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Immediate newborn outcomes of early neonates born to mothers who received magnesium sulphate during intrapartum at Kawempe National Referral Hospital- Uganda

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Abstract

Background: Magnesium sulphate (MgSO4) is a drug used to prevent and treat preeclampsia with severe features (PEC) and eclampsia in pregnant women. MgSO4 is also known to readily cross the placenta, fetal membranes and into the fetus and amniotic fluid and may produce hypotonia and hypotension. We set out to assess immediate newborn outcomes of early neonates born to mothers with preeclampsia receiving MgSO4 during intrapartum period.

Methods: This was an analytical observational cohort study at Kawempe National Referral Hospital in Uganda. Two hundred ten pregnant mothers with PEC or eclampsia were recruited in the study after receiving the loading dose of MgSO4 and then followed through labour and delivery to observe immediate newborn outcomes using Apgar score and the hospitalized newborns were followed through their first seven days of life and scored using Thompson scores. SPSS version 23 was used to analyse data to report frequencies, means and relationships between variables through chi square and analysis of variance (ANOVA) tests. P values <0.05 were considered statistically significant.

Results: The majority, 178/210 (84.8%), of the mothers delivered live babies, while 32/210 (15.2%) delivered stillbirths (13/32; 40.6% FSBs and 19/32; 59.4% MSBs). The mean (SD) Apgar score was 9.02 (1.45) with the majority 166/210 (93.3%) of the newborns having seven or higher. Factors significantly associated with the Apgar scores were maternal diagnosis (p<0.001) and NICU admissions (p<0.001). Apgar scores significantly differed by the gestational age (p<0.001), liquor state (p<0.001), labor induction (p<0.001) and birth weight (p<0.001). The mean (SD) Thompson score was 3.31 (±4.63) units. The majority 37/55 (67.3%) of the children had mild Hypoxic-Ischemic Encephalopathy (HIE) whereas 17/55 (30.9) were normal without HIE. Only one child had severe HIE. Thompson scores significantly differed by the mode of delivery (p<0.033).

Conclusions: Most NICU admissions were due to respiratory distress and preterm delivery, low Apgar score was more common in males and was associated to PEC than eclampsia and with caesarian births. Most deaths occurred with the first three days of life.

Keywords: Immediate Newborn Outcomes; Intrapartum; Magnesium Sulphate; Apgar Score; Thompson Score; Uganda

Abbreviations: AOR: Adjusted Odds Ratio; FSB: Fresh Still Birth; LBW: Low Birth Weight MgSO4: Magnesium Sulphate; MSB: Macerated Still-Birth; SVD: Spontaneous Vaginal Delivery; NICU: Neonatal Intensive Care Unit; UCG: Uganda Clinical Guidelines; WHO: World Health Organization; PEC: Pre-eclampsia with severe feature

Background

Pre-eclampsia is a multisystem, highly variable disorder unique to pregnancy characterized by high blood pressure and protein in the urine that usually arises after 20 weeks of pregnancy; it is a leading cause of maternal fetal/neonatal morbidity and mortality in both developed and third world countries [1]. The World Health Organization recommends using Magnesium sulphate (MgSO4) as the anticonvulsant drug of choice for the prevention of seizures in women with PEC and prevention of recurrence of seizures in eclamptic women [2]. In PEC and eclampsia, MgSO4 is administered as a 14g loading dose, followed by 5g every four hours for 24 hours after the mother has given birth or until the last convulsion in eclampsia, +whatever of the two comes last [2,3]. After administration, about 40% of plasma magnesium is protein bound, the unbound magnesium ion diffuses into the extravascular and extracellular space, into bone, and across the placenta and fetal membranes and into the fetus and amniotic fluid. In pregnant women, apparent volumes of distribution usually reach constant values between the third and fourth hours after administration, and range from 0.250 to 0.442 L/kg [4].

Infants of mothers with pre-eclampsia are at approximately 2-fold higher risk of neonatal death and increased risk of low Apgar scores, seizures, neonatal encephalopathy, and neonatal intensive care admission [5]. In addition, when mothers of infants are treated with MgSO4 administered for longer than seven days, there is low calcium in the baby's bones [4,6]. Despite previous studies reporting; fetal abnormalities such as hypocalcaemia, skeletal demineralization, osteopenia, congenital rickets, and other skeletal abnormalities following continuous maternal administration for more than 5 to 7 days [7], neonatal fractures and increased pediatric mortality when the drug is used in preterm labor and given for longer than 7 days [8]. Signs of hypermagnesemia, including respiratory and neuromuscular depression when administered in two hours preceding delivery [9,10]. Therefore, the current study aimed to assess the immediate newborn outcomes of early neonates born to mothers who received magnesium sulphate during intrapartum at Kawempe National Referral Hospital. The study site was chosen because it is a national referral hospital where almost all mothers with severe obstetric conditions are referred hence easy to obtain the study participants.

Methods

Study Area and Design

The study used an analytical observational cohort design to newborns in Kawempe National Referral Hospital, Uganda. The hospital is a government national referral facility with a 200-bed capacity that serves as a clinical, training, and research facility. The study was conducted in the labour ward, severe PET ward, obstetric theatre, HDU, ICU, postnatal ward, and neonatal intensive care unit.

Study Participants

Respondents were mother baby pairs of pregnant women diagnosed with PEC or eclampsia and had received magnesium sulphate during labour and their newborn babies.

Inclusion and Exclusion Criteria

Mothers at 28 weeks of gestation diagnosed with PEC or eclampsia during triaging and being treated with MgSO4 intrapartum or prelabour were recruited in the study and their newborn babies. All mothers fitting the inclusion criteria but for various reasons missed receiving MgSO4 were excluded from the study and the unconscious mothers who could not consent or answer any questions asked by the researcher were also excluded from the study.

Sample Size Calculation

The sample size was determined by the Kish Leslie formula [11] for survey studies at a 16.0% prevalence of eclampsia documented by Milln and Nakimuli from a study that quantified the burden of complex medical conditions on the obstetric high-dependency unit at Mulago National referral Hospital in Uganda [12] for a 95% confidence interval and a precision of 0.05 thus yielding a total targeted sample of 210 mothers baby pairs of women with preeclampsia.

Sampling Procedure

Given that the labour ward at the hospital is the admission point for all mothers in labour irrespective of the underlying condition, it was desirable to use a consecutive sampling technique as it allows every participant who meets the inclusion criteria to be selected [13] until the requires sample size is achieved.

Data Collection Methods and Tools

Structured questionnaires with mainly close-ended questions, socio-demographic, obstetric characteristics, and delivery characteristics were obtained from the mothers through interviews that lasted for 30 to 45 minutes. Prior to the actual assessment, research assistants were trained and deployed with the drafted tools between 22nd and 28th August 2022. Actual data collection commenced on 29 August 2022 and ended on 16 October 2022. The total follow-up time from the time of recruitment of the mother to the final data collection from the newborn took seven days. The Principal Investigator was part of the entire process of data collection including the actual observation of Apgar and Thompson scoring. Apgar and Thompson scoring: Apgar scoring was done by the midwife who delivered the mother and the research assistant only copied the score that the midwife gave, therefore, newborn parameters such as the heart rate, muscle tone and other signs were captured and recorded in the patient files to ascertain the need for extra medical care or emergencies. This was done twice; at 1 minute after birth, and repeated 5 minutes after birth. Thompson scoring of the newborns was done by the principal investigator and research assistants on the fifth day of

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admissions and on the day of discharged for the babies who were discharged before five days of hospital stay.

Data Analysis

Analysis of Apgar scores were categorised as low for scores less than seven and normal for scores between 7-10. On the other hand, Thompson's scores were categorized as 0 for normal, between 1 and 10 for mild neonatal encephalopathy, between 11 and 14 for moderate neonatal encephalopathy, and 15 and 22 for severe neonatal encephalopathy. Statistical analysis was performed using the IBM SPSS Statistics software version 26. The mean and standard deviations were computed for continuous variables. Categorical variables were analysed to report descriptive statistics and cross-tabulations using the Pearson chi-squared test. For continuous and categorical variables, the statistical association using ANOVA techniques was used and to make inferences about the differences in means between the two groups under consideration, the p-values < 0.05 was considered statistically significant.

Data Availability Declaration

Both the acquired and analyzed data are not publicly available because of the lack of authorization from the agreement made with the Research Ethics Committee that the database would remain with the corresponding author only. However, all data can be made available by the corresponding author upon reasonable request and authorization from the Research Ethics Committee.

Study Questionnaire

The questionnaire which was used in this study was specifically developed for the study although it incorporated time tested tools of newborn scores such as Apgar score which was developed by Virginia Apgar (1962), Thompson score by (Thompson et, al, 1997) which were used to assess the immediate newborn outcomes in this study.

Results

Characteristics of Study Participants

Overall, the study assessed 210 mother newborn dyads. The mothers received magnesium sulphate at the hospital. Immediate newborns outcomes including the Apgar scores and Thompson scores of the newborns were evaluated. Details regarding sociodemographic factors of mothers, MgSO4 administration patterns as well as newborn characteristics have been published [14].

Apgar Scores of Neonates Born to Mothers Receiving Mgso4

Overall, 32/210 (15.2%) delivered stillbirths (13/32; 40.6% FSBs and 19/32; 59.4% MSBs), 178/210 (84.8%), of the mothers delivered live babies and were Apgar scored. The mean (SD) Apgar score was 9.02 (1.45). The lowest and highest Apgar scores were 2.00 and 10.00 respectively (Table 1).

Factors Associated with Newborn Apgar Scores

As shown in the table 2 below, Apgar scores were significantly associated with the diagnosis ($p<0.001$) with the majority (89.8%) of children who scored highly coming from mothers with PEC. Apgar scores were not significantly associated ($p>0.05$) with factors such as the age, marital status, gestational age, and blood pressure. Apgar scores were not significantly associated with labour and delivery factors ($p>0.05$). However, majority of children with high Apgar scores were those from mothers who produced by caesarean section (65.1%) and were in active labour (54.3%).

Variations in Apgar Scores with Birth Outcomes

Apgar scores were significantly associated with the admission of the child to the neonatal intensive care unit ($p<0.001$) with the majority (68.4%) of the babies with high Apgar scores being those who were not admitted to the NICU. The Apgar scores were not significantly ($p>0.05$) associated with other newborn outcomes. However, the majority of babies with low Apgar scores were males (58.7%) and those who spent between 4 to 7 days in the NICU (50.0%) (Table 3).

ANOVA Table of Differences in Apgar Scores

As shown in the table below, the mean Apgar scores significantly differed by the gestational age ($p<0.001$), liquor state ($p<0.001$), labour induction ($p<0.001$) and birth weight of the newborn babies ($p<0.001$). Mothers who delivered at 34 to 36 weeks and at 37 and above weeks scored significantly higher Apgar scores 8.60 (2.82), $p<0.001$ and 8.42 (2.95), $p<0.001$ respectively, compared to those who produced at 33 or lesser weeks 5.02 (4.42). Mothers that had clear liquor and those that had meconium-stained liquor had significantly higher Apgar scores. Newborns to mothers with bloodstained liquor scored significantly lower Apgar scores 1.42 (3.37), $p<0.001$. Apgar scores were significantly lower among babies born to mothers who were labour induced compared to those who were not induced. In addition, higher Apgar scores were observed among babies born weighing more than 2.4 kilograms 8.77 (2.69), $p<0.001$ and those weighing between 1.5 to 2.4 kilograms 7.51 (3.98), $p = 0.041$ compared to those who weighed below 1.5 kilograms 4.00 (4.42), $p<0.001$ (Table 4).

Thompson Scores of Neonates Born to Mothers Receiving Mgso4

As shown in the table below, 55 babies were Thompson score. The mean (SD) Thompson score was 3.31 (±4.63) units. The majority 37 (67.3%) of the children had mild Hypoxic-Ischemic Encephalopathy (HIE), 17 (30.9) were normal without HIE and one child had severe HIE. None of the assessed children had moderate HIE (Table 5).

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Table 1.

Variable	Frequency (percent)	Mean (SD)
Apgar scores		
Less than 7	12 (6.7)	9.02 (1.45)
7 and above	166 (93.3)	

*Apgar scores were categorized as low for <7 and high for 7 and above.

Table 2: Factors associated with Apgar scores.

Variable		Apgar scores n (%)		Chi-square value
	Low	High		
	Sociodemographic factors			
Age category	24 and below	7 (58.3)	67 (40.4)	X2(2)1.507, p=0.471
	25 to 35	4 (33.3)	82 (49.4)	
	Above 35	1 (8.3)	17 (10.2)	
Marital status	Not married	3 (25.0)	35 (21.2)	X2(1) 0.758, p=0.758
	Married	9 (75.0)	130 (78.8)	
Systolic BP (mmHg)	<149	2 (16.7)	18 (10.8)	X2(2)0.576, p=0.750
	150 to 159	3 (25.0)	35 (21.1)	
	>159	7 (58.3)	113 (68.1)	
Diastolic BP (mmHg	<89	0 (0.0)	13 (7.8)	X2(2)1.766, p=0.414
	90 to 99	5 (41.7)	46 (27.7)	
	>99	7 (58.3)	107 (64.5)	
Diagnosis	Severe preeclampsia	7 (58.3)	149 (89.8)	X2(1)10.203, p<0.001*
	Eclampsia	5 (41.7)	17 (10.2)	
		Delivery characteristics		
Birth mode	SVD	3 (25.0)	58 (34.9)	X2(2)0.586, p=0.746
	C-section and others	9 (75.0)	108 (65.1)	
Stage of membrane rapture	Latent	1 (20.0)	17 (18.5)	X2(1)0.527, p=0.913
	Active	2 (40.0)	50 (54.3)	

Table 3: Variations in Apgar scores with birth outcomes.

Variable Low		Apgar scores n (%)		Chi-square value
		High		
Sex	Male	7 (58.3)	89 (53.6)	X2(1)0.100, p=0.751
	Female	5 (41.7)	77 (46.4)	
Admission to NICU	No	0 (0.0)	108 (68.4)	X2(1)2.491, p<0.001*
	Yes	12 (100.0)	50 (31.6)	
Reasons for NICU admission	Preterm and RD	7 (58.3)	37 (72.5)	X2(2)1.732, p=0.421
	Others	5 (41.7%)	14 (27.5)	
Days spent in NICU	<3 days	5 (41.7)	18 (34.6)	X2(2)1.061, p=0.588
	4 to 7 days	6 (50.0)	29 (44.2)	
	>7 days	1 (8.3)	11 (21.2)	

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Table 4: ANOVA table of differences in Apgar scores.

Characteristics		n (percent)	Mean (SD)	ANOVA p-value	Covariates	Post-hoc p-value
Gestational age	33 or less	47 (22.4)	5.02 (4.42)	<0.001*	34 to 36	<0.001*
	34 to 36	41 (19.5)	8.60 (2.82)		37 or above	<0.001*
	37 and above	122 (58.1)	8.42 (2.95)		34 to 36	0.945
Liquor state	Clear	153 (73.2)	8.55 (2.77)		Meconium stained	<0.001*
	Meconium stained	44 (21.1)	6.59 (4.08)	<0.001*	Blood stained	<0.001*
	Blood stained	12 (5.7)	1.42 (3.37)		clear	<0.001*
Labour induction	Yes	148 (70.5)	8.32 (3.05)	<0.001*	-	-
	No	62 (29.5)	6.21 (4.32)		-	-
Birth weight in kgs	<1.5	32 (15.2)	4.00 (4.42)		1.5 to 2.4	<0.001*
	1.5 to 2.4	58 (27.6)	7.51 (3.98)	0.001*	>2.4	0.041*
	>2.4	120 (57.1)	8.77 (2.69)		<1.5	<0.001*

Post hoc tests are not performed for labour induction because there are fewer than three groups.

Table 5: Thompson scores of the assessed new-borns.

Variable		Status	Frequency (percent)	Mean (SD)
Thompson	0	Normal	17 (30.9)	3.31 (±4.63)
	1 to 10	Mild HIE	37 (67.3)	
	11 to 14	Moderate HIE	0 (0.0)	
	15 and above	Severe HIE	1 (1.8)	

Variations in Thompson scores

As shown in the table 6 below, Thompson scores were not significantly (p>0.05) associated with any of the sociodemographic factors. However, HIE was mainly observed among children born at gestation age between 33 and below (39.5%), systolic pressure >159 mmHg (65.8%), diastolic pressure >99 (73.6%) and those with severe preeclampsia (86.8%). Thompson scores were not significantly (p>0.05) associated with delivery and birth related characteristics. However, the majority of babies who presented with HIE were from mothers who produced by caesarean section (65.8%), were not labour induced (78.9%), membrane rapture occurred in the active stage of labour (57.1%) and had clear liquor (73.7%) (Table 6).

ANOVA Table of Differences in Thompson scores

As shown in table below, Thompson scores significantly differed by the mode of delivery. Babies delivered through the SVD method scored exhibited higher Apgar scores 5.47 (7.22) compared to their counterparts delivered through the emergency caesarean section 2.50 (0.46) (Table 7).

Variations in Thompson by Newborn Outcomes

As shown in the table below, Thompson scores were not significantly (p>0.05) associated with newborn outcomes. Babies with HIE were mainly female (63.2%), weighed between 1500 to 2400 grams (47.4%), were preterm with respiratory distress (73.7%) and spent between 4 to 7 days in the NICU (52.6%) (Table 8).

Discussion

In this study, we assessed the immediate newborn outcomes of early neonates born to mothers who received MgSO4 during intrapartum period. It was found that overall, 127(60.5%) of the mothers delivered by emergency caesarean section, 32 (15.2%) of mothers delivered stillbirths, the majority, 178 (84.8%), delivered live babies and were Apgar scored. Of these, 31.0% babies had complications, and were admitted to the neonatal intensive care unit (NICU). NICU admissions were mostly due to respiratory distress 21.4%, preterm delivery 21.0%, and 5.5% died within seven days.

Apgar Scores of Neonates Born to Mothers Receiving MgSO4

Apgar score is a general and quick assessment of a newborn's well-being immediately after birth and is recorded at one minute and five minutes from the time of birth [15,16]. Apgar is an acronym that depicts Appearance, Pulse, Grimace, Activity, and Respiration. These are used to assess the newborn's skin color, heart rate, reflexes, muscle tone and breathing rate and effort respectively [16]. These five elements are used to check the newborn's health at one and five minutes. Each is scored on a scale of 0 to 2, with 2 being the best score and sums up to a total of 10. This score can be affected by both maternal, labor process and fetal conditions [17].

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Table 6: Variations in Thompson scores.

Variables		Thompson Scores n (%)		Chi-Square Value
		Normal	HIE present	
	Sociodemographic Factors			
Maternal age (years)	24 and below	6 (35.3)	18 (47.4)	X2(2)1.149, p=0.563
	25 to 35	9 (52.9)	18 (47.4)	
	Above 35	2 (11.8)	2 (5.3)	
Marital status	Not married	6 (35.3)	8 (21.1)	X2(1)1.255, p=0.263
	Married	11 (64.7)	30 (78.9)	
Gestational age (weeks)	33 and below	5 (29.4)	15 (39.5)	X2(2)3.022, p=0.221
	34 to 36	3 (17.6)	12 (31.6)	
	37 and above	9 (52.9)	11 (28.9)	
Systolic BP (mmHg)	<149	3 (17.6)	4 (10.5)	X2(2)0.558, p=0.757
	150to 159	4 (23.5)	9 (23.7)	
	>159	10 (58.8)	25 (65.8)	
Diastolic BP (mmHg)	<89	0 (0.0)	2 (5.3)	X2(2)3.014, p=0.222
	90 to 99	7 (41.2)	8 (21.1)	
	>99	10 (58.8)	28 (73.6)	
Diagnosis	Severe preeclampsia	11 (64.7)	33 (86.8)	X2(1)3.597, p=0.058
	Eclampsia	6 (35.3)	5 (13.2)	
	Delivery characteristics			
Labour induction	No	13 (76.5)	30 (78.9)	X2(1) 0.042, p=0.837
	Yes	4 (23.5)	8 (21.1)	
Membrane rapture stage	Latent	1 (20.0)	2 (9.5)	X2(2)2.394, p=0.302
	Active	4 (80.0)	12 (57.1)	
	Second	0 (0.0)	7 (33.3)	
Liquor state	Clear	15 (88.2)	28 (73.7)	X2(2)1.600, p=0.449
	Meconium stained	2 (11.8)	9 (23.7)	
	Blood stained	0 (0.0)	1 (2.6)	

Table 7: ANOVA table of differences in Thompson scores.

Variable	n (percent)	Mean (SD)	ANOVA-value	p-value
Delivery mode				
SVD	15 (27.3)	5.47 (7.22)	(1,53) = 4.784	0.033*
Emergency C-section	40 (72.7)	2.50 (0.46)		

Table 8: Variations in Thompson by new-born outcomes.

Variable	Thompson Scores n (%)		Chi-Square Value
	Normal	HIE Present	
Sex			
Male	9 (52.9)	14 (36.8)	X^2 (1) 1.251, p=0.263
Female	8 (47.1)	24 (63.2)	
Birth weight (Grams)			
<1500	2 (11.8)	11 (28.9)	X^2 (2) 2.122, p=0.346
1500 to 2400	9 (52.9)	18 (47.4)	
>2400	6 (35.3)	9 (23.7)	

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Admission to NICU			
No	0 (0.0)	2 (5.4)	X^2 (1) 0.954, p=0.329
Yes	17 (100.0)	35 (94.6)	
Reasons for NICU admissions			
Preterm and respiratory distress	9 (52.9%)	28 (73.7)	X^2 (1) 2.295, p=0.130
Others	8 (47.1)	10 (26.3)	
Days spent in NICU			
<3 days	7 (41.2)	9 (23.7)	X^2 (2) 1.746, p=0.418
4 to 7 days	7 (41.2)	20 (52.6)	
>7 days	3 (17.6)	9 (23.7)	

The one-minute Apgar score indicates the baby's physical health, and how labor and delivery processes were handled thus determining whether immediate or future medical treatment will be required. The five-minute Apgar score assesses how the baby is adapting to extra uterine life, how he/ she has reacted to previous resuscitation attempts if such efforts were made [18]. Overall, a large majority (93.3%) of the babies born to mothers who received MgSO4 at Kawempe National Referral Hospital scored high or desirable Apgar scores at 5 minutes. Notably, the majority of babies with high Apgar scores were born to mothers with PEC and were not admitted to NICU. These high Apgar scores in the study could be linked to the high proportion of women with PEC who had no complications and caesarean deliveries. Similar to this finding, Sirenden et al found that women with severe preeclampsia with no complications who delivered by caesarean section had newborns with Apgar scores of 7 to 10 at five minutes [19].

Overall, Apgar score were significantly associated with maternal diagnosis with a large majority of babies who scored above seven at five minutes being those from mothers that had PEC. This is probably due to the fits in eclampsia that cut off oxygen supply to the fetus putting an increased risk of distress to the fetus of mothers diagnosed with eclampsia [19]. Neonates born to mothers whose pregnancies were complicated by PEC for which the mother received intrapartum magnesium sulphate showed Apgar scores ranging from 5- 6 at one minute, 6-7 at five minutes and 6-8 at ten minutes.

Factors significantly associated with low Apgar scores among newborns were maternal diagnosis and admission status as new-borns who needed more care were admitted to NICU unlike their counterparts who did not need more care and were sent to postnatal ward with their mothers. This concurs with findings documented in another study that found that NICU admission or gestational age were both significantly associated with one and five-minute Apgar scores and were directly related to gestational age as it affected respiratory efforts, muscle tone, and reflexes thus low gestational age decreased Apgar score [20].

Low Apgar scores have also been observed in neonates born to mothers who have received magnesium sulphate in labour along with a higher incidence of hypotonia and lower median Apgar scores than control infants [21]. Infants born to mothers treated with magnesium sulphate were more likely to be hypotonic and have lower Apgar scores at birth [4]. This is comparable to our analysis of variance test which revealed that Apgar scores among newborns significantly differed by various factors such as the gestational age, liquor state, induction and birthweight. Moreover, on average, mean scores were higher among babies born at a higher gestational age, mothers who underwent induction, had clear liquor and babies with higher birth weight.

Thompson Scores of Neonates Born to Mothers Receiving MgSO4

Thompson score is a clinical assessment tool, describing both neurological and vital parameters after neonatal resuscitation. It is a clinical tool comprising of a set of clinical signs associated with central nervous system dysfunction [22]. Thompson score uses nine parameters of measure namely tone, consciousness, fits, posture, moro, grasp, suck, respiration and fontanel, the score is used to assess the status of a child following birth asphyxia or low Apgar score [23-26]. In Thompson scoring system, a score of 0 is normal and the maximum score is 22 which signifies the worst possible status of Hypoxic-Ischemic Encephalopathy (HIE). Neonates with score 1-10 are considered to have mild HIE, 11-14 have moderate HIE and 15-22 are considered to have severe HIE.

Neonates born to mothers who have been treated with magnesium sulphate during labour get neurological complications that require them to stay in hospital for further management ranging from neonatal special care to neonatal intensive care as they have respiratory difficulties, feeding and gag reflex difficulties, among others as a result on in utero exposure to magnesium sulphate [27]. This was also the case in our study as 31% of the total neonates were admitted to NICU after birth.

Overall, slightly more than two thirds of the newborns presented with mild HIE whereas only one child had severe HIE. Close to one-third (30.9%) of the babies did not have HIE. Respiratory failure and hypotonia resulting from utero magnesium

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toxicity have been reported in infants even if the mother's levels of magnesium sulphate are within normal limits affecting these neonates, including term neonates, not just temporarily with the respiratory effect but also causing hypotonia in the newborn, hypoxic-ischemic encephalopathy of a newborn [28].

Neonates exposed to utero MgSO4 may be associated independently with NICU admission in a dose dependent relationship. These neonates need respiratory resuscitation with intravenous fluid and nutritional support, likely due to feeding difficulties in exposed neonates as they end up with poor gag and suckling reflexes [9]. This was similar to the findings in this study as the neonates admitted to NICU were mostly due to respiratory distress and were also treated with intravenous and nutritional support due to feeding difficulties. Exposure to magnesium sulphate proximal to delivery that is less than twelve hours is associated with reduced odds of cerebral palsy in preterm births compared with more remote exposure or no exposure at all [8,29].

Notably, the majority of babies who presented with HIE were those born to mothers at a low gestational age, had severe preeclampsia, delivered by caesarean section, were not labour induced, had membrane raptures during the active stage of labour and had clear liquor. Still, the findings revealed that babies with HIE were mainly female, weighed between 1500 to 2400 grams, were preterm with respiratory distress and spent between four to five days in the neonatal intensive care unit. Hypermagnesemia was recognized as a reason for hypotonia, apparent neonatal encephalopathy, and temporary respiratory failure in a neonate born to a mother who received magnesium sulphate during labour [30]. Moreover, Thompson scores among newborns significantly differed by the mode of delivery. Babies delivered through the SVD method exhibited higher Apgar scores compared to their counterparts delivered through the emergency caesarean section. The higher Apgar scores among babies delivered through the SVD might be linked to the fact that they were born to mothers with PEC who had no complication unlike their counterparts whose mothers got complications and had to deliver by emergency caesarean section [8].

Study Strength and limitations

The study site hospital had a good stock of MgSO4 and was readily available for use which made it easy to attain the number of mothers receiving MgSO4 during intrapartum period that were need for the study.

We were not in a position to take cord blood to measure neonatal serum MgSO4 concentrations, hence we did not analyze it to determine concentrations of MgSO4 in the newborn. Since the unit does not monitor the intrapartum mothers on labor progress charts like patographs, it was difficult to ascertain if the low Apgar score in newborns of mothers who delivered by emergency caesarean section were due to other factors such as prolonged labor, failed induction etc... In addition, we had limited time and resources hence could not take on a bigger sample size or follow up newborns that were not admitted in NICU since they got discharged to go home with twenty-four hours of being born.

Conclusions

Despite the majority of the assessed newborns having high Apgar scores, it is worth noting that both labour related characteristics and child related factors negatively affected the Apgar scores among the newborns. The low Apgar scores in newborns of mothers who gave birth at a low gestational age and low birth weight point to wider health system weaknesses that put babies at a risk of premature deaths. On the other hand, the majority of the newborns exhibited mild HIE with only one child having severe HIE with only a fraction of children being without HIE. HIE among newborns put children at risk of short short-term effects such as difficulty breathing, abnormal response to light, and challenges with blood pressure and heart. And long-term effects such as permanent brain damage and a number of conditions, including: developmental delays, hearing or vision loss, intellectual disability, epilepsy, cerebral palsy, mental health conditions etc.

Recommendations

Use of the midwifery model that allows the midwife to manage all mothers with no complications, monitoring mothers on labor progress tools such as partograph, which will guide labor management and alert the midwife when complications arise so that intervention can be made that prevent fetal distress occurrences as fetal distress usually not only result in low apgar score but in HIE as well. Pregnant women with known hypertension and those who develop gestational need to be closely followed throughout their pregnancy journey so that they do not PEC or eclampsia and if they do, it should be managed in hospital early to prevent preterm delivery and other complications that arise as a result preeclampsia. study needs to be done where newborn cord blood will be taken off to measure neonatal serum MgSO4 concentrations and also follow up the newborns who are sent home with their mothers within 24 hours of being born as some of them tend to come back for admission with in the first seven days of life.

Declaration

Ethics approval and Consent to Participate

Ethical review and approval were obtained from the Research Ethics Committee (REC) of the School of Health Sciences, College of Health Sciences at Makerere University under REC number MAKSHSREC-2022-330. Administrative clearance and permission to collect data were obtained from the management of Kawempe National Referral hospital. For all mother baby pair participants, a written informed consent to participate voluntarily in the study prior to data collection was given to the mother and were informed that there would be no consequences if they withdraw from the

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study at any given point of the study if they wished not to continue. Mothers of newborns who could not read or write were asked to provide informed verbal consent after the script was read to them by the research assistant in order to assist in the comprehension of the research and informed verbal consent process, and these participants signed the written consent form by putting a thumb print. Information collected from the respondents was held with confidentiality through the use of anonymous questionnaires which were filed and kept under lock and key throughout the whole data collection and analysis process.

Availability of Data and Materials

The acquired and/or analyzed data are not publicly available because of the lack of authorization from the agreement with the Research Ethics Committee that the database would remain with the corresponding author only. However, all data can be made available by the corresponding author upon reasonable request.

Data collection Tool Used and Data Set

The questionnaire that was used to collect data for this study and a data set have been provided as Appendix 1 and 2 respectively in the supplementary information section of this file.

Competing Interests

I declare that the authors of this study have no competing interests as defined by Journal of pediatrics and pediatric Medicine, or other interests that might be perceived to influence the results reported in this study, and/or discussion reported in this paper.

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Authors' Contributions

Mariam Birungi was the primary author of this paper, she carried out the study right from proposal writing to data collection to dissertation and manuscript writing, she also identified the journal for publication and has responded to all comments raised up until the paper was ready for publication. Scovia Nalugo Mbalinda was the primary supervisor and mentor of the lead author, contributed in conceptualizing of the topic of research and was the primary reviewer of the whole research project writing, all the other authors were supervisors and reviewers. All authors approved the final draft of the paper.

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