepal. NJOG. 2017;23(2): 61-4. doi:10.3126/ njog. v12I2.19956

11. Adhikari S, Rao K, BK G, Bahadur N. Morbidities and Outcome of a Neonatal Intensive Care in Western Nepal. JNHRC. 2017;15(2):141-5. doi:10.3126/jnhrc.v15i2.18203.

12. Roma KM, Pyakurel M, Gupta V, Kanodia P. Clinical Profile and Outcome of Neonates Admitted to Neonatal Intensive Care Unit of NGMC. JNGMC. 2017;15(1):20-22. doi: https://doi.org/10.3126/jngmc.v15i1.23533

13. Shah GS, Yadav S, Thapa A, Shah L. Clinical Profile and Outcome of Neonates Admitted to Neonatal Intensive Care Unit (NICU) at a Tertiary Care Centre in Eastern Nepal. J Nep Paediatr Soc.2013;33(3):177-81. doi: 10.3126/jnps.v33i3.8447.

14. Paudel L, Kalakheti B, Sharma K. Prevalence and Outcome of Preterm Neonates Admitted to Neonatal Unit of a Tertiary Care Center in Western Nepal. J Lumbini Med Coll. 2018; 6(2):6. doi: 10.22502/jlmc.v6i2.218.

15. Kanodia P, Yadav SK, Bhatta NK, Singh RR. Disease profile and Outcome of Newborn admitted to Neonatology unit of BPKIHS. Journal of College of Medical Sciences-Nepal. 2015;11:20-4. doi:

https://doi.org/10.3126/jcmsn.v11i3.14059

16. Jehan I, Harris H, Salat S, Zeb A, Mobeen N, Pasha O.Neonatal mortality, risk factors, and causes: A Prospective population-based cohort study in urban Pakistan. Bull World Health Organ 2009; 87(2):130-8 doi: 10.2471/blt.08.050963.

17. Adikane H, Surwase K, Pawar V, Chaudhari K. A prospective observational study of morbidity and mortality profile of neonates admitted in neonatal intensive care unit of the secondary care center in central Maharashtra, India. Int J Contemp Pediatr 2018;5:1403-8 doi: http://dx.doi.org/10.18203/2349-3291.ijcp20182536

18. Mehata S, Paudel YR, Dariang M, Aryal KK, Lal BK, Khanal MN, et al. Trends and Inequalities in Use of Maternal Health Care Services in Nepal: Strategy in the Search for Improvements. BioMed Research International. 2017;2017:5079234. doi https://doi.org/10.1186/s12889-020-10066-z

19. Rai P, Sindan N, Acharya BD, Shah R, Shrestha S. Adolescent Pregnancy and its Outcome in a Rural Teaching Hospital, Karnali Academy of Health Science, Jumla. Journal of Karnali Academy of Health Sciences. 2019;2(2):107-111. doi: https://doi.org/10.3126/jkahs.v2i2.25169

20. Suwal A. Obstetric and prenatal outcome of teenage pregnancy. JNHRC 2012;10(20);52-6 PMID: 22929638

21. Paudel D, Shrestha IB, Siebeck M, Rehfuess EA. Neonatal health in Nepal: analysis of absolute and relative inequalities and impact of current efforts to reduce neonatal mortality. BMC Public Health. 2013;13(1):1239. doi: https://doi.org/10.1186/1471-2458-13-1239