Outcome of Extremely Low Birthweight Infants at the University Hospital of the West Indies, Jamaica

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ABSTRACT

Objective: *To describe the early outcome of extremely low birthweight infants delivered at the University Hospital of the West Indies.*

Methods: *A two-year retrospective review of the charts of all live, inborn extremely low birthweight infants admitted to the neonatal unit between January 1, 2002 and December 31, 2003 was conducted. Differences between survivors and non-survivors were determined using analysis of variance and predictors of outcome were determined using multiple regression models.*

Results: *During the study period, 47 extremely low birthweight infants were admitted to the neonatal unit. The mean ± SD birthweight and gestational age of these infants were 780 ± 137 g and 27 ± 2 weeks respectively. Twenty (43%) infants survived. Babies (19; 58%) of gestational age $ 27 weeks had in-creased survival compared to those < 27 weeks, (1; 7%;* p *= 0.001) and babies weighing $ 750 g had increased survival (17, 65%) compared to those weighing < 750 g, (3, 14%;* p *< 0.001). Infants delivered by Caesarean section had improved survival 15 (58%) over those delivered vaginally (5, 24%;* p *= 0.02). All six (100%) infants whose mothers did not receive prenatal steroids died while 18 (50%) infants whose mothers received prenatal steroids died (*p *= 0.02). Significant factors associated with outcome were offered and gender was entered into a multiple regression model; gestational age and female gender remained independent predictors of survival.*

Conclusion: *Obstetric measures for the prevention of preterm delivery need to be optimized in order to decrease the morbidity and mortality associated with extremely low birthweight infants.*

Resultado de Neonatos de Peso Extremadamente Bajo al Nacer en el Hospital Universitario de West Indies, Jamaica

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RESUMEN

Objetivo: *Describir el resultado precoz de neonatos de peso extremadamente bajo al nacer, en partos realizados en el Hospital Universitario de West Indies.*

Métodos: *Se llevó a cabo un estudio retrospectivo de dos años de las estadísticas médicas de todos los neonatos de peso extremadamente bajo, nacidos en la unidad de cuidados neonatales de este mismo hospital entre enero 1 de 2002 y diciembre 31 de 2003. Las diferencias entre los sobrevivientes y los no sobrevivientes fueron determinadas usando análisis de varianza y los predictores de resultado fueron determinados usando modelos de regresión múltiple.*

Resultados: *Durante el periodo de estudio, 47 neonatos de peso extremadamente bajo al nace, fueron ingresados a la unidad de cuidados neonatales. La media ± desviación estándar (SD) del peso al nacer y la edad gestacional de estos neonatos fueron 780 ± 137 g y 27 ± 2 semanas, respectivamente. Veinte (43%) neonatos sobrevivieron. Los bebés (19; 58%) de edad gestacional $ 27 semanas habían aumentado su supervivencia en comparación con aquellos < 27 semanas, uno (7%;* p *= 0.001) y los bebés que pesaban $ 750 g habían aumentado su supervivencia a 17 (65%) en comparación con aquellos que pesaban < 750 g, 3 (14%)* p *< 0.001. Los neonatos nacidos de partos por cesárea habían mejorado supervivencia a 15 (58%) por encima de los 5 (24%)* p *= 0.02 nacidos por parto vaginal. Todos los neonatos de un número de seis (100%), cuyas madres no recibieron esteroides prenatales*

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murieron, en tanto que 18 (50%) neonatos cuyas madres recibieron esteroides prenatales murieron, p *= 0.02. Se ofrecieron factores significativos asociados con el resultado y el género se entró en un modelo de regresión múltiple; la edad del gestacional y el género "hembra" continuaron siendo predictores independientes de supervivencia.*

Conclusión: *Las medidas obstétricas para la prevención del parto pretérmino necesitan ser optimizadas a fin de disminuir la morbosidad y la mortalidad asociadas con los neonatos de peso extremadamente bajo al nacer.*

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INTRODUCTION

Although extremely low birthweight infants (ELBW, birthweight < 1000g) represent approximately 1% of live births, their length of stay in the neonatal unit can be protracted exacting a heavy burden on hospital resources. Improvement in perinatal care of high risk mothers and advances in neonatal intensive care have resulted in improved survival of these infants in developed countries (1–4). Outcome of these infants in developing countries is thought to be generally poor due to lack of financial resources limiting the necessary technological advances needed to optimally care for these infants. However, there have always been some ELBW infants who have survived despite the absence of technology driven neonatal intensive care measures.

The aim of this study was to determine the outcome of extremely low birthweight infants at the University Hospital of the West Indies (UHWI) where limited resources for care of these infants are present and available. Limited resources are defined as the ability to provide warmth, circulatory supportive measures, ventilatory support by means of conventional mechanical ventilation, bubble continuous positive airway pressure (CPAP) or head box oxygen, enteral feeds and appropriate antibiotics.

METHODS

The UHWI is located in urban Jamaica and is a university-affiliated institution. This hospital, along with two other public hospitals, serves mainly the population of Kingston and St Andrew, approximately 652 000 people (5).

The neonatal unit at the UHWI presently has a maximum capacity of 30 beds and the small Neonatal Intensive Care Unit established in 2001 is a six-bed unit, with the capability of ventilating only three neonates at any one time. Parents pay for all services offered in the neonatal unit, a down payment is required soon after admission and a final bill is tallied at the end of hospital stay. Therefore, there is universal access to the limited resources which is not dependent on ability to pay. Neonates who do not access mechanical ventilation are given ventilatory support using bubble nasopharyngeal CPAP or head-box oxygen. Surfactant is available but due to financial cost (J$36 000 per vial which has to be paid prior to administration) is not accessible to most of the babies. During the study period total parenteral nutrition was not available at this institution. Four consultant paediatricians, one of whom has specialist training in neonatology, are responsible for medical care of the neonates. Care of the neonates is left to the clinical judgement of the individual consultants.

Study Population

This was a two-year retrospective, descriptive study looking at all live, inborn, ELBW infants admitted to the neonatal unit of the UHWI between January 1, 2002 and December 31, 2003. Study patients were identified from the neonatal unit admission logbook and the delivery log book of the maternity unit. Patients' charts were retrieved and data on maternal and neonatal demographics, clinical course and outcome (status at discharge from the unit) were extracted.

Statistical Analysis

Descriptive analyses were performed; differences between survivors and non-survivors were determined using analysis of variance. Chi-square tests were used for categorical variables and independent *t* test for continuous variables. Predictors of outcome were determined using multiple logistic regression models. Statistical significance was taken at the level $p < 0.05$. Analyses were performed using the Statistical Package for Social Sciences (SPSS) version 11. The UWI/UHWI Faculty of Medical Sciences Ethics Committee granted approval for this study to be conducted.

RESULTS

During the study period, there was a total of 4648 live births, 47 (1%) were extremely low birthweight and were admitted to the neonatal unit, six (13%) of these were small for gestational age infants. The mean ± SD birthweight and gestational age of these infants were 780 ± 137 g (range 520 –999 g) and 27 ± 2 weeks (range 24–32 weeks) respectively. Characteristics of the neonates are shown in Table 1.

Table 1: Neonatal characteristics of ELBW infants at the UHWI

Characteristic	Non-survivors (%)	Survivors (%)
Male	13 (65)	7 (35)
Female	14 (52)	13 (48)
± No. ventilated	11 (52)	10 (48)
Surfactant given	3 (75)	1 (25)
5 min Apgar < 7	7 (70)	3 (30)
Mean (SD) birthweight (g)	724 (139)	856 (93)*
Mean (SD) gestational age (wks)	26 (1.6)	29 (2)*

$p < 0.001$ ± No = numbers

Twenty (43%) infants survived and 27 (57%) died, the mean ± SD birthweight and gestational age of the survivors were significantly higher 856 ± 93 g and 28.7 ± 2 weeks than those of the non-survivors 724 ± 139 g and 26 ± 1.6 weeks respectively ($p < 0.001$). The highest mortality rate was seen in infants weighing < 750 g and those < 27 weeks gestational age. Neonates weighing < 750 g accounted for 45% of the study population but contributed to 86% of the mortality in the study. Likewise, infants < 27 weeks gestation accounted for 30% of the study population but contributed to 93% of mortality. There were 27 (57%) females and 20 (43%) males; 13 (48%) females survived while seven (35%) males survived.

The mean ± SD maternal age was 28.8 ± 6.5 years; there were three (6%) mothers less than 20 years and 2 (4%) mothers older than 40 years. Six (13%) mothers had antepartum haemorrhage, nine (19%) had prolonged rupture of membranes for greater than 18 hours and one (2%) had chorioamnionitis. Thirty-six (77%) mothers received prenatal steroids, 26 (55%) infants were delivered by Caesarean section and 21 (45%) infants received mechanical ventilation. Four (9%) babies received surfactant three of whose mothers also received prenatal steroids. Maternal risk factors for delivery of a preterm infant are shown in Table 2. Nine-

Table 2: Maternal risk factors for prematurity

Characteristic	Frequency (%)
Pre-eclampsia	19 (40)
Previous pregnancy losses	17 (36)
Previous preterm delivery	8 (17)
Antepartum haemorrhage	6 (13)
Multiple gestation	2 (4)
Anaemia	1 (2)

Mothers could have more than one risk factor

teen (40%) mothers had Pregnancy Induced Hypertension, of these, 18 (95%) were delivered by Caesarean section.

Factors associated with outcome can be seen in Table 3. Babies of gestational age $ 27 weeks had increased survival (19; 58%) compared to those < 27 weeks, (1, 7% $p = 0.001$) and babies weighing $ 750g had increased survival (17, 65%) compared to those weighing < 750g, (3, 14%; $p < 0.001$). Infants (15, 58%) delivered by Caesarean section had improved survival, over those delivered vaginally (5; 24%, $p = 0.02$). All six (100%) infants whose mothers did not receive prenatal steroids died while 18 (50%) infants whose mothers received prenatal steroids died ($p = 0.02$).

Significant factors associated with outcome were offered and gender was entered into a multiple regression model; since birthweight and gestational age were highly correlated (Pearson's correlation coefficient, r 0.7, $p < 0.001$) only gestational age was entered into the model. Gestational age and female gender remained independent predictors of mortality. Forty-six (98%) infants had some evidence of Respiratory Distress Syndrome at birth. The most common

Table 3: Factors associated with outcome in ELBW infants born at the UHWI, 2002–2003

Variable	Non-survivors %	Survivors %	N	P value Fisher's exact test
Gender				
Male	13 (65)	7 (35)	20	0.27
Female	14 (52)	13 (48)	27	
Pre-natal steroids				
Not given	6 (100)	0 (0)	6	0.02
Given	18 (50)	18 (50)	36	
Weight				
500–749 g	18 (86)	3 (14)	21	0.000
750–999 g	9 (35)	17 (65)	26	
Gestational age				
< 27 weeks	13 (93)	1 (7)	14	0.001
$ 27 weeks	14 (42)	19 (58)	33	
Mode of delivery				
SVD	16 (76)	5 (24)	21	0.02
LSCS	11 (42)	15 (58)	26	
Presentation				
Vertex	13 (48)	14 (52)	27	0.14
Non-vertex	13 (68)	6 (32)	19	
5 min Apgar				
< 7	7 (70)	3 (30)	10	0.16
$ 7	14 (45)	17 (55)	31	

complications seen were sepsis five (10%), pulmonary haemorrhage three (6%) and intraventricular haemorrhage two (4%), the most common cause of mortality was respiratory insufficiency 20/27 (74%). Of the neonates who died, 16 (59%) were not ventilated, of these 13 (81%) died from respiratory insufficiency, two (13%) died from sepsis and one (6%) died of a pulmonary haemorrhage.

DISCUSSION

The mortality rate of 43% seen in this study is higher than that seen in some developing countries where survival rates of 10–32% have been reported. Okoji and Oruamabo in Nigeria report a 10% survival rate, while Ali in Trinidad reported a survival rate of 12% and Velaphi *et al* in South Africa reported a survival rate of 32% (6–8). In those studies, there was limited or no access to mechanical ventilation, surfactant and parenteral nutrition.

The survival rate in this study of 14% for neonates weighing 500–749 g and 65% for those weighing 751–999 g is comparable to that reported by Duman *et al* for Turkey where they had survival rates of 13% and 74% respectively (9). However, in their study, 54% of the babies received mechanical ventilation and 36% received surfactant compared to this population where 45% of the neonates were ventilated and only 9% received surfactant.

Centres in developing countries that have ready access to neonatal intensive care measures such as mechanical ventilation and parenteral nutrition report higher survival rates than that seen in this study. Sehgal *et al* in Delhi, India reported an overall 57% survival rate, 50% of their study population were ventilated and 50% received parenteral nutrition (10). Tsao *et al* in Taiwan had an overall 60% survival rate, in their study 85% of the neonates were ventilated and 47% received surfactant (11).

In developed countries where there is universal access to mechanical ventilation, surfactant administration and parenteral nutrition survival rates as high as 55% for neonates weighing 501–750 g and 85% for those weighing 751 –1000 g have been documented; in one study, 62% of the neonates received surfactant, 72% received conventional ventilation and 24% high frequency ventilation (1).

In this study, babies weighing less than 750 g and those less than 27 weeks gestation contribute a greater per cent to mortality of ELBW. This is not unexpected as it is these smaller babies that require the prolonged ventilatory and parenteral nutritional support that is not readily available at this centre. The increase in mortality with decrease in weight and maturity has been previously documented. Piecuch *et al* have reported survival rates of 38% for babies 500–599 g, 62% for babies 600–699 g, 75% for babies 700–799 g, 82% for babies 800–899 g and 87% for babies 900–999 g (12).

The increase in survival of preterm infants delivered by Caesarean section over those delivered vaginally has also been previously documented. Lee and Gould demonstrated a survival advantage associated with Caesarean section up to 1300 g, this decrease in mortality persisted after adjusting for other factors associated with mortality (13). This finding possibly reflects the benefit of a Caesarean section being a more controlled mode of delivery thereby eliminating the complications of a precipitous birth which can occur in a vaginal delivery.

The positive effect on outcome of the administration of prenatal steroids to mothers with impending preterm delivery is well documented. Crowley *et al* carried out a systematic review of relevant controlled trials looking at the effects of corticosteroid administration before pre-term delivery. Data from twelve controlled trials show that corticosteroids reduced the occurrence of Respiratory Distress Syndrome overall. Reduction in respiratory morbidity was associated with reduction in the risk of neonatal death (14). This study has also documented an improved survival of infants whose mothers received prenatal steroids. Gestational age and female gender were found to be independent predictors of mortality in ELBW infants in this study.

This study has demonstrated that despite limited resources and access to neonatal intensive care measures, a reasonable survival rate can be achieved for babies weighing greater than 750 g and babies of 27 weeks and greater gestational age. However the outcome for babies less than 750 g and less than 27 weeks gestation is extremely poor. Further improvement in survival will require universal access to mechanical ventilation and surfactant administration. Presently only 45% of neonates at this institution receive mechanical ventilation and 8% receive surfactant; 81% of babies who did not receive ventilation and died had respiratory insufficiency as the terminal event. The positive effect of surfactant use in the reduction of mortality and morbidity from respiratory distress syndrome has been documented (15).

Additionally, there is the need for the implementation of a total parenteral nutrition programme to support these infants who are the most vulnerable to the adverse effects of malnutrition. Georgieff *et al* have clearly shown the benefits of parenteral nutrition in the management of preterm infants and the positive effect on survival (16).

Concurrently, obstetric measures for the prevention of preterm delivery, close monitoring of high risk pregnancies and judicious use of tocolytics to prolong gestation need to be optimized in order to decrease the number of ELBW infants delivered and the associated mortality and morbidity.

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