

A Review of Delivery Room Resuscitation in Neonates above 1500 grams Birthweight in a Tertiary Hospital in South Africa

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ABSTRACT

Background: There is limited information on delivery room resuscitation in sub-Saharan Africa

Objectives: To audit delivery room resuscitation and determine the survival to discharge of neonates who were resuscitated at birth in a tertiary referral centre in South Africa

Methods: This was a retrospective, descriptive study of delivery room resuscitation in all inborn neonates >1500g birthweight admitted to the neonatal unit within 24 hours at a tertiary referral hospital in Johannesburg, South Africa. between 01/01/2013 and 30/06/2016

Results: There were 32081 live births at the institution during the study period. The study sample comprised 2966 neonates. The majority of neonates was male (n=1740/2964, 58.7%). The mean birth weight was 2645 grams (SD 805) and gestational age was 36.5 weeks (SD 3.5) The most common mode of delivery was Caesarean section (CS) (1865/2948, 63.2%). The overall mortality rate was 4.2% (125 / 2966) with 29.6 % (37/125) of the deaths occurring in the delivery room. Only 37% of babies (1089/2966) did not require resuscitation at birth. Mortality rates were 5.1% (96/1877) for babies who received oxygen at birth. Advanced delivery room resuscitation (ADRR) (intubation, adrenaline and /or chest compressions) was required in 7.5% (221/2966) of babies and 29.0% of babies who required ADRR died (64/221). Multivariate logistic regression revealed that the variables most strongly associated with ADRR were birth weight (OR 0.999; 95% CI 0.990- 1.000; p=0.018), presence of HIE (OR 2.902 95% CI 1.387-6.072; p=0.005) and death (OR 4.575, 95% CI 2.2112 – 9.914, p<0.001).

Conclusion: Mothers with high risk pregnancies must be identified and referred to adequately equipped centres for delivery.

INTRODUCTION

Despite significant advances in neonatal care and outcomes, South Africa still has an unacceptably high neonatal mortality rate. In South Africa, 40% of deaths in children under the age of five years occur in the neonatal period. (1) Hypoxia is an important cause of both neonatal morbidity and mortality in South Africa.(2-4)

Most neonates achieve the transition from intra-uterine to extra-uterine life without any problem, but a few neonates will require extensive resuscitation at birth. (5-7). Approximately 2% of all neonates will require intubation at birth to support respiratory function and 0.1–0.2% of neonates will require chest compressions and/or adrenaline for survival (6, 8). Adequate delivery room resuscitation is required to reduce neonatal morbidity from hypoxia.(3) Successful advanced neonatal resuscitation requires the ability to provide manual ventilation, endotracheal intubation, chest compressions, vascular access and drug administration. It is also necessary for staff to work as a team. The ability to predict which neonates will require advanced resuscitation before birth allows optimal utilisation of both staff and resources, which is especially relevant in low and middle income countries (LMICS).(6-8). An important question is whether or not the need for advanced life-support can be predicted prior to delivery. (9-12).

Not only does perinatal asphyxia cause death, but neonates are at increased risk of morbidity, particularly neonatal encephalopathy (NE) and long term neurological handicap in term and near-term infants.(13) Other researchers have reported that advanced delivery room resuscitation (ADRR) in neonates is associated with increased morbidity and mortality.(14) There is limited information published on

neonatal resuscitation in sub-Saharan Africa. The aim of this study was to audit delivery room resuscitation in babies with a birth weight above 1500 grams at a tertiary centre in South Africa. Objectives were to determine how many babies required ADRR, the outcomes of babies who underwent different levels of delivery room resuscitation and to establish associations with the need for ADRR.

METHODS

This was a retrospective, descriptive review of delivery room resuscitation in all neonates with a birthweight above 1500 grams admitted to a tertiary neonatal unit between 01 January 2013 and 30 June 2016. Very low birth weight (VLBW) infants may require delivery room resuscitation for complications of prematurity and not only perinatal asphyxia, so were excluded from this analysis. All neonates with a birth weight above 1500 grams with complete delivery room information were included in the study. Neonates were excluded if they had major birth defects, they were born elsewhere, they were admitted to the neonatal unit from the postnatal wards after 24 hours of age or if the history of resuscitation was not known. Neonates who required any kind of support including oxygen therapy, bag mask ventilation, chest compressions, administration of adrenaline or endotracheal intubation immediately after birth were considered to have been resuscitated. A single neonate could have received all levels of resuscitation and would be analysed as such.

Study site

The study site was a tertiary referral hospital which received many high risk obstetric and neonatal cases. All births were attended by a midwife. Paediatric staff was only present if the fetus was considered to be compromised. All health care workers were trained in neonatal resuscitation

according to the South African Neonatal Resuscitation algorithm (www.resuscitation-council.co.za). Paediatric interns and registrars were present on site all the time and available to assist with neonatal resuscitation as required.

Database

The neonatal records at the study site were kept on a REDCap (Research Electronic Data Capture) electronic database which is a secure, web-based program that has been designed to aid data capture for the purpose of clinical audit and quality improvement.(15) The data were collected upon discharge of patients and entered into the REDCap Database.(15) Data was verified at various times – initially against the patient records and after entry onto the computer. Maternal characteristics, delivery room details, neonatal demographics, clinical characteristics and outcome were collected

Statistical analysis

The data was entered into an MS Excel (Microsoft, USA) spreadsheet and imported into statistical software package SPSS version 23 (IBM, USA). The continuous variables were described using means and standard deviation (SD) and categorical variables were described using frequencies and percentages. Only valid cases were analysed and reported i.e. missing data was not included in the analysis. Outcome was defined as death or discharge from hospital. For the purposes of analysis, discharge was defined as discharge home or transfer to a step down facility. The levels of delivery room resuscitation were compared with outcome. Advanced delivery room resuscitation (ADRR) was defined as the need for chest compressions, endotracheal intubation or the administration of adrenaline. Outcome, maternal and neonatal characteristics were compared between those babies who required ADRR and those

who did not. Categorical variables were compared using Chi-square tests and continuous variables were compared unpaired t-tests (as the data was normally distributed). A p-value of <0.05 was considered to be significant. Variables with significantly associated with ADRR on univariate analysis were entered into a multivariate logistic regression model to determine which were most strongly associated with ADRR.

Hypoxic ischaemic encephalopathy (HIE) referred to Sarnat grades 2 and 3.(16) Necrotising enterocolitis (NEC) referred to stages 2 or 3.(17). Delivery room death was defined as death in the delivery room, prior to admission to a neonatal ward.

Ethics

Ethical approval for the study was granted by the Human Research Ethics Committee at the University of the Witwatersrand, Johannesburg (clearance certificate number (M151109)

RESULTS

There were 32 081 live births at the hospital during the study period. There were 4346 infants with a birth weight above 1500 grams admitted over the 42 month period. There was no history of outcome on 28 infants, 303 infants had major congenital abnormalities, 944 infants were born elsewhere, 48 infants were admitted after 24 hours of life, 40 infants had unknown history of resuscitation and in 17 infants had no recorded birth weight. Thus 2966 infants were analysed and met all criteria.

The majority of infants was male (1740/2966, 58.7%). The mean birth weight was 2645 grams (SD 805) g and gestational age was 36.5 weeks (SD 3.5). The overall mortality rate was 4.2% (125/2966) with 29.6 % (37/125) of the deaths occurring in the delivery room. Multiple gestation was recorded in 10.7% (317/2950) and 10.2%

(304/2915) had an Apgar score below 5 at 5 minutes.

The mean maternal age was 28.1 years (SD 6.1). The majority of mothers was black (2811/2922, 94.8%) and most mothers had attended antenatal care (2591 /2842,

91.2 %). The most common mode of delivery was Caesarean Section (CS) (1865/2948, 63.2%). The overall CS rate was 48.3% at CMJAH during the study period. Additional maternal information is shown in Table 1.

Table 1: Baseline characteristics of mothers

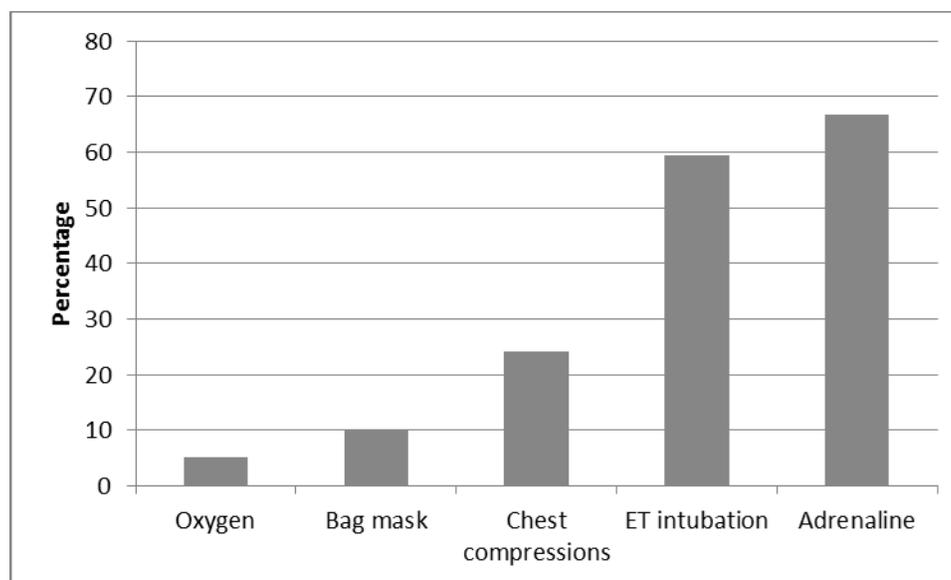
Characteristic	Valid cases	n	%
Race-no. (%)			
Black	2922	2811	96.2
White		45	1.5
Others		66	2.3
Parity			
0	2708	719	26.5
1		983	36.3
2		593	22.0
3		279	10.3
>3		134	4.9
Mode delivery -%			
Normal delivery	2941	945	32.2
CS emergency		1492	50.7
CS elective		373	12.7
Assisted vaginal delivery		83	2.8
Vaginal breech		48	1.6
Antenatal care	2842	2591	91.2
Antenatal Steroids	1680	275	16.4
Chorioamnionitis	2791	79	2.7
Maternal hypertension	2765	289	10.5
Maternal HIV	2886	842	29.2
Maternal syphilis	2839	48	1.7
Maternal diabetes	2842	120	4.2

Only 37% of babies (1089/2966) did not require resuscitation at birth. The different levels of delivery room resuscitation in the 2966 babies are shown in Table 2. Figure 1 shows the mortality rate

for different levels of resuscitation. Mortality increased with advancing level of intervention ($p < 0.001$). More than half the babies who were intubated or received adrenaline died.

Table 2: Level of resuscitation in the delivery room

Resuscitation	Number	% of total sample
None	1089	37.0
Oxygen	1877	63.3
Bag mask ventilation	828	27.9
Chest compressions	178	6.0
Intubation	79	2.7
Adrenaline	18	0.6

Figure 1: Percentage Mortality vs Level of resuscitation

Advanced delivery room resuscitation (ADRR)

There were 221/2966 (7.5%) of babies who required ADRR. Significant associations with the need for ADRR are shown in Table 3. Maternal factors associated with an increased need for ADRR included lack of antenatal care and no antenatal steroids, as well as vaginal breech delivery. Elective CS was associated with a reduced chance of ADRR. Neonatal factors, including, HIE, MAS, PPHN, metabolic acidosis and the need for mechanical ventilation were all more common in babies who received ADRR. Babies who required ADRR were of a significantly higher

gestational age than those who did not (37.0 weeks (SD 3.4) vs 36.5 weeks (SD 3.5); $p=0.03$). Mothers of babies who required ADRR were significantly younger than those who did not (27.3 years (SD 6.0) vs 28.2 years (SD 6.0); $p=0.047$). Significantly more babies who required ADRR died compared to those who did not (64/221 (29.0%) vs 61/2745 (2.2%); $p<0.001$). The need for ADRR was also significantly associated with death in the delivery room (24/221 (10.9%) vs 13/2745 (0.5%); $p<0.001$). The relationship between the 5 minute Apgar score and ADRR or death is shown in Table 4.

Table 3: Maternal and neonatal characteristics significantly associated with the need for advanced delivery room resuscitation

Characteristic	No advanced delivery room resuscitation	Advanced delivery room resuscitation	P Value
Antenatal care	2412/2745 (87.9%)	179/221(81.0%)	<0.001
Antenatal steroids	261/2745 (9.5%)	14/221 (6.3 %)	<0.001
Vaginal breech delivery	39/2745 (1.4%)	9/221 (4.1%)	<0.001
Elective Caesarean Section	360/2745 (13.1%)	13/221(5.9%)	<0.001
Maternal diabetes	118/2629 (4.5%)	2/213 (0.9%)	0.013
Persistentpulmonary hypertension of the neonate	39/2734 (1.4%)	8/198 (4.0%)	<0.001
Transient tachypnoea of the newborn	1244/2734 (45.5%)	32/198 (16.2%)	<0.001
Metabolic acidosis	39/2734 (1.4%)	32/198 (16.2%)	<0.001
Meconiumaspiration syndrome	206/2734 (7.5%)	29/198 (14.6%)	<0.001
Hypoxicischaemic encephalopathy	90/153 (58.8%)	71/83 (85.5%)	<0.001
Mechanical ventilation	157/2577 (6.1%)	21/198 (10.6%)	0.006

Table 4: Apgar score at 5 minutes

	Apgar 0 to 3	Apgar 4 to 6	Apgar 7 to 10	p value
Death	42/96 (43.8%)	46/451 (10.2%)	36/2368 (1.5%)	<0.001
Advanced delivery room resuscitation	68/96 (70.8%)	106/451 (23.5%)	46/2368 (1.9%)	<0.001
HIE	54/58 (93.1%)	82/133 (61.7%)	25/44 (56.8%)	<0.001

Other maternal characteristics, including hypertension, HIV, age below 18 years, parity, chorioamnionitis, multiple gestation and syphilis were not associated with the need for ADRR. Similarly, other neonatal characteristics, including birth weight, nasal continuous positive airways therapy, hypotension requiring inotropes, steroid therapy for chronic lung disease, sepsis, pulmonary haemorrhage, respiratory distress syndrome, NEC and pneumothorax were not significantly associated with the need for ADRR.

Multivariate logistic regression revealed that the variables most strongly associated with ADRR were birth weight (OR 0.999; 95% CI 0.990- 1.000; p=0.018), presence of HIE (OR 2.902 95% CI 1.387- 6.072; p=0.005) and death (OR 4.575, 95% CI 2.2112 – 9.914, p<0.001).

DISCUSSION

There is limited information on delivery room resuscitation of neonates in sub-Saharan Africa. The present study reviewed neonatal resuscitation in babies with a birth weight above 1500 grams born

in a tertiary referral hospital in Johannesburg, South Africa. In the present study, only 27.9% of infants received bag mask ventilation, 10% of them died, 6% of infants received chest compression, 24.2% of them died and 2.7% of infants received endotracheal intubation, 59.5% of them died. Our observed incidence of delivery room resuscitation is similar to other reports which showed that 25.4% received bag mask ventilation and 3.7% were intubated (18, 19). Chest compressions were more frequent than intubation in the current study. The South African neonatal resuscitation algorithm teaches that infants should be intubated after the institution of chest compressions, because most birth attendants are not paediatricians and therefore less likely to be skilled at intubation.

Advanced delivery room resuscitation was required in 7.5 % of the neonates in the present study. Our study confirmed previous reports of increasing mortality with advanced levels of neonatal resuscitation (19). Infants who required ADRR have a high risk of death and HIE. Infants who receive ADRR should therefore be admitted to a neonatal unit for observation and post resuscitation care. Interestingly, no other neonatal complication, including NEC, PPHN, MAS or sepsis was significantly associated with ADRR on logistic regression.

The high CS rate in the present study is most likely due to the fact that the study site was a tertiary referral centre for high risk pregnancies. In the local context, uncomplicated pregnancies were delivered vaginally in regional hospitals and midwife obstetric clinics. Our data also showed that neonates delivered by elective CS required the least amount of neonatal resuscitation. These results are in agreement with a recent report from Nepal, where both fetal and maternal outcomes were better with elective CS as compared to emergency CS (20). However, late preterm neonates born by CS

were reported to be more likely to require delivery room bag and mask ventilation. (11, 12) Future studies may be required to explore the relationship between the mode of delivery and delivery room resuscitation requirement in new born. This information may assist to identify infants at high risk of requiring extensive resuscitation.

The five minute Apgar score was significantly associated with HIE, death and the need for ADRR. This is in agreement with a recent study from the UK which concluded that the Apgar score was an indicator of poor outcome and is still relevant today. (21).

In the present study, we did not compare the outcome of inborn with that of out born infants. Previous reports have found that babies born in hospital have better outcomes, with regard to both morbidity and mortality, compared to those born outside hospital. (18) High risk pregnancies should be referred to properly equipped medical centres for delivery.

Study Limitations

The retrospective nature of the study meant that not all information was available for all patients. The duration of resuscitation, the level of experience of the health worker resuscitating the babies and whether or not the level of resuscitation was appropriate could not be evaluated. Obstetric factors, including duration of labour, indication for CS and meconium staining of the liquor were not evaluated.

Conclusion

Advanced levels of delivery room resuscitation are associated with increased mortality and short term morbidities. The need for advanced neonatal resuscitation could be included in scores to predict neonatal mortality. Infants born by elective CS required less resuscitation compared with other modes of delivery, but delivery of all neonates by CS is not feasible. High risk

pregnancies should be identified early and mothers referred to a tertiary obstetric facility for delivery. Close monitoring of respiratory status is indicated for infants who received ventilatory support at birth.

Implications of the study

There is limited information available on the need for advanced delivery room resuscitation in sub-Saharan Africa. The data provided in this study confirms the need for high risk pregnancies to be delivered in properly equipped centres with trained staff available. Identification and proper referral of these pregnancies and provision of proper equipment and staff training for neonatal resuscitation are priorities for neonatal care in South Africa.

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Author's declaration

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