SHORT COMMUNICATION

Development of High-Risk Newborns – A Follow-up Study from Birth to One Year

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We followed 55 high-risk newborns from birth till one year using Trivandrum Development Screening Chart (TDSC) and Denver Development Screening Test (DDST). We also assessed their muscle tone, vision and hearing. Babies were classified into mild, moderate, and severe risk groups using a scoring system. Babies with developmental delay were categorized as having mild, moderate, or severe delay. The risk score was significantly associated with the severity of developmental delay (P<0.001). Abnormalities of tone were also associated with development delay (P<0.001).

Keywords: *Development, Developmental delay, High-Risk newborn.*

Advances in Perinatal care and establishment of improved neonatal services have increased the survival rates of many high-risk newborns in developing countries. Developmental delay is anticipated in these babies and its early recognition is important, so as to provide early interventional services(1,2). Ideal developmental assessment tools are elaborate and require expertise in the field. Simplified tools need to be devised to help the pediatrician working under constraints. In this study, we followed up high risk newborns from birth to one year and the pattern and outcome of their development were assessed using Trivandrum Development Screening Chart (TDSC), and Denver Development Screening Test (DDST).

METHODS

This was a prospective follow up study on high-risk neonates admitted to a level III neonatology unit in Southern India during April 2004 to September 2005. The risk factors were defined by standard criteria(3). Follow-ups was carried out for development assessment at 2 weeks, 2 months, 4 months, 8 months and 1 year of age. Risk factors of the study population were categorized under three domains *i.e.,* prenatal, natal and postnatal factors. Based on the revised classification of high-risk baby(4-7), a scoring system was developed for the ease of classifying babies into mild, moderate and severe risk categories. A score of 3 and 2 were given for each item in the severe and moderate risk category respectively. All other risk factors were given a score of 1 each as shown in ***Table* I**.

Total risk score for each baby was calculated and categorized as ≤ 5 - mild risk, 6 – 9 - moderate risk and >9 - severe risk for developmental delay. At each visit weight, length and head circumference were plotted on CDC 2000 growth chart. For development screening Trivandrum Development Screening Chart (TDSC)(8) was adopted as the main tool along with Denver Development Screening test (DDST)(9) for comparison. Amiel-Tison angles for tone, and vision and hearing assessment were also done during each visit. All babies had early intervention therapy using audiovisuals and passive stimulation for joints advised as domiciliary. At one

TABLE I HIGH RISK SCORING SYSTEM

Score 3	Birth wt < 1250g, gestational age 30 weeks or less, intra ventricular haemorrhage, severe asphyxia, severe neurological problems*, abnormal neurologic examination at discharge, significant feeding problems, intracranial pathology congenital or acquired, prolonged hypoglycemia, multiple/major congenital anomaly/genetic disorders.
Score 2	Birth weight between 1250-1500g, prolonged ventilation, jaundice – exchange transfusion, severe pre-ecclamptic toxemia, diabetic mother on insulin.
Score 1	Birth weight > 1500g, gestational age 30 weeks to 35 weeks, mild birth asphyxia, jaundice-phototherapy, sepsis, respiratory distress syndrome, congenital heart disease, early circulatory failure**, hypoglycemia / hypocalcemia, mechanical ventilation, consanguinity, mental retardation, previous abortion, infertility treatment, develop-mental delay in sibling, neonatal death in family, deaf parent, hypertensive mother on drugs

** Structural anomalies in brain, refractory seizures, severe hypoxic ischemic encephalopathy; ** Prolonged capillary filling time (> 3 seconds).*

year of age, babies were categorized into normal and those having developmental delay. Babies failing to achieve target milestones in one domain were designated as having mild delay; two, as having moderate delay and three or more as having severe delay. Isolated vision and hearing defects were considered as severe delay. Chi-square test was used for risk scoring and severity of developmental delay and Kappa statistics for finding the agreement between TDSC and DDST.

RESULTS

255 newborn babies were initially enrolled for the study but only 55 babies could complete the 1 year follow-up. There were 26 male and 29 female babies.

The risk factors obtained are enumerated as (I). Prenatal factors - deaf parent 3 (5%), consanguinity 3 (5%), mental retardation 1 (2%), neonatal death 1 (2%), developmental delay 1 (2%), hypertensive mother on drugs 19 (34.5%), diabetic mother on insulin 9 (16%), previous abortion 7 (13%), infertility treatment 3 (5%). (II). Natal factors - apgar 7 at 5 minutes 10 (18%), apgar 0 at 5 minutes 4 (7%), cleft lip/palate 1 (2%), Down syndrome 1 (2%), dysmorphic facies 1 (2%), birthweight <1250 grams 5 (9%), 1250-1500g 6 (11%), 1501-2000g 21 (38%), 2001-2500g 21 (38%), >4000g 2 (4%), gestational age <30 weeks 3 (5%), 31-35 weeks 24 (44%), >35 weeks 28 (51 %). (III). Postnatal factors – jaundice-phototherapy 20 (36%), jaundice-exchange transfusion 3 (5%), respiratory distress syndrome 16 (29%), mechanical ventilation 6 (11%), neonatal seizures 6 (11%), poor feeding 5 (9%), hypoglycemia 4 (7%), sepsis 2 (4%), acute hydrocephalus 2 (4%), congenital heart disease 1 (2%), meningitis 1 (2%), intraventricular heamorrhage 1 (2%), disseminated intravascular coagulation 1 (2%). 20 babies had less than 2 risk factors and 35 babies had more than 2 risk factors. Risk score was <5 in 35 babies; 6-9 in 13 babies; and >9 in 7 babies.

Developmental assessment: While TDSC revealed developmental delay among 16 babies, as per DDST, 20 babies had delay. Of these, 7 had global delay (*i.e.*, affecting 4 domains) 2 had delay in 3 domains and 11 had delay in 1 or 2 domains. Of the 20 babies with less than 2 risk factors, 1 had delay whereas among 35 babies with more than 2 risk factors, 20 had delay (P<0.001).

Risk score and developmental outcome: Of the 35 babies with mild risk (Score ≤5), 6 revealed mild delay at one year of age. Of the 13 babies with moderate risk (score 6-9), 5 had mild delay, 1 had moderate delay and 1 had severe developmental delay. Rest of the 20 babies had normal development. Of the 7 babies with severe risk for developmental delay (score >9), 1 had moderate delay and 6 had severe delay. The relationship between a higher score and severity of developmental delay was highly significant (P<0.001).

Tone and developmental outcome: Out of 35 normal babies, 6 had hypertonia. Out of 11 babies with mild developmental delay, 6 had hypertonia. Among the 2 with moderate delay, 1 had hypertonia and 1 had hypotonia. Among the 7 with severe delay, 6 had hypertonia and 1 had hypotonia. The correlation between abnormal tone and developmental delay was highly significant (p<0.001).

Comparison between TDSC and DDST: While DDST revealed delay in 20 babies, the 4 babies not

WHAT THIS STUDY ADDS?

- Babies with severe risk factors and co-existence of multiple risk factors have the worst neurodevelopmental outcome.

picked up by TDSC had only mild motor delay. Kappa statistics showed that the two tests are in excellent agreement with each other.

Hearing and vision with developmental outcome: Out of 55, 9 babies had abnormal hearing perception by simple clinical assessment. One had mild delay, with one parent deaf. One with moderate delay had exchange transfusion for hyperbilirubinemia. 7 had severe delay, out of which one had exchange transfusion for hyperbilirubinemia, 5 babies had hypoxic ischaemic encephalopathy and one had hydrocephalus. Three out of 55 had visual impairment of which two were <30 weeks and the third was a term baby who had mechanical ventilation for birth asphyxia. All three had received oxygen for more than 5 days and all of them had severe developmental delay.

DISCUSSION

In this study the high risk scoring system effectively categorized newborn babies into mild, moderate and severe risk groups. All these babies were periodically assessed with TDSC and DDST and had early interventional services. The risk score was significantly associated with the severity of developmental delay (P<0.001). Abnormalities of tone, vision and hearing were also associated with developmental delay. Thus, it can be stated that babies with severe risk factors and co-existence of multiple risk factors have the worst neurodevelopmental outcome.

Of the two methods used, Denver Development Screening Test (Denver II) is the most extensively used screening test all over the world, but it is time consuming (20 to 30 min) whereas TDSC is so simple that a trained paramedical staff can complete the test in 5 to 7 minutes. TDSC was equally good in detecting major aberrations in development during infancy as revealed by Kappa statistics (0.84).Thus, TDSC can be promoted for screening delay in infant development, where resources are poor.

No similar data could be obtained from literature where multiple risk factors were correlated with developmental outcome. Hence the observation that risk scoring can predict the neurodevelopmental prognosis in high risk babies is highly helpful so as to start early intervention. It is also known that consistent abnormalities of tone may be associated with cerebral palsy highlighting the need for following up muscle tone in babies with development delay(10). Bilirubin induced neurological damage , prematurity, and HIE are well established causes for hearing impairment(11,12). Among the causes for visual impairment, prematurity, perinatal hypoxia , delayed dendritic and synaptic formation in the cortex and delayed myelination of the optic nerve are the possibilities(13,14). Thus, the need for vision and hearing screening for high risk babies cannot be over emphasized.

Our study had few limitations. The sample size was 55 as 143 babies dropped out and all babies could not be submitted to a standard set of investigations like neurosonogram, CT scan and MRI due to ethical reasons as well as financial constraints.These tests were done only when clinically suspected.

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