RESEARCH PAPER

Transient Tone Abnormalities in "High Risk" Infants and Cognitive Outcome at Five Years

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Objective: To identify transient tone abnormalities and determine its prevalence in "high risk" infants and their cognitive outcome at 5 years.

Design: Prospective cohort observational study.

Setting: High risk infants discharged from a level II neonatal unit in a 12 month period, and followed upto 5 years.

Methods: High risk infants and normal controls were assessed for abnormalities of tone using the method described by Amiel-Tison at 3, 6, 9, 12 months. An IQ by Stanford–Binet method and a preschool inventory by Ayres, Bobath was done at 5 years. Those infants who had normal tone at 6 and 12 months were called normal high risk (HR) group and those who had abnormalities at 6 months, which disappeared at 12 months, were called the transient tone abnormalities (TTA) group.

Results: Out of 190 high risk infants, 113 were normal HR and 67 (35.2%) were labeled as TTA. Ten infants with cerebral palsy had abnormal tone throughout the first year. Controls had normal tone throughout the follow-up period. Although there was no difference in the IQ of the TTA group (98.5 $\pm$ 12.4) and the normal HR (99.1$\pm$13.1) group, it was significantly less (P=0.04) than that of controls (106.1 $\pm$ 9.1). Preschool inventory in TTA children showed poor language development (P=0.014).

Conclusion: Many of the tone abnormalities detected at 6 months resolve by 12 months, hence a hasty diagnosis of cerebral palsy should not be made. High risk infants with transient tone abnormalities have a normal cognitive outcome at 5 years, except for poor language skills.

Key words: *High risk Neonate*, Outcome, Prognosis, Tone abnormalities.

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Early identification of infants at risk for neurologic and developmental handicap is the main aim of neonatal follow up programs. Most of the studies from the developed countries report on follow up of infants weighing less than 1500g. Our 'high risk' infant population consists of preterm low birthweight babies, as well as full term babies with risk factors like birth asphyxia and hyperbilirubinemia. Besides, a large percentage of our low birthweight babies are small for gestational age (SGA) and this intrauterine malnutrition may add a different dimension to their neurodevelopment.

A syndrome of transiently abnormal neurologic signs in preterm infants was described by Drillen(1) in 1972. She identified neuromotor abnormalities in 40% of infants with birthweight less than 2000g and normalization of these findings in majority of infants by one year of age. She followed them upto school age and reported a normal IQ. Amiel-Tison defined transient tone abnormalities as abnormalities of tone which are present in early infancy, which disappear by the end of the first year(2). However, she questioned the presumption that these abnormalities are innocuous and found that these children later had school difficulties(3). The aim of our follow-up study was to identify transient tone abnormalities and to determine its prevalence in 'high risk' infants in the first year and their subsequent cognitive outcome at 5 years.

METHODS

Infants discharged from a Level II care Neonatal Unit of KEM Hospital, Pune during a 12 month period starting from 1st October, 1990, were enrolled in this prospective follow up study. The criteria for selection as high risk were (*i*) birthweight less than 2000 g; (*ii*) gestation less than 37 weeks; (*iii*) seizures; (*iv*) apnea; (*v*) hypoxic ischemic encephalopathy – Sarnat stage II or III; (*vi*) intraventricular hemorrhage >grade I; (*vii*) hyperbilirubinemia needing treatment; and (*viii*) respiratory distress with a Silverman Anderson score(4) of ≥3. Infants with congenital anomalies were excluded. Full term infants with a normal antenatal, natal and postnatal course, born during the same period, were enrolled as controls. Ethical clearance was obtained from the hospital committee and parental consent was taken.

These infants were assessed for tone abnormalities at 3, 6, 9 and12 months using the method described by Amiel-Tison(5). Corrected age was used in preterms. Evaluation of muscle tone is the fundamental part of this method. The evaluation of muscle tone is based on the study of spontaneous posture, passive tone and active tone. Passive tone is measured by popliteal, adductor and dorsiflexor angles in the lower extremity and scarf sign in the upper extremity. The range for normal angles in Indian infants has been previously described by us(6). Active tone comprises of spontaneous movements and movements provoked by maneuvers such as pull to sit and pull to stand.

Based on this examination, the infants were categorized in three groups – (*i*) hypertonia, (*ii*) hypotonia, and (*iii*) minor tone abnormalities like mild hypertonia or hypotonia in one extremity, mild adductor or abductor spasm at the hip joint, and mild hypertonia of the neck extensors. The assessment was jointly done by the neonatologist and occupational therapist. All infants found to have tone abnormalities were given occupational therapy.

If there were no tone abnormalities at 6 and 12 months, the group was called normal high risk (HR) group. If tone abnormalities were present at 6 months, but disappeared at 12 months, they were called transient tone abnormalities (TTA) group. Those infants who persisted to have tone abnormalities at 6 and 12 months, were diagnosed as cerebral palsy, and referred to our rehabilitation centre and excluded from further follow up.

The study children were recalled at 5 years of age and an IQ was done by a trained psychologist using Kulkshetra's adaptation of Stanford Binet Intelligence scale(7). An IQ ≥85 was considered as normal. A preschool inventory described by Ayres, Bobath(8) was also used, which consists of assessment of 7 areas of development – gross motor, fine motor, perception, intersensory integration, preschool skills, activities of daily living, and language development.

Statistical analysis was done using ANOVA for comparing means. The difference in groups was analyzed using chi-square test. *P* value less than 0.05 was considered as significant. Analysis was done using Statistical Package for Social Science (SPSS) for Windows (version 10.0).

RESULTS

Two hundred and eight consecutive neonates discharged from the neonatal unit were enrolled in this study. Sixteen families lived in far off cities and could not come for regular follow up. Two babies died after going home. The birthweight and gestational age of this cohort of 190 neonates is shown in ***Table* I**. The cohort had 115 (60.5%) males. Out of the 49 controls, 37 were males. Out of the 119 preterms, 57(47.9%) were small for gestational age (SGA). Out of the 71 full term infants, 38 (53.5%) were SGA.

One hundred and thirteen infants had normal tone at 6 and 12 months and formed the normal HR group. The flow chart of the cohort is shown in ***Fig.* I**. Seventy seven (40.5%) infants had tone abnormalities at 6 months. Sixteen (20.7%) had hypertonia, 23 (29.8%) had hypotonia and 38 (49.3%) had minor tone abnormalities. Sixty seven (87%) infants started normalizing at 9 months, and had no tone abnormalities at 12 months. This group was called the transient tone abnormalities or TTA group. Out of 16 infants with hypertonia, 12 normalized at 12 months. Out of the 23 infants with hypotonia, 17 normalized, and all 38 infants with

TABLE I BIRTHWEIGHT AND GESTATIONAL AGE OF THE COHORT (*n*=190)

Birthweight (g)	*n* (%)	Gestational Age (wk)	*n* (%)
<1500	33 (17.3)	< 30	7 (3.7)
1500-1999	94 (49.5)	31-32	21 (11.0)
2000-2499	26 (13.7)	33-34	51 (26.8)
		35-36	40 (21.0)
≥2500	37 (19.5)	≥37	71 (37.4)

minor tone abnormalities became normal at 12 months. Ten infants had abnormal tone (4 hypertonia, 6 hypotonia) at 6 and 12 months and were diagnosed as cerebral palsy and referred to our rehabilitation center and excluded from the study. Thus, the prevalence of TTA was 35.2% in the whole high risk cohort.

There was no difference in the proportion of TTA between fullterms and preterms (30.8% and 35.9%, respectively), VLBW infants and those with birthweight ≥1500g (41% and 30%, respectively), and SGA and AGA infants (37.8% and 36.4%, respectively).

All these infants were recalled at 5 years and an IQ was done. The mean IQ of the TTA group (98.5±12.4) was significantly lower than that of controls (106±9.8) (*P*=0.04), but it was well within normal limits. There was no difference in the mean IQ of the TTA and normal high risk group.

The preschool inventory showed that there was no difference in the six skills in the TTA and normal HR group. In the six items of language development, the TTA group fared poorly. Out of 42 controls, only 4 failed, whereas out of 62 children from the TTA group, 45 failed in language development. This difference was significant (*P*=0.001).

DISCUSSION

Many of the tone abnormalities detected in the first six months in high risk infants start normalizing by 9 months and disappear by 12 months. Our study showed a prevalence of 35.2% for transient tone abnormalities in a high risk cohort consisting of preterm and full term infants. Half of the infants with TTA had minor tone abnormalities and all these normalized at one year. There was no difference in the prevalence rate amongst preterm and full term infants, and SGA and AGA infants. When the infants with TTA were recalled at 5 years, their IQ was within normal limits and there was no difference between the mean IQ of the TTA group and the normal high risk group.

Transient tone abnormalities have been reported in several follow up studies of preterm infants(9-11). Amiel Tison(3) reported these abnormalities in a small study of full term infants. Bradt, *et al*.(11) have stated that more transient tone abnormalities occur in preterms compared to full terms. But the cohort in all these studies(9-11) had many more VLBW infants compared to ours. We found no significant difference in the incidence of TTA between our small number of VLBW infants and those weighing ≥1500 g. Another major difference between our cohort and those reported in the Western literature was the higher number of SGA infants. However, there was no difference in the incidence of TTA between the SGA and AGA group.

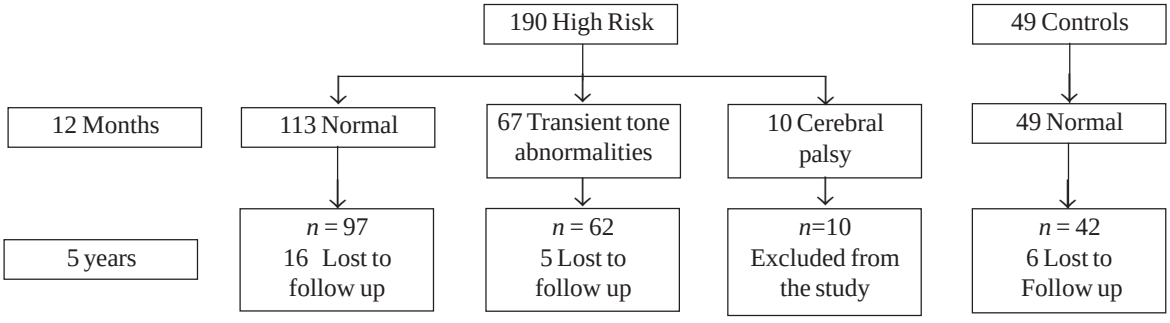

FIG. 1 *Flowchart of study participants.*

WHAT THIS STUDY ADDS?

- The prevalence of transient tone abnormalities in high risk infants was 35.2%. Many of the tone abnormalities in high risk infants at 6 months resolve by 12 months.

In a large follow up study of high risk infants, Matile, *et al*.(11) reported that hypertonia found at 6 months disappeared in 81.2% cases. The tone abnormalities in our high risk cohort disappeared in 87% of cases. Pedersen, *et al*.(12) felt that the specificity of motor evaluation at 7 months regarding cerebral palsy is unsatisfactory since dystonia at this age is most often transient.

Sommerfelt, *et al*.(14) reported normal cognitive development in low birthweight children with transient tone abnormalities at 5 years. Our children with TTA also had normal cognitive development at 5 years. deVries, *et al*.(15) assessed preterms and full terms on two motor items from the Bayley Scales at 39 weeks corrected age and at 2.5 years. They found correlation between poor hand function at 39 weeks and 2.5 years. They postulated that preterm children had problems in adequately coordinating their muscle power compared to those born at term. We found no problems in gross motor, fine motor and coordination in our TTA group at 5 years. The only abnormal finding on the preschool inventory was poor language development in the TTA group. Gosselin, *et al*.(16) also found language problems in their group with minor neurological signs. D'Eugenio, *et al*.(17) followed a group of preterm infants with gestation of 28-32 weeks and found the incidence of transient abnormalities to be 82%. They followed them upto 4 years and concluded that these neurologic abnormalities did not predict cognitive delay.

In conclusion, our study of a cohort consisting of preterm and full term infants with a high number of SGA infants shows that many of the tone abnormalities detected at 6 months are transient and resolve by twelve months. Hence, a hasty diagnosis of cerebral palsy should not be made till the latter part of the first year. These abnormalities of tone are not predictive of poor outcome. Our children with transient tone abnormalities did not show any cognitive impairment at 5 years, except for poor language skills.

Contributors: SC conceived the project, supervised data collection, wrote the manuscript and will be guarantor for the paper. MB collected the data. AC did IQ tests. BP did preschool inventory. AP supervised data collection. MH made home visits, ensured appointments. The final manuscript was approved by all authors.

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