International Journal of Education, Science and Social Sciences

Original Research Article

Neonatal Factors Predisposing Neonates to Nosocomial Infections at Moi Teaching and Referral Hospital

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Received: 8th June, 2024, Accepted: 29th July, 2024, Published: 21st August, 2024

Abstract

Nosocomial infections occur during healthcare service delivery as an adverse outcome of medical care. They account for approximately 40% of all childhood mortality and are more common among premature neonates and those with intra-partum complications. This study aimed to assess neonatal factors that predisposes neonates to nosocomial infections in the new-born unit of Moi Teaching and Referral Hospital (MTRH). The study adopted a cross- sectional descriptive study design among neonates younger than 28 days admitted at the new-born unit in MTRH. Neonatal clinical information was obtained from their medical records. Data was statistically analysed using SPSS version 26. Categorical variables such as sex, presence of co-morbidities and feeding techniques were summarized using frequencies with corresponding percentages. Continuous variables such as gestational age at birth, duration of hospitalization among others were summarized using mean with their corresponding standard deviations (SD). Pearson chi-Square was used to determine the likelihood neonatal factors predisposing neonates to nosocomial infections. Ethical approval (Approval No: 0003349) was obtained from MTRH's Institutional Ethical Review Committee (IREC) prior to study commencement. This study enrolled 113 neonates of whom 58 (51.3%) were

https://doi.org/10.69897/16kyxj17

preterm (gestation age of 20-37 weeks) while the rest were full term neonates (>37 weeks). Majority of the neonates had a normal birth weight with 86 (76.1%) of them having been on mechanical ventilation. This study recorded more neonates (91) whose duration of hospitalization was ≤28 days with 63 having nosocomial infection while 90 neonates were on parenteral feeding out of which 66 contracted nosocomial infections. There was no significant ($p > 0.05$) association between neonatal characteristics and the occurrence nosocomial infections. Occurrence of nosocomial infections statistically determined to be not dependent on neonatal characteristics. Since nosocomial infections are a major cause of neonatal morbidity that predicts childhood mortality, it is important to identify risk factors of nosocomial infections. Understanding the risk factors will inform policy updates and implementation. There is need to enhance infection prevention and control strategies at the neonatal units to help reduce the nosocomial infection burden and diversity.

Keywords: **Nosocomial infections, Neonates, New-born unit, MTRH**

Introduction

Nosocomial (health care-associated) infections occur in the course of health care delivery (Ahoyo *et al.,* 2014). These infections are defined as nosocomial if they were not present or incubating at the time of admission and may be occupational infections among staff (Pal *et al.,* 2020). Most nosocomial infections occur via primary transmission route and/or environmental reservoir (Moffa *et al.,* 2017). Microbial reservoirs for these pathogens are often found on inanimate surfaces within the clinical care settings. One-third of hospital acquired infections would be avoided if proper infection prevention and control measures are established. Despite existence of infection prevention and control measures and robust infection surveillance programs, the risk of developing neonatal nosocomial infections still remains high.

These nosocomial infections lead to prolonged hospital stays, long-term disability, increased resistance of microorganisms to antimicrobials, massive additional costs for health systems, high costs for patients and their family, and unnecessary deaths (Al-Jabri *et al.,* 2019; Kanamori *et al.,* 2017; Ramasethu, 2017). Because of its growing global burden, there has been a worldwide consensus, through the WHO, for urgent action for infection prevention and control (IPC).

Neonatal mortality is increasingly being recognized as an important global public health challenge that must be addressed if we are to reduce child health disparities between developed and developing countries (Ahoyo

https://doi.org/10.69897/16kyxj17

et al. 2014). Most of the estimated 4 million neonatal deaths per year occur in low- and middle-income countries (Lawn *et al.* 2014) with infections, birth asphyxia, consequences of premature birth and low birth weight as the predisposing factors. More than one-third of these deaths are estimated to be due to severe infections to neonates (Jahan, 2016). Low birth weight neonates, preterm or premature birth, with underlying disease and those who undergo invasive procedures have an elevated risk of nosocomial infections (Choobdar *et al.,* 2020).

The risk of nosocomial infection in neonatal units have not yet been determined as there are no cleaning guidelines available that meet hospital standards. There is paucity of data in Kenyan referral facilities like Moi Teaching and Referral Hospital (MTRH) on the combination neonatal and environmental risk factors that predispose neonates to nosocomial infections. The aim of the present study is to assess neonatal factors that predisposes neonates to nosocomial infections at Moi Teaching and Referral Hospital neonatal unit.

Materials and Methods

This was an observational study among neonates aged 28 days old and below suspected to have nosocomial infections. The study was conducted at Moi Teaching and Referral Hospital (MTRH) New-born Unit. MTRH is the second largest referral facility in Kenya serving the entire western Kenya region and offers both clinical, training and research services. Riley Mother and Baby Hospital offers maternity and neonatal care to patients of diverse ethnic backgrounds. The facility was selected for the study due to the availability of a new-born unit (NBU) which can handle about 100 neonates at a time. This study targeted neonates admitted to the new-born unit between June 2019 to February 2020 and managed to enroll the targeted 113 neonates. A purposive sampling technique was adopted to select specific cubes of the neonatal units. Every new-born child whose mother gave informed written consent was included in the study continuously until the desired sample size was achieved. Sample size was calculated using Fischer's formula (Israel, 1992) and applying the prevalence of nosocomial infections at MTRH estimated at 8% in 2018. The children who met eligibility requirements were sampled consecutively until the determined sample size (113) was achieved.

From every participant, neonatal data was collected from hospital records. This information provided a basis for investigating other predisposing factors. The neonatal data of interest included date and time of birth, gestational age at the time of birth, sex, and birth weight, duration of hospitalization, parenteral feeding and mechanical ventilation.

https://doi.org/10.69897/16kyxj17

The collected data was keyed into the data entry tool in SPSS version 26 for statistical analysis. Categorical variables such as sex, presence of co-morbidities and feeding techniques were summarized using frequencies with corresponding percentages. Continuous variables such as gestational age at birth, duration of hospitalization among others were summarized using mean with their corresponding standard deviation (SD). Multivariate analysis using compound correspondence analysis technique was used to test the association between neonatal characteristics and the occurrence of nosocomial infections. The p-values were obtained using Pearson chi-square to determine the likelihood of nosocomial infections with emphasis on possible predisposing neonatal characteristics at their corresponding 95% confidence intervals.

The study was approved before commencement by the Institutional Research and Ethics Committee (IREC) of Moi Teaching and Referral Hospital (MTRH) and Moi University School of Medicine and permission to conduct the study was sought from MTRH management (Approval No: 0003349). A written informed consent was obtained from all consenting mothers or care givers prior to commencement of the study. Confidentiality was maintained throughout the study using a password protected database and limiting the access only to the principal investigator and the research assistants.

Results and Discussions

This study enrolled 113 neonates, with 84 participants (74.34%) having nosocomial confirmed through blood culture tests. Proportionately, there were nearly similar levels of infections across various neonatal factors (gestational age, neonatal sex, birth weight, parenteral feeding, duration of hospitalization and utilization of mechanical ventilation) of interest in the current study.

Majority of the participants in this study 63 (55.75%) were female with male accounting for 44.25%. Of the 84 positive cases, 46 were from female neonates while 38 were male (Table 1). These finding contrasts those reported from India (Kumari & Vedavati, 2018), Nepal (Yadav *et al.*, 2018) and Trinidad and Tobago (Elliott, 2020). In Nepal, the proportion of male (50.91%) to female (49.09%) neonates was nearly equal in an initial study (Yadav *et al.*, 2017) and twice as high male proportion (64%) compared to that of female (36%) neonates in the second study (Yadav *et al.*, 2018) respectively.

https://doi.org/10.69897/16kyxj17

Table 1: Factors Predisposing Neonates to Nosocomial Infections

Host Factors	Sub-categories	Nosocomial infection			
		Yes	No	Total	p-value
Neonate gender	Female	46	17	63	0.718
	Male	38	12	50	
Gestational Age	Preterm	42	16	58	0.631
	Term	42	13	55	
Birth weight	XLBW	3	4	7	0.259
	VLBW	11	3	14	
	LBW	25	7	32	
	Normal	45	15	60	
Mechanical Ventilation	Yes	63	23	86	0.639
	No	21	6	27	
Parenteral feeding	Yes	66	24	90	0.629
	No	18	5	23	
Duration of Hospitalization	>28 days	21	1	22	0.926
	≤28days	63	28	91	

Key: *XLBW–Extremely low birthweight; VLBW–Very low birthweight, LBW-Low birthweight.*

Similar higher male (63.63%) proportions were reported in an Indian study (Kumari & Vedavati, 2018) and in Trinidad and Tobago (Elliott, 2020) at 56%. The contrasting results to other studies could be attributed to biological differences in immune response, hormonal influences and anatomical factors. The gestational age of a neonate impacts birth weight and cumulative passive immunity attained by the neonate from the mother. These factors impact on the neonate's susceptibility to infections. Nearly equal proportions of preterm 58 (51.33%) and full term 55 (48.67%) neonates were enrolled in this study. The positivity was also in equal proportions with 42 cases of nosocomial infections recorded in each category (Table 1). This study did not find any association (p=0.631) between gestational age of the neonate at the time of birth and the occurrence of nosocomial infections. This finding is similar to findings of other studies conducted in various continents where no association was reported (Chen *et al.*, 2017; Dobbler *et al.*, 2017; Mehar *et al.*, 2013; Kayange *et al.*, 2010). In Tanzania, Kayange *et al.* (2010), reported that gestational age did not significantly (p=0.206) affect the occurrence of nosocomial infections. In both China (Chen *et al.*, 2017) and India (Mehar *et al.*, 2013), it was established that there was no statistically significant association between gestational age and nosocomial infections with p-values

https://doi.org/10.69897/16kyxj17

of 0.210 and 0.133 respectively. Similar outcome (p=0.072) was also reported in a study conducted in Brazil (Dobbler *et al.*, 2017).

More than half (53.10%) of all the enrolled neonates in the current study had a normal birth weight out of whom 45 neonates tested positive for nosocomial infections (Table 1). Although previous studies (Wang *et al.*, 2013; Das *et al.*, 2011; Fatmi *et al.*, 2020; Kayange *et al.*, 2010; Bangi & Devi 2014) have reported birth weight as a predictor of possible susceptibility to nosocomial infections, this study did not find a significant association (p=0.259) between birth weight and nosocomial infections. In India (Das *et al.*, 2011; Bangi & Devi 2014), Spain (Fatmi *et al.*, 2020), Egypt (Ghaith *et al.*, 2020) and Tanzania (Kayange *et al.*, 2010) found that there was a statistically significant association between birth weight and gestational age with all these studies reporting a p-value below 0.05. Nosocomial infections are not limited to low-birth-weight neonates, as any neonate irrespective of their birth weight are at risk of infections.

Since most of these neonates were admitted in the new-born unit, more than three quarters (76.11%; n=86) of them needed mechanical ventilation. 63 of neonates in this study were on mechanical ventilation tested positive for nosocomial infections (Table 1). High proportions of low birthweight and preterm neonates increase the likelihood for mechanical ventilation of the new-borns to improve their treatment outcomes. However, mechanical ventilation can offer a reservoir for infection, and this could be attributed to the high proportion of infections. On the other hand, 27 neonates were not on mechanical ventilation with 21 of them testing positive. The statistically insignificant (p=0.639) means that mechanical ventilation is not directly linked to nosocomial infections based on this study. Therefore, mechanical ventilation did not significantly increase the likelihood of nosocomial infections among those enrolled in this study, just as it was seen in India (Das *et al.*, 2011) and Egypt (Ghaith *et al.*, 2020). This contrasts with findings in Tanzania (Kayange *et al.*, 2010) and another study in India (Bangi & Devi, 2014) which found that mechanical ventilation significantly increased the likelihood of nosocomial infections.

In this study, 90 neonates were on parenteral feeding out of which 66 contracted nosocomial infections (Table 1). Despite many neonates (73.33%) being on parenteral feeding testing positive, the statistically insignificant chi-square test p-value of 0.629 at $P \leq 0.05$ indicates that parenteral feeding does not predispose neonates to nosocomial infections. Findings from this study differ from those of other previous authors who documented those invasive procedures increases the risks of infections (Yadav *et al.,* 2018; Cristina *et al.,* 2019). Ghaith *et al.*, 2020, also reported that parenteral feeding significantly (p<0.001) increased the risk of nosocomial infections in a study conducted in Egypt (Ghaith *et al.*, 2020). The differences could be attributed to the study

https://doi.org/10.69897/16kyxj17

design, setting differences as well as possibility of proper sterilization procedures at MTRH.

Prolonged hospitalization could increase the likelihood of nosocomial infection when assessed on the face value. However, this study recorded more neonates (91) whose duration of hospitalization was ≤28 days with 63 having nosocomial infection (Table 1). The statistically insignificant chi-square test p-value of 0.926 at P ≤ 0.05 indicates that prolonged hospitalization does not predispose neonates to nosocomial infections. These findings are similar to those reported in India (Das *et al.*, 2011; Bangi & Devi 2014), Spain (Fatmi *et al.*, 2020) and Tanzania (Kayange *et al.*, 2010).

Conclusion and Recommendation

This study concludes that there was not statistical significance (p > 0.05) between gestational age, gender, birth weight, parenteral feeding, duration of hospitalization and use of mechanical ventilation and the likelihood of nosocomial infections among new-borns diagnosed with nosocomial infection at the neonatal unit in Moi Teaching and Referral Hospital. The occurrence of nosocomial infections at the neonatal unit was not dependent on neonatal characteristics. Therefore, there is need to enhance infection prevention and control strategies at neonatal units to help reduce the nosocomial infection burden and diversity.

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