

OUTCOME OF INFANTS WEIGHING 500 – 999 GRAMS AT BIRTH IN A SINGAPORE HOSPITAL (1990 – 1993)

N K Ho, S B Lim

ABSTRACT

Over a 4-year period (1990-1993) 126 babies weighing 500-999 grams (0.39% of 32,362 livebirths) were born in the hospital that provides tertiary care. Seventy-eight babies (61.9%) were discharged alive. Survival rate (79.4% or 50/63) was higher in the larger babies (800-999 gm) than in the smaller babies (28/63 of the 500-799 gm or 44.4%, $p=0.0001$). Survival rates among the 2 periods, 1990-91 (period 1) and 1992-93 (period 2) have also improved, from 44/74 or 59.5% to 34/52 or 65.4%, $p=0.62$ (NS).

Surfactant replacement therapy (SRT) has an impact on decreasing the mortality for babies <1,000 gm. Only 35.3% (6/17) babies had SRT in 1993. Other perinatal factors are also contributing to a better outcome of these high risk babies.

Neurodevelopmental outcome at 2 years of age of the 39 babies (50%) born in period 1 has been determined. Thirty-five percent (5/14) of the smaller babies and 28% (7/25) of the larger babies had MDI (Bayley Mental Developmental Index) of <69. For cerebral palsy, it was 14% and 8% respectively; and for neurosensory disorder, 7% and 4% respectively. Some babies had a combination of 2 or 3 major impairments. It is estimated that 33% of babies who weighed less than 1,000 gm at birth had a disability. It was found that severe intraventricular haemorrhage (IVH) of grade III and IV correlated significantly with MDI of <69 ($p<0.05$).

Severe IVH in period 2 (17.2%) did not differ significantly from that of period 1 (29.4%, $p=0.55$). However, it is encouraging to see that no survivors had severe IVH in 1993. Other indicators of neonatal morbidity were also examined. There was no significant decline in severe retinopathy (ROP), stage 3 or more, in the 2 periods (20.5% vs 29.4%). However, significantly less bronchopulmonary dysplasias (BPD) were observed (52.3% vs 26.5%, $p=0.039$).

Deducing from 1993 findings, it is hoped that the neurodevelopmental outcome of babies born in 1992-93 will be improved. The relevance of these findings when applied to the developing countries is discussed.

Keywords: extremely low birth weight (ELBW) infants, outcome of, Singapore, developing countries

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INTRODUCTION

The extremely low birth weight (ELBW) infants or those born with a birth weight of less than 1,000 gm constitute a group of high risk infants. They survived because of development, advancement as well as proper organisation of neonatal intensive care. There is growing concern for these ELBW infants who survive with significant handicaps both physically and mentally, with sensory or neurological sequelae. What is the long term prognosis with respect to their learning and school achievement? The present report presents the experience of our ELBW infants over the past 4 years. It is no doubt with improvement of neonatal care and further gain in experience of management of ELBW infants that we continue to see better outcome of this group of high-risk infants. What is the relevance of these findings when applied to the developing countries?

METHODS AND MATERIALS

All the babies of less than 1,000 gm at birth, born in the years 1990, 1991, 1992 and 1993, were studied retrospectively. The records of all these babies of <1000 gm at birth can be found in the department's infant record book. These records were cross-

checked with the computer records of the Hospital as well as the record book from the High Risk Follow-up Clinic. The Clinic was set up in 1991 for developmental assessment of all the high risk babies born in the hospital. The case records were then retrieved from the medical records office for study.

We confined our study on the ELBW survivors and examined the survival rates over the past few years. Survivors were those babies who were discharged from the hospital alive. All our babies were born in the hospital and were managed by us. We also looked at the indicators of neonatal morbidity which include intracranial haemorrhage (grade III or IV intraventricular haemorrhage – IVH or periventricular leucomalacia - PVL), bronchopulmonary dysplasia (BPD) and retinopathy of prematurity (stage 3 or 4 ROP). These are the important risk factors responsible for poor neurodevelopmental outcome.

The infants are studied according to their birth weight, stratified in 100 gm groups. In recent years there are many reports of outcome of the ELBW babies based on gestational age in the medical literature. The reasons for adopting birth weight in the studies will be discussed.

RESULTS

From 1990 to 1993, over a 4-year period, 32,362 livebirths were managed by the Department. There were 126 babies, or 0.39% of all livebirths who weighed between 500-999 gm at birth. Seventy-eight babies or 61.9% of these babies were discharged alive, giving a survival rate of 61.9%. There were significantly more survivals (79.4% or 50/63) in the group of larger babies (800-999 gm), when compared to the group of smaller babies, between 500-799 gm (44.4% or 28/63). Survival rates among the 2 periods, 1990-1991 (period 1) and 1992-1993 (period 2) have also improved, from 59/5% or 44/74 to 65.4% or 34/52. The p value was however 0.62 (Table I).

Department of Neonatology I
Kandang Kerbau Hospital
Hampshire Road
Singapore 0821

N K Ho, M Med (Paed), FAMS, FRACP
Senior Consultant & Head

S B Lim, MBBS, M Med (Paed)
Consultant

Correspondence to: Dr Ho Nai Kiong

Table I – ELBW infants (1990-1993)

Total livebirths	– 32,362		
Total ELBW Infants	– 126 (0.39%)		
No. survived	– 78 (61.9%)		
			Survival rate
Birthweight	800-999	n=50 (63)	79.4%
	500-799	n=28 (63)	44.4%
			p=0.0001
Period	1990-1991	n=44 (74)	59.5%
	1992-1993	n=34 (52)	65.4%
			p=0.62 (NS)

NS: Not significant

Developmental assessment of the babies born in 1990 and 1991 has been completed. The neurodevelopmental outcome, at 2 years of age, of the ELBW infants born in this period is presented. The outcome for those born in 1992 and 1993 is being assessed. Neurodevelopmental impairment, according to birth weight, is shown in Table II. Thirty-five percent (5/14) of the smaller babies and 28% (7/25) of the larger babies had MDI (Bayley Mental Developmental Index) of <69. For cerebral palsy, it was 14% and 8%; and for neurosensory disorder, 7% and 4% respectively. Some babies however had a combination of 2 or 3 major impairments which interfered with the child's function and led to disability or handicap. It is estimated that 33% of babies, of less than 1000 gm at birth, had a disability. Our experience is compared with those of Saigal, Bennett and Kitchen (Table III).

Table II – Major neurodevelopmental impairment according to birth weight (1990-1991)

	<800g (n=14)	800-999g (n=25)	Total
MDI < 69	5 (35%)	7 (28%)	12 (30.8%)
Cerebral Palsy	2 (14%)	2 (8%)	4 (10.3%)
Neurosensory	1 (7%)	1 (4%)	2 (5%)

Some with 2 or 3 major impairments
MDI – Mental Developmental Index
39 of 44 survivors (88.6%) were assessed

Table III – Comparison of percentage impairment of ELBW infants

	Bennett	Saigal	Kitchen	Ho
Period	1977-80	1981-84	1985-87	1990-91
Weight	< 800	500-800	500-800	500-800
Follow-up	3 Yrs n=16	3 Yrs n=50	2 Yrs n=24	2 Yrs n=39
Impairments				
None	81	66	83.3	67
Mild	} 19	16	12.5	} 33
Moderate		12	4.2	
Severe		6	0	

We found that severe intraventricular haemorrhage (IVH) of grade III and IV correlated significantly with MDI (p<0.05).

Though severe IVH in period 2 (14.7%) did not differ significantly from that of period 1 (22.7% at p=0.55), it is encouraging to see that no survivors had severe IVH in 1993 (Table IV).

Table IV – Severe IVH in ELBW survivors (1990-1993)

1990-1991	10/44	22.7%
1992-1993	5/34	14.7%

p=0.55
*No severe IVH in 1993

Other indicators of neonatal morbidity were also examined. There was no significant decline in severe retinopathy (ROP), stage 3 or more, in the 2 periods (20.5% vs 29.4%). However, significantly less bronchopulmonary dysplasias (BPD) were observed (52.3% vs 26.5%, p=0.039) (Table V).

**Table V – ELBW infants (1990-1993)
Other indicators of neonatal morbidity**

	1990-1991 (n=44)	1992-1993 (n=34)	
Severe ROP (> Stage 3)	9 (20.5%)	10 (29.4%)	(p=0.517)
BPD	23 (52.3%)	9 (26.5%)	(p=0.039)

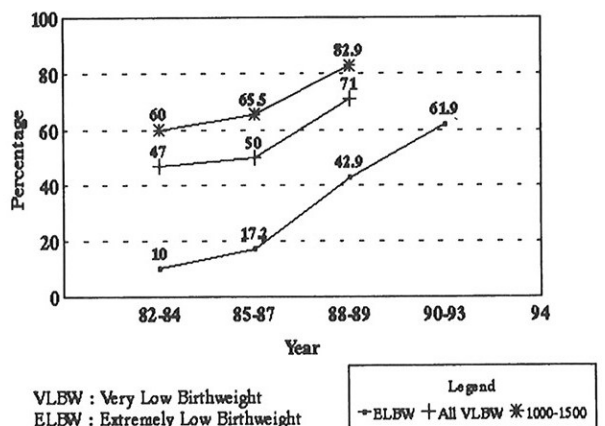
ROP = Retinopathy of Prematurity
BPD = Bronchopulmonary Dysplasia

DISCUSSION

Beginning in the eighties, there was improvement in the survival rates of the very low birth weight (VLBW <1500 gm) as well as the extremely low birth weight (ELBW) babies⁽¹⁾ (Fig 1). Many centres, however, produce different VLBW survival rates (and outcome). Such differences depend on what make up the group of VLBW infants. The survival rate of the VLBW infants will be better if more babies belong to the 1,000-1,500 gm group. Also the attitude and aggressiveness of obstetric management as well as the definition of livebirth or stillbirth definitely affect the number of infants included as ELBW⁽²⁾. For instance, the viability limit of a foetus was defined at 24 weeks of gestation, below which it is considered as an abortion and not a ELBW livebirth. Some centres would not consider a 500 gm foetus as livebirth. Nevertheless, the viability limit as defined in the Eugenic Protection Law in Japan was amended from 24 completed weeks of gestation to 22 weeks in 1991⁽³⁾.

The outcome of infants weighing between 1,000 to 1,500 gm at birth has largely been improved, though it is not uniformly

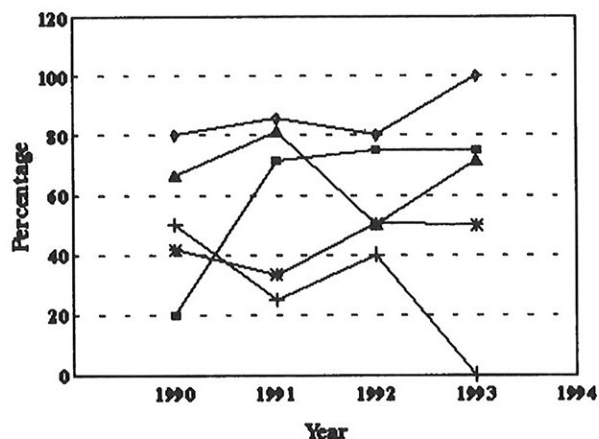
Fig 1 – Survival Rates of VLBW Babies (1982-1989)



so in the developing countries. Presently, most established neonatal centres are focusing on the problems of this very high risk group of ELBW infants and more reports are appearing.

The survival rate of the ELBW infants improved from 42.9% in 1988-1989 to 61.9% in 1990-1993. (Fig 1) The survival rates of these ELBW infants, stratified in 100 gm, from 1990-1993 are also shown (Fig 2). Many factors are responsible for the improvement including advancement of neonatal intensive care, better knowledge of pathophysiology of the premature infants, organised delivery room care with active resuscitative techniques as well as risk identification and efficient transport of the sick infants including *in utero* transfer of the foetus.

**Fig 2 – Survival rates of ELBW infants (1990-1993)
Department of Neonatology I, KKH**



LEGEND		
—+—	—x—	—□—
—△—	—●—	
500-599	600-699	700-799
800-899	900-999	

In recent years, mortality has decreased following the advent of surfactant replacement therapy (SRT)^(4,5) and it is encouraging to note that there were no differences in neurological outcome between surfactant-treated and non treated infants and the proportion of impaired survivals was not increased⁽⁶⁾. However, exogenous surfactant replacement therapy is no panacea for management of ELBW infants.

Antenatal administration of corticosteroids plays an important role in reducing the mortality and the severity or frequency of respiratory disorders and intracranial haemorrhage in the premature infants, which are the high risk factors for poor neurodevelopmental outcome⁽⁷⁾.

It is encouraging to see that many centres have reported better follow-up results and outcome of these ELBW infants in the past few years^(8,9). One would expect the outcome to continue to improve. However, with these good results, what sort of message are the developing countries getting?

One has to take note that the good results came mainly from well-known centres with well-equipped facilities as well as well-organised set-up in neonatal care.

Therefore, it cannot be assumed that the reports from developed countries are applicable to developing countries. ELBW infants are not routinely ventilated in some centres⁽¹⁰⁾. Even with such excellent care in the developed countries, increased survival of these ELBW infants is not without a price. These infants may survive with morbidity including chronic lung diseases, intraventricular haemorrhage, periventricular leucomalacia, sepsis, retinopathy of prematurity, etc. Prolonged hospitalisation and intensive care also mean higher medical cost. One would ask the following questions: what happens to those ELBW infants born in the developing countries where similar

facilities or set up are not available or substandard and where support services for handicapped children are not available? Do they have a similar or different guideline in the care of these ELBW infants and do they set a limit below which no active resuscitation would be done. It is observed that, in many developing countries, newborn babies are looked after in the general paediatric unit by general paediatricians. Neonatal unit or neonatal intensive care unit has yet to be formed. It follows that many units have no cranio-ultrasound equipment to grade the severity of intracranial haemorrhage, knowing that the extent of intracranial haemorrhage as well as periventricular leucomalacia have a close correlation with neurodevelopmental outcome of these infants^(6,11,12). One also wonders how many centres in the developing countries have set up a developmental assessment clinic for formal developmental and intellectual testing of these high risk babies for a period of as long as 8 to 10 years, and have a well-planned early intervention programme for these infants. It is therefore impossible to predict the neurodevelopmental outcome of the ELBW infants born in the developing countries.

In 1988, the New York State Task Force on Life and Law concluded that although technological advances may improve survival further among infants born after 23 or 24 weeks of gestation, they will not lower this threshold for survival⁽¹³⁾. Many also agreed that aggressive resuscitation was not warranted for infants born at 22 weeks^(12,14). However, for infants born between 23 or 24 weeks, decision of resuscitation should be flexible. From Canada, Davies⁽¹⁵⁾ also believed that the economic and psychosocial costs of caring ELBW infants could be warranted in developed countries for neonates with a good chance of survival and long-term outcome. As mentioned earlier, the viability limit in Japan was amended from 24 completed weeks of gestation to 22 weeks in 1991⁽³⁾.

Increasing numbers of reports on the outcome of these ELBW infants based on gestational age rather than birth weight subgroups are appearing in the medical literature⁽¹²⁾. The importance of adopting gestational age is that foetal or organ maturity at birth is the ultimate determinant of outcome and usually obstetric decisions have to be based on foetal maturity. Unfortunately it is difficult to adopt such system in the developing countries because many women do not attend antenatal clinic and are also unable to time their gestation. Some do not even know or remember their own menstrual dates! In some places, babies are not even weighed at birth and births are not notified and registered! It is just impossible to study these babies. The scattergram of data on birthweight and gestational age of all our ELBW infants born between 1990 to 1993 was constructed. Unfortunately, we fail to show any close correlation between these variables. Nevertheless since gestational age and birth weight have independent though similar relationships to outcome, birth weight, which is easier to determine, may remain as an objective means of measurement for the ELBW infants in developing countries.

It is difficult for a centre in the developing countries to make decision on resuscitating or managing a ELBW infant based on the good results of other advanced centres. There are many factors that contribute to and are responsible for the success of the management. Counselling the parents on the likely outcome of the ELBW infant based on experience from these centres is most misleading when the particular unit has not first met the basic requirements for a neonatal intensive care unit.

Prevention of premature births or prematurity is still the most ideal answer for decreasing the incidence of poor neurodevelopmental outcome in ELBW infants. The next frontier will include optimisation of neonatal care, extension of care into

the home after discharge and concurrent introduction of intervention and family support programmes. These could also improve developmental outcome of these high risk children⁽¹⁶⁻¹⁸⁾.

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