

Small Babies on a Small Island: Survival of Very Low Birthweight Infants in Antigua and Barbuda 1986 to 2006

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ABSTRACT

Introduction: Recent attention has been focussed on pregnancy outcomes in developing countries, with the publication of the World Health Organization Report 2005, *Make Every Mother and Child Count* and the Neonatal Survival Series from the Lancet in 2005. Scant outcome data from the smaller islands of the Caribbean exist for very low birthweight (VLBW) babies (birthweight < 1500 g).

Patients and Methods: A retrospective review of mortality data on VLBW babies in Antigua and Barbuda was performed. Antigua and Barbuda had a population of 71 500 with per capita income of (US) \$6054 dollars in 1998. In November 1985, a neonatal Special Care Nursery (SCN) was established. The survival to discharge from SCN for VLBW babies was reviewed from January 1986 to December 2006.

Results: There were 26 455 babies born from 1986 to 2006; 344 (1.3%) were VLBW babies. Survival to SCN discharge was 45% from 1986 to 1992, 46% from 1993 to 1999, and increased to 60% from 2000 to 2006 ($p < 0.05$ compared with the first two time-periods). Babies from 1000 to 1499 g accounted for 64% of VLBW babies and survival to SCN discharge was 60% from 1986 to 1992, 58% from 1993 to 1999, and increased to 83% from 2000 to 2006 ($p < 0.01$ compared with the first time period; $p < 0.001$ compared with the second). Babies < 1000g accounted for 36% of VLBW babies and survival to SCN discharge was 10% from 1986 to 1992, increased to 25% from 1993 to 1999 and to 28% from 2000 to 2006 (trend of $p < 0.10$ compared with first time period). Conservative newborn care only was available. Antenatal steroids were given from 2000 to 2006.

Conclusion: The outlook for VLBW babies using conservative newborn care techniques has significantly improved over 21-years in Antigua and Barbuda.

Keywords: Survival, very low birthweight babies

Bebés Pequeños en Islas Pequeñas: Supervivencia de Infantes con muy Bajo Peso al Nacer en Antigua y Barbuda, de 1986 a 2006

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RESUMEN

Introducción: Recientemente se ha centrado la atención en los resultados del embarazo en los países en vías de desarrollo, a partir de la publicación del Informe 2005 de la Organización Mundial de la Salud, *Que cada madre y cada niño cuente* y la Serie de Supervivencia Neonatal de la Lancet en 2005. Son escasos los datos de resultados existentes en las islas más pequeñas del Caribe, acerca de los bebés con muy bajo peso al nacer (MBPN) (peso al nacer < 1500 g).

Pacientes y Métodos: Se llevó a cabo una revisión retrospectiva de datos sobre la mortalidad de bebés MBPN en Antigua y Barbuda. Antigua y Barbuda tenían una población de 71 500 con un ingreso per cápita de \$6054 USD en 1998. En noviembre de 1985, se creó una Sala de Cuidados Especiales del

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Recién Nacido (SCN). La supervivencia en término de los bebés MBPN dados de alta de la SCN fue examinada de enero de 1986 a diciembre de 2006.

Resultados: De 1986 a 2006, hubo 26 455 bebés nacidos; de ellos 344 (1.3%) fueron bebés MBPN. La supervivencia en término de las altas de la SCN fue de 45% de 1986 a 1992, 46% de 1993 a 1999, y aumentó a 60% de 2000 a 2006 ($p < 0.05$ en comparación con los primeros dos periodos de tiempo). Los bebés de 1000 a 1499g representaron el 64% de los bebés MBPN y la cifra de los supervivientes dados de alta del SCN fue de 60% de 1986 a 1992, 58% de 1993 a 1999, y aumentó a 83% de 2000 a 2006 ($p < 0.01$ en comparación con el primer periodo de tiempo; $p < 0.001$ en comparación con el segundo). Los bebés < 1000 g representaron el 36% de los bebés MBPN, y la supervivencia en términos de los dados de alta de la SCN fue 10% de 1986 a 1992, aumentó a 25% de 1993 a 1999, y a 28% de 2000 a 2006 (la tendencia de $p < 0.10$ en comparación con el primer periodo de tiempo). Sólo hubo disponible atención neonatal conservadora. Se administraron esteroides antenatales desde el año 2000 al 2006.

Conclusión: El pronóstico para MBPN usando técnicas de cuidado neonatal conservadoras ha mejorado significativamente a lo largo de 21 años en Antigua y Barbuda.

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Palabras claves: Supervivencia, bebés con muy bajo peso al nacer

INTRODUCTION

Attention has been directed toward improving maternal and neonatal outcomes in developing countries through the publication of the World Health Report 2005: *Make Every Mother and Child Count* (1) and the Lancet *Neonatal Survival Series* in 2005 (2). Survival rates have increased dramatically for very low birthweight babies (VLBW), less than 1500 g, in developed countries in the past two decades, increasing from about 75% to 95% for VLBW babies of 1000 to 1499 g and from 25% to 70% for babies below 1000 grams (3–10). The cost for the survival of VLBW babies is high, with average treatment cost of US \$93 000 per surviving baby less than 1500 grams, US \$138 800 for those 750 to 999 g, and US\$273 900 for those less than 750 g in California in 1987 (11). Surviving VLBW babies have significant morbidity with roughly 33% having significant neurologic, pulmonary or visual impairment (4–8, 10, 12–14). For VLBW babies less than 1000 g, significant deficits are seen about 45% of the time (8, 15–17). The monetary costs, as well as the ethics, of aggressive treatment have led to some debate as to resource allocation in the United States of America (USA) and outside (18–20).

Little information is available on survival of VLBW infants in the smaller islands of the Caribbean. In November 1985, a Special Care Nursery (SCN) was established in Antigua and Barbuda to care for sick newborns. It is the only neonatal care facility in the country. The population in Antigua and Barbuda was about 71 000, with a per capita income of US \$6054 in 1998. The population was 90% Afro-Caribbean, 8% mixed and 2% “other” by self-description in the last census. Perinatal care included doctor- or midwife-attended deliveries, the use of isolettes to warm infants, the use of intravenous fluids and blood transfusion, access to parenteral antibiotics and other medications and the use of phototherapy lights and oxygen. The term “conservative newborn care” has been used for such treatment regimens

(21). Mechanical ventilation, surfactant and parenteral nutrition represent more advanced care and were not yet available in Antigua and Barbuda. This report concerns the mortality of VLBW babies from January 1986 to December 2006, and the contribution of VLBW babies to neonatal and infant mortality rates in this resource challenged environment of a small Caribbean country.

PATIENTS AND METHODS

A retrospective review of Maternity Ward and SCN records from 1986 to 2006 at the Holberton Hospital in Antigua and Barbuda was undertaken. Data collected included the number of deliveries, number of VLBW babies and number of VLBW babies surviving until discharge from the SCN. The SCN at Holberton Hospital in St John’s, Antigua and Barbuda, is the only site providing neonatal care in the country, serving a population of 71 000, 90% Afro-Caribbean, 8% mixed race by self-description at last census, average per capita income about US \$6054 in 1998, about 70% from tourism. The SCN also provides care for babies born outside the hospital and receives about two or three babies per year from surrounding islands. In November 1985, the SCN was established by Dr M O’Garra, with the advice of Dr J W Kendig (Division of Neonatology, University of Rochester School of Medicine and Dentistry, Rochester, New York, USA) for the care of neonates with medical problems. Perinatal support in 1986 included deliveries attended by a nurse midwife or physician, isolettes to keep babies warm, intravenous fluids and blood, phototherapy lights, oxygen by hood or nasal cannula, parenteral antibiotics and other medications. In 1992, two nurses specifically trained in neonatal intensive care returned from one year overseas to train and supervise nurses caring for newborns in the SCN. Nurses in Antigua and Barbuda are nursing school graduates trained as general nurses, but often have additional training in midwifery. Staffing in SCN includes at least one registered

nurse per shift, with a caretaker to infant ratio of 1:3 or 1:4. From 1986 to 1992, Dr O'Garra, certified by the Royal College in paediatrics, was the only physician involved in the SCN. On Dr O'Garra's retirement in 1992, Dr T C Martin, certified by the American Board of Paediatrics, and Dr L Lovell-Roberts, certified by the Royal College in Paediatrics, alternated attending responsibilities for the SCN. One or two house doctors, essentially internship level of training, were available on paediatrics. Rounds were made daily, with daily notes and orders. No specific written protocols were used in the SCN but several interventions were commonly employed. All VLBW infants were placed in isolettes, given oxygen to maintain oxygen saturation of 95% or greater. The babies were started on aminophylline intravenously to prevent apnoea and bradycardia. Phototherapy was initiated on admission on all VLBW babies to prevent hyperbilirubinaemia. The babies were not fed enterally until one week of age. Intravenous fluids included 10% dextrose (as tolerated) in water for two days and then in 0.2 normal saline *per* an umbilical venous catheter. Antibiotics, usually ampicillin and gentamicin, were used liberally for signs or symptoms of possible neonatal sepsis (*eg* tachypnoea, hypothermia). A third generation cephalosporin (if available) was added at day 2 if the babies did not improve. The babies were given packed red blood cell transfusions for packed cell volumes below 30%.

All pregnant women had prenatal care available at no out-of-pocket cost through a network of government supported village clinics. Prenatal screening included physical examination with blood pressure and weight, urinalysis, haemogram, blood group and type, screen for syphilis and, recently, voluntary screening for human immunodeficiency virus. There was a high-risk obstetrical clinic also available at the public hospital. An obstetrician had been available at the hospital since 1983, with this service expanded to three obstetricians by 1992. One or two house doctors were assigned to obstetrics. About 75% of deliveries at Holberton Hospital were attended by nurse midwives. The Caesarean section deliveries increased from 7% in the late 1980s to 11% in the early 2000s (22, 23). By 2000, the obstetricians had instituted the widespread use of fetal ultrasound (24) and the use of prenatal corticosteroids for mothers delivering early.

The survival figures for VLBW babies for the seven-year period, from January 1986 to December 1992, were compared with those from the seven-year period, from January 1993 to December 1999, when trained neonatal nurses were employed in the SCN. The survival figures from these two seven-year periods were compared with the seven-year period, January 2000 to December 2006, when ultrasound and prenatal corticosteroids were available. Comparisons were made using chi-square test on STAT101 software® (STAT101, Addison-Westley Minitab Inc, Redding, MA 1993).

RESULTS

There were 26 455 babies born in Antigua and Barbuda between January 1986 and December 2006. Of these, there were 344 (1.3%) VLBW babies, all admitted to the SCN at Holberton Hospital. For the period of January 1986 to December 1992, survival until SCN discharge was 49/107 or 45%. From January 1993 to December 1999, 47/102 or 46% survived until SCN discharge, no significant change comparing the first time period with the second. From January 2000 to December 2006, 81/135 or 60% of VLBW babies survived until SCN discharge. The change in survival from the first time period, 45%, and the second time period, 46%, compared with the most recent time period, 60%, were statistically significantly different ($p < 0.05$ for both comparisons).

Of VLBW babies with birthweight 1000 to 1499g, 46/77 (60%) survived until SCN discharge from 1986 to 1992. This number was essentially unchanged from 1993 to

Table: Survival of very low birthweight infants below 1000 g in developing countries: The contribution of more advanced treatment modalities.

Country	Ventilator	Surfactant	TPN*	Survival
Antigua	None	None	None	28%
Jamaica (37)	46%	9%	None	43%
Turkey (38)	54%	36%	NA**	53%
India (39)	50%	NA	50%	57%
Taiwan b (40)	85%	47%	NA	60%

* TPN = total parenteral nutrition, ** NA = not available

1999, 46/77 (58%). The survival increased to 65/78 (83%) from 2000 to 2006, significantly improved over 1986 to 1992 ($p < 0.01$) and 1993 to 1999 ($p < 0.001$). For VLBW babies less than 1000g, the survival until SCN discharge was 3/27 or 10% from 1986 to 1992. The survival increased to 9/27 or 25% from 1993 to 1999, $p < 0.20$, suggesting a trend only. From 2000 to 2006, the survival of VLBW babies below 1000 g increased to 16/41 or 28%, $p < 0.10$ compared with the earliest period.

The infant mortality rate (IMR) in Antigua and Barbuda from 1977 to 1986 was 27 per 1000 live births and the neonatal mortality rate (NMR) was 20 per 1000 live births (23). In 1999–2000, the IMR was 12 per 1000 live births with a NMR of 8 per 1000 live births (1, 26). The VLBW babies between 2000 and 2006 accounted for 7.7 deaths per 1191 babies born per year, about 6.5 per 1000 live births, roughly 54% of the IMR and 81% of the NMR in Antigua and Barbuda.

DISCUSSION

Outcomes for premature infants have improved dramatically in the past two decades in developed countries (3–10). This is especially true for VLBW babies born weighing less than 1500 g. This report documents a parallel improvement in

outcomes for VLBW babies in Antigua and Barbuda. Treatment of low birthrate babies in Antigua and Barbuda included attended deliveries, use of isolettes, intravenous fluids, blood replacement, oxygen by hood or cannula, phototherapy, antibiotics and other parenteral medications. These resources are generally available in the smaller island countries of the Caribbean. Over 21-years, a significant increase in survival rate from 45% to 60% has been seen using the above techniques associated with "conservative newborn care" (21). Data from other developing countries using conservative newborn care is similar to Antigua and Barbuda. In 1992 in Trinidad and Tobago, VLBW babies had a 39% survival rate (27) and in Papua New Guinea, survival of VLBW infants was 46% using similar techniques (28).

Mechanical ventilation, surfactant and parenteral nutrition, which are considered more advanced treatment modalities, were not available to babies in Antigua and Barbuda. Available data from some developing countries suggest that further improvement in survival of VLBW babies can be achieved with the application of these more advanced treatment modalities. In Jamaica, from 1987 to 1997, the survival rate for VLBW babies overall was 54%, with 74% of those babies from 1000 to 1499 g surviving and 20% of babies less than 1000 g surviving with conservative newborn care (29). The establishment of a neonatal intensive care unit at the University Hospital of the West Indies in 2001, with initially mechanical ventilation and then surfactant use, resulted in a significant increase in survival of VLBW from 55 to 69% (30). The use of surfactant in Curaçao was associated with an increase in survival from 65 to 75% for VLBW babies with respiratory distress (31). The outcome for VLBW babies improved in Turkey, with survival of 84% (32) and in South America, with survival of 73% (33) with the use of mechanical ventilation and surfactant.

For VLBW babies below 1000g at birth, survival with conservative neonatal care, without new technology, is about 10 to 30% (26, 34–36), similar to the 28% in Antigua and Barbuda. The availability of mechanical ventilation in Jamaica was associated with a doubling of survival rates for VLBW babies (30, 37), with VLBW babies below 1000 g having increased survival to 43% (37). A series of reports from less developed countries suggest that survival of VLBW babies less than 1000 g is technology dependent (Table) with increasing use of mechanical ventilation, surfactant and parenteral nutrition resulting in increasing survival of VLBW babies (37–41).

In Antigua and Barbuda, the use of conservative newborn management techniques has improved survival of babies with birthweight of 1500 to 2499 g to 97% (42). This study reports an 83% survival rate for babies of birthweight 1000 to 1499 g using conservative care techniques in Antigua and Barbuda. Those babies below 1000g continue to present a challenge. With improved care of larger infants, the contribution of VLBW infants to the IMR and NMR in Antigua and Barbuda has become more significant. The VLBW

infants given conservative newborn care accounted for 54% of the IMR and 81% of the NMR in Antigua and Barbuda. A similar 60% contribution to the IMR was seen in Trinidad and Tobago (27). Further improvement in IMR and NMR in these more advanced developing countries will probably involve a greater investment in the newer neonatal management technologies. The data presented from developing countries suggest that outcomes for VLBW less than 1000 g can be improved using these technologies in economically challenged settings (28, 37–41).

About 33% of surviving VLBW babies in developed countries have significant neurologic, pulmonary or sensorineural impairment (4–8, 10, 12–14). For VLBW babies less than 1000 g significant defects are seen about 45% of the time (8, 15–17). Although VLBW baby survival has improved in developed countries, the rates of disabilities have remained unchanged (43). In Trinidad, 10% of surviving VLBW babies were considered handicapped (27). In Turkey, advances in VLBW survival were accompanied by handicapped rates similar to the higher rates of developed countries (38). An analysis of data from a screening programme for disabilities in Antigua and Barbuda, revealed that prematurity and neonatal asphyxia accounted for 18% of children with severe disabilities, accounting for about 0.5 per 1000 children less than 15-years old (44). With a VLBW prevalence of 13/1000 births and an average survival of 25% (3.25/1000 per year), possibly 15% of VLBW babies could be represented in the group of children with severe handicaps in Antigua and Barbuda.

The interventions for the poorest of developing countries may include attended deliveries, maternal and newborn skin antisepsis, newborn resuscitation, delayed umbilical cord clamping, umbilical cord antisepsis, hypothermia prevention and management, hypoglycaemia prevention and management, breastfeeding, prevention and treatment of *ophthalmia neonatorum*, vitamin K prophylaxis, hepatitis B vaccination, vitamin A supplementation, kangaroo maternal care, skin emollient therapy, hyperbilirubinaemia screening and pneumonia care (45). For the more advanced developing countries of Latin America and the Caribbean, movement beyond this conservative newborn care has become a possibility. Variation in the application of newer treatment modalities will depend on available resources and will require individualized approaches, even within the different regions in a country (46).

In Antigua and Barbuda, the costs of providing advanced neonatal care would include equipment, medication, training, personnel and staffing. Mechanical ventilators, respiratory care equipment, medications (such as surfactant, parenteral nutrition *etc.*), respiratory therapists, nurse and doctor training would present an up-front investment. Staffing would need to include around the clock in-house respiratory therapy and physician coverage, as well as nurse to patient staffing ratio of 1:1 or 1:2.

In Antigua and Barbuda, it is estimated that eight or nine small babies per year would be saved if results from developed countries could be matched (42). Mechanical ventilation would appear to be the intervention resulting in the greatest improvement in survival but surfactant and continuous positive airway pressure (CPAP) might be a useful initial intervention, avoiding the increase in staffing that full mechanical ventilation would entail (47). The possibility of regionalization of neonatal services could be considered for the smaller island countries of the English-speaking Caribbean, lowering the costs per VLBW baby by pooling some resources.

Limitations of this study include the inability to assess prenatal interventions and their contributions to mortality of VLBW babies in Antigua and Barbuda. Factors such as maternal infection, antenatal corticosteroid use, Caesarean section, birth interval and single *versus* multiple births were not assessed (3, 5, 48, 49). The gestational age for VLBW was not available and 15% of low birthweight babies have been shown to have fetal growth retardation with greater maturity (50). Autopsies were not available so the cause of death of VLBW babies in Antigua and Barbuda could not be assessed.

In summary, the success in the improvement of survival of VLBW babies in developed countries has been remarkable. For Antigua and Barbuda, a small developing country in the Caribbean, the data show similar trends, but of less impressive magnitude. As improvements in care and survival of VLBW babies in developed countries continue (51), developing countries are under increasing pressure to improve support of their VLBW babies. Currently, the cost of low birthweight babies accounts for 47% of infant hospital care costs and 27% of paediatric hospital care costs in the USA (52). Developing countries must assess their individual resources and use evidence-based approaches in moving forward. This study provides some information that may further the discussion and assist in those decisions.

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