BURDEN AND OUTCOMES OF BIRTH ASPHYXIA IN NEONATES ADMITTED TO THE NEONATAL INTENSIVE CARE UNIT OF THE TAMALE TEACHING HOSPITAL

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Abstract

Objective: The aim of this study was to determine the burden, outcomes and factors associated with outcomes of birth asphyxia among sick neonates admitted to the Neonatal Intensive Care Unit (NICU) of the Tamale Teaching Hospital (TTH).

Patients and Methods: A retrospective descriptive study design was used. Subjects included all neonates admitted to the unit with diagnosis of birth asphyxia, during the study period (January 2018-December 2019), who met the inclusion criteria. Descriptive statistics were presented in tables and graphs. Multiple logistic regression was used to identify independent predictors of mortality.

Results: The prevalence of birth asphyxia was 17.6% of admissions. There were more males (594,60.3%) than females and most (707,74.3%) of the cases seen were inborn. Majority (617,63.3%) were delivered via spontaneous vaginal delivery. APGAR scores ≤ 3 was seen in 259(26.3%) of the babies. The case fatality rate was 14.9% and more than half (78,53%) occurred within the first 24 hours of admission. Outborn babies were 2.7 times more likely to die from birth asphyxia compared to inborn babies(p-value=<0.001). Babies with APGAR scores ≤ 3 were 3.9 times more likely to die compared to babies with APGAR scores 4-6 at one minute, (p-value=<0.001) and babies born to mothers < 20 years of age were 2 times more likely to die as compared to older mothers (p-value=0.048).

Conclusions: Birth asphyxia is common in our facility. Outborn babies, babies with one-minute APGAR score ≤3, and maternal age < 20 years were significantly associated with mortality.

Key Words: *Birth asphyxia, APGAR score, case fatality, Tamale*

Introduction

Birth asphyxia is defined as failure to initiate and sustain breathing at birth.[1] The World Health Organization (WHO) in their International Classification of disease (ICD-10) used a one (1) minute APGAR score of 0-3, and 4-7 to describe severe birth asphyxia, and mild and moderate birth asphyxia respectively.[2] It is ranked as the sixth commonest cause of death in children under five, accounting for 8% of these deaths, globally.[3] In neonates globally, it is the second commonest cause of mortality, after prematurity and related complications.[4] There is disparity in the trends of the mortality with most of the deaths occurring in Low and Middle Income countries.[5]

Birth asphyxia has been recognized as a major cause of admission and death in Neonatal Intensive Care Units (NICU).[6,7] In Africa, varying occurrence have been reported. Ilah et al reported a prevalence of 21.1% at a specialist clinic in Nigeria with a similar prevalence (21%) seen in a study in Tanzania and Ethopia.[8,9,10] Siakwa et al reported that 20% of neonatal deaths in a teaching hospital in Ghana were due to birth asphyxia[11] and a study in Korle Bu Teaching Hospital showed high prevalence of asphyxia, with case fatality rate of 21.8%.[12]

Babies with birth asphyxia may have unfavourable outcomes such as mortality[12-14] and neurological disabilities such as cerebral palsy and developmental delay.[13-15] Dilenge et al concluded from a review of studies that intended to determine the developmental outcome of asphyxiated term neonates, that 5% to 100% of neonates that met the asphyxia criteria in each study developed severe neurological deficits later in life.[16]

Despite the reduction in the incidence of birth asphyxia with the institution of various interventions like the helping babies breathe, the mortality still remains high. Improvement in perinatal care and frequent training of staff is key to improving survival.

Our study aimed to determine the burden, outcomes and factors associated with outcomes of birth asphyxia among sick neonates admitted to the NICU of the Tamale Teaching Hospital (TTH), Tamale, Ghana.

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Patients and Methods

Study design and setting:

This retrospective descriptive study was conducted in the NICU of the TTH, the only tertiary hospital serving the Northern part of Ghana. The hospital serves as the teaching hospital for the University for Development Studies School of

Medicine, Tamale, Ghana. The NICU is a 50 cot/incubator capacity unit that receives and manages neonates with both surgical and medical conditions either born within or referred from other facilities within the catchment area.[17] Referrals to the unit are especially common from primary and secondary health institutions from the Northern, North East, Savannah, Upper East and Upper West Regions of Ghana.

Operational definitions:

Severe birth asphyxia: one (1) minute APGAR score between 0 and 3.[2]

Mild - moderate birth asphyxia: One (1) minute APGAR score between 4 and 6. [2]

Study population:

The study included all neonates born in the TTH, referred from other facilities or delivered home and subsequently admitted to the NICU with diagnosis of birth asphyxia, during the two-year study period (January, 2018 to December, 2019).

Inclusion criteria

All babies admitted to the TTH NICU with admission diagnosis of Birth asphyxia, defined as an APGAR score <7 at one (1) minute.[2]

Exclusion criteria

Babies with birth weight less than 2500g; gestational age < 35weeks; and babies with birth defects and congenital infections were excluded from the study.

Data collection procedure and tool:

Our NICU keeps electronic record of all admissions and outcomes of babies admitted into the unit. This database was set up in 2018 to capture routine data at discharge. The study team designed a data collection tool to extract neonatal and maternal demographic information, birth records of baby, clinical information on admission and outcomes of the admission. The electronic data base was then searched for all patients with a one-minute APGAR score < 7. Out of these, records of babies who did not meet the inclusion criteria as defined earlier were excluded from the data. The information of all eligible patients was then extracted into an excel sheet and cleaned.

Data analysis:

The data that was cleaned was transferred to the Statistical Package for Social Science (SPSS) version 23 and STATA12.1 for the data analysis. Descriptive statistics of frequencies and means (SD) were analysed and results were presented in tables and graphs.

Using STATA 12.1, we determined the influence of our independent variables (gender of baby, place of delivery, mode of delivery, birthweight, APGAR scores, maternal parity and maternal age) on our dependent variable (mortality). Analysis was done at two levels: bivariate and multiple logistic regression. Independent variables that produced P values of < 0.1 in the bivariate logistic regression were included in the final multiple logistic regression model that produced adjusted odds ratios (AOR). P values < 0.05 at 95% confidence interval (CI) were considered statistically significant in the final model.

Ethical considerations:

We obtained permission from the Research and Development Department of the TTH before carrying out this retrospective chart review. The investigators had no contact with participants or their parents during the study period.

Results

Demographic and baseline characteristics

Out of 5,590 neonates admitted to the NICU, 985 neonates met the study inclusion criteria and were recruited into the study. The prevalence of birth asphyxia, using our study definition, was 17.6%. There were more males (594,60.3%) than females (391,39.7%) and most (707,74.3%) of the cases seen were delivered in TTH. Majority (617,63.3%) were delivered via SVD. The APGAR score at one minute were 4 - 6 in most (726,73.7%) cases, with a score ≤ 3 seen in 259(26.3%) of the babies.

With respect to maternal factors, 110 (42.8%) of the cases were seen in primigravida mothers and 612 (83.5%) of the mothers were aged between 20 and 35 years. Table 1 shows the details of baseline characteristics of the study participants.

Outcomes

Out of the 985 babies included in our study, 147 died giving a case fatality rate of 14.9%. In all groups, that is both survivors and those who died, the duration of stay at NICU ranged from 0 to 40 days, with a median of 3 days. In the mortality group, the median length of stay at the NICU was one (1) day (range 0-34 days), and in the patients that were discharged, the median was 3 days (range 0 to 40 days). Figure 1 gives the distribution of the length of stay at the NICU among the babies who died in admission.

With respect to mortality, more than half (78,53%) were seen within the first 24 hours of admission and most of the deaths (92.5%) occurred within 6 days of admission.

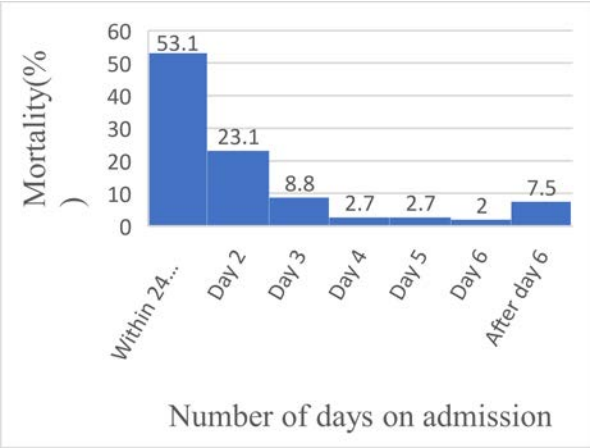

Figure 1: Distribution of death at the NICU by length of stay

Factors associated with outcomes

Gender, maternal parity, mode of delivery, birth weight, APGAR scores, place of delivery and maternal age was analysed to find out their effect on the outcome variable (mortality).

In the bivariate analysis, outborn babies, babies with APGAR scores ≤ 3 and babies born to mothers <20 years of age were more likely to die (table 2). In the multiple logistic regression analysis (table 3), outborn babies were 2.7 times likely to die from birth asphyxia compared to inborn babies (AOR = 2.75; P <0.001). Babies with APGAR scores ≤ 3 were 3.9 times likely to die compared to babies with APGAR scores 4-6 at one minute. (AOR = 3.92; P <0.001) and babies born to mothers < 20 years of age were twice more likely to die as compared to older mothers (AOR = 2.01; P =0.048).

Table 1: Demographic and baseline characteristics

Variable	Frequency (%)*
Gender of baby	
Male	594(60.3)
Female	391(39.7)
Place of delivery	
Inborn	707(74.3)
Outborn	249(25.7)
Birth Weight(kg)	
2.5 to 4	945(95.9)
>4	40(4.1)
Mode of delivery	
SVD	617(63.3)
C/S	358(36.7)
APGAR scores at 1 minute	
4-6	726(73.7)
0-3	259(26.3)
APGAR scores at 5 minutes	
4-6	433(88.4)
0-3	57(11.6)
Temperature on arrival (℃)	
>36.5	374(68.5)
36.5-37.7	118(27.1)
<37.5	54(9.9)
Maternal parity	
1	110(42.8)
2-4	108(42.0)
>4	39(15.2)
Maternal age(years)	
< 20	56(7.6)
20-35	612(83.5)
>35	65(8.9)
Age on admission	
Within 24 hours	801(81.3)
2 days	64(6.5)
>2 days	120(12)
Median:0 day	
Range: 0 to 28 days	

**Not all frequencies add up to 985 due to missing data for some of the variables. Percentages are calculated using the total valid count for each variable*

Table 2: Bivariate logistic regression analysis of predictors of mortality among babies admitted in our NICU with birth asphyxia.

Variables	Mortality*		COR (95% CI)	p-value
	Yes (%)	No (%)		
Gender				
Male	94(15.8)	500(84.2)	Reference	
Female	53(13.6)	338(86.4)	(0.580-1.200)	0.328
Place of delivery				
Inborn	83(11.7)	624(88.3)	Reference	
Outborn	60(24.1)	189(75.9)	2.387(1.649-3.455)	<0.001
Mode of delivery				
SVD	99(16.0)	518(84.0)	Reference	
C/S	45(12.6)	313(87.4)	0.752(0.515-1.099)	0.141
Birth Weight (kg)				
2.5 to 4	143(15.1)	802(84.9)	Reference	
>4	4(10.0)	36(90.0)	0.623(.218-1.778)	0.377
APGAR scores				
4-6	71(9.8)	655(90.2)	Reference	<0.001
0-3	76(29.3)	183(70.7)	3.831(2.666-5.506)	
Maternal parity				
1	13(11.8)	97(88.2)	0.590(0.277-1.255)	0.171
2-4	20(18.5)	88(81.5)	Reference	
>4	5(12.8)	34(87.2)	0.647(0.225,1.862)	0.420
Maternal age(years)				
<20	6(28.6)	40(71.4)	2.381(1.278-4.438)	0.006
20-35	88(14.4)	524(85.6)	Reference	
>35	11(16.9)	54(83.1)	1.21(0.610-2.410)	0.582

**Not all frequencies add up to 985 due to missing data for some of the variables. Percentages are calculated using the total valid count for each variable*

Table 3: Multiple logistic regression analysis of predictors of mortality among babies admitted in our NICU with birth asphyxia.

Variables	Mortality*		AOR (95% CI)	p-value
	Yes (%)	No (%)		
Place of delivery				
Inborn	83(11.7)	624(88.3)	Reference	
Outborn	60(24.1)	189(75.9)	2.750(1.760-4.30)	<0.001
APGAR scores at 1 minute				
4-6	71(9.8)	655(90.2)	Reference	
0-3	76(29.3)	183(70.7)	3.921 (2.548- 6.034)	<0.001
Maternal age(years)				
<20	6(28.6)	40(71.4)	2.013(1.007-4.024)	0.048
20-35	88(14.4)	524(85.6)	Reference	
>35	11(16.9)	54(83.1)	1.214(0.591-2.496)	0.598

**Not all frequencies add up to 985 due to missing data for some of the variables. Percentages are calculated using the total valid count for each variable*

Discussion

Birth asphyxia constitutes a global risk to neonatal survival with almost a quarter of neonatal deaths attributable to it.[18] In Africa and Ghana, it is on record as one of the major causes of neonatal morbidity and mortality.[12,19-21] Studies from Ghana's two largest hospitals have reported high burden of birth asphyxia and case fatality rates.[11,12] Our study aimed to document the burden, outcomes and factors associated with outcomes of birth asphyxia among sick neonates admitted to the NICU of the TTH, Tamale, Ghana.

We recorded a prevalence of birth asphyxia of 17.6% out of all the admissions during the study period. This was similar to the 17.5% reported in a study in Tanzania.[6]

Our finding was, however, lower than the 61.8% incidence reported by Mumuni *et al* in a study in Accra, Ghana and the 22.6% reported by Woday in Ethiopia.[1,12] The lower prevalence could be explained by differences in inclusion criteria in our study, that is the exclusion of low birthweight neonates and patients with congenital anomalies. Woday et al included babies with gestational age of 28 weeks and above whereas the study in Accra,

Ghana included term neonates.[1,12] Studies have shown that neonates with low birthweight have increased risk of birth asphyxia.[10,22,23] Our prevalence was however higher than the 9.7 % reported by Üzel et al in Turkey and the 5.1% in India.[24,25] This is expected as the rates of birth asphyxia is known to reduce with improvement in obstetric care.[26]

A case fatality rate of 14.9% was seen in our study. This was lower than the 21.8% reported in a previous study at the Korle-Bu Teaching hospital.[12] Methodological differences may account for this difference, as we excluded babies with birth weight < 2.5kg from our study, a variable has been associated with poor neonatal outcomes.[22,27] In addition, the APGAR scores in the Korle Bu study were relatively lower compared to what we documented in our study, although this parameter has been stated to be a poor predictor of early neonatal outcomes.[28] Our case fatality rate of 14.9% was similar to studies in Nigeria(14.7%) and Nepal(15.7%).[29,30] Predictors of mortality in our study were severity of APGAR scores at presentation, place of delivery and maternal age. Babies with APGAR scores ≤3 at one minute were 3.9 times (AOR = 3.92; P <0.001), likely to die compared to babies with an APGAR score of 4-6 at one minute. Lower APGAR scores have been linked with poor outcomes such as mortality and cerebral palsy in previous studies. [8,14,31] Outborn babies were 2.75 times (AOR = 2.75; P <0.001) likely to die from birth asphyxia as compared to inborn babies, a finding that conforms with reports of previous studies.[32,33] This could be explained by delayed presentation to the hospital, especially those presenting from other regions. A previous study showed that mortality in birth asphyxia is associated with late arrival to the NICU.[34]

Low maternal age has been generally associated with poor pregnancy outcomes and an association between maternal age and outcome of birth asphyxia has also been noted.[32,35,36] In our study, babies delivered by mothers of ages < 20 years were twice likely to die from birth asphyxia (AOR = 2.01; P =0.048) as compared to those delivered by mothers between 20 and 35 years of age. Biological immaturity of teenage mothers has been suggested as one reason responsible for this observation.[37,38] Teenage mothers are still growing, even during pregnancy, and thus compete with the developing fetus for nutrients. This coupled with the immaturity of the blood supply to the uterus may account for the poor outcomes seen in mothers < 20 years of age.[37]

Limitations

The main limitation of this study is the retrospective nature. We were limited with respect to maternal factors, such as diseases in pregnancy and information on frequency and quality of antenatal care provided. We could not also capture labor related factors such as duration of labor, and complications in labor that may contribute to birth asphyxia, as these information were not documented in the records of the patients.

Conclusions and recommendations

Birth asphyxia was common in our facility during the study period. Outborn babies, one-minute APGAR score ≤3, and maternal age < 20 years were significantly associated with increased risk of death. Further studies are needed to elucidate, especially maternal and health system factors associated with birth asphyxia in our facility, so that interventions can be planned to address them.

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Author contributions

Alhassan Abdul-Mumin: Conceived the study, contributed to data collection, cleaning, analysis and writing and revision of the manuscript
Kingsley Appiah Bimpong: Contributed to the data collection, performed the initial data analysis and contributed to writing of the manuscript
Sheila Agyeiwaa Owusu and Mary Joan Kpiniong: Contributed to the study design, data collection and writing of the manuscript
All authors revised the final manuscript and approved of its submission to the Post Graduate Medical Journal of Ghana.

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