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Original Article

Study of Adverse Perinatal Events in full term small for Gestational age (SGA) Babies with or without Fetal Malnutrition

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Introduction

Fetal malnutrition (FM) is a risk factor for increased neonatal morbidities and mortalities worldwide. Clinicians challenge is to identify SGA babies whose health is endangered in utero because of a hostile intrauterine environment and to monitor and intervene appropriately[1].

This prospective observational study aim to know prevalence of fetal malnutrition in term SGA babies and to study occurrence of adverse perinatal events in term SGA babies with or without fetal malnutrition. Assessment of nutritional status of fetus has been a major concern to many clinicians because of the potentially serious sequelae of malnutrition on multiple organ systems[2,3]. Fetal biometry has been used to identify malnourished fetuses as early as possible. Perinatal problems and or long term central nervous system sequelae are known to occur primarily in babies with fetal malnutrition (FM) whether appropriate for gestational age (AGA) or SGA but less so among those who are SGA but without fetal malnutrition[4]. There is a need for prompt identification of babies with FM. Features of malnutrition must therefore be sought for, and appropriately diagnosed and treated in every baby at risk. The anticipatory management of such infants at birth may decrease morbidity and improve the survival of such infants[4,5,6]. Study enrolled 903 term SGA neonates.CAN Score is applied and anthropometric evaluation is carried out between 24 to 48 hour of birth. Babies with adverse perinatal events are treated according to standard hospital protocol.

Prevalance of fetal malnutrition in present study is 34.21% in term SGA babies. All anthropometric parameters like birth weight, length, head circumference and ponderal index are significantly low in SGA babies with fetal malnutrition as compared to SGA babies without FM. “Fetal malnutrition”, is a term coined by Scott and Usher[6], defined as failure to acquire

adequate quantum of fat and muscle mass during intrauterine growth[4,5]. In severe FM, the neonate may look "emaciated" or "marasmic" as the skin appears "several sizes" too large for the baby. Fetal growth retardation is a risk factor for postnatal growth retardation, cardiovascular and metabolic problems later on in life and adverse neurodevelopmental outcome[7].

Material and Methods

The present prospective observational study was conducted in the Neonatology unit of Tertiary care Institute at Government Medical College Nagpur, of central India. The study group consisted of 903 term SGA (wt.<2.5 kg) neonates of gestational age >37 weeks born with NVD/LSCS. Babies with major congenital malformations, premature babies (<37 weeks of GA) and weight > 2.5 kg were excluded. After obtaining written informed consent from parents, clinical assessment of nutrition and anthropometric evaluation were carried out between 24 to 48 hr of birth in all neonates,so Sample size required for study was 844.Hence 903 newborn were included in the study[8]. Institutional ethical clearance obtained for the study.

Prospectively, we enrolled 903 term SGA neonates born at our center, for the study. All observations were made by a single observer in a warm well lighted room. Weight was obtained using a digital scale with a capacity of 20kgs. And sensitivity of ± 5gm. The CAN score was obtained on the basis of superficial readily detectable signs of malnutrition in the newborn as described by Metcoff[4].

Each sign was rated 1 (worst, severe FM) to 4(best, well nourished). The highest attainable score was 36 and the lowest was 9. Fetal malnutrition was concluded in those with a CAN Score of less than 25. Before starting study, inter and intraobserver variation of CAN Score was tested was found to be within acceptable norm (P > 0.05). A cut off value of tenth centile was used to define SGA. A cut off value for length was used 46.3cm and Head circumference was 32.1cm. Gestational age assessment was based on accurate recollection of date of the last menstrual period by the mother, when a doubt existed, findings from recent ultrasound examinations was taken into consideration and assessment of new born using Expanded New Ballard score is used to assign gestational age in completed weeks. Head circumference (HC) was measured with a non-stretchable measuring tape just above the supraorbital prominence anteriorly and over the maximum occipital prominence posteriorly excluding the ears. Length was measured using an infantometer. A slight pressure was applied at the newborn's knees to ensure full extension of lower extremities. A value below 3rd centile was taken as abnormal. Babies with adverse perinatal events were admitted in special care neonatal unit and were treated according to standard hospital protocol.

The hypothesis of this study was that nutritional status of term SGA babies is more important prognostically than its birth weight. In this study parallel analysis of the birth weight, ponderal index and nutritional status of term SGA babies will allow us to identify the method that provided the most useful prognostic information in terms of perinatal morbidity.

Statistical Analysis

Demographic, Anthropometric and clinical parameters were presented as mean± SD. Categorical variables were expressed in actual numbers and percentages. Unpaired t-test was performed to compare mean birth weight, Ponderal index (PI), Length, and Head circumference (HC) between well nourished and fetal malnutrition groups. Categorical variables are compared by Chi square statistics. Multivariate logistic regression analysis was performed to find the effect of length, ponderal index (PI) & CAN Score expressed as continuous variables on neonatal morbidity. $p<0.05$ was considered as statistical significance. All tests were 2 sided. Statistical software STATA version 10.0 was used for Statistical analysis.

Results

In present study 903 term SGA neonates 477(52.8%) (wt <2.5kg) were males and 426(47.2%) were females. Of all these term SGA babies, 309 (34.21%) were detected to have Fetal malnutrition based on CAN Score of < 25. Thus prevalence of fetal malnutrition in SGA babies is 34.21%.

Table 1: Anthropometric characteristic of SGA population by CAN score

	CAN Score		p.value
	<25 SGA (FM)	≥ 25 SGA	
Birth weight(kg)	1.82 ± 0.35	2.07 ± 0.27	0.000,HS
Length(cm)	47.04 ± 1.01	47.09 ± 0. 66	0.4175,NS
Head circumference(cm)	32.14 ± 0.84	32.61 ± 0.62	0.000,HS
Ponderal Index	1.89 ± 0.31	2.12 ± 0.22	0.000,HS

(Table 1) Shows that all anthropometric parameters are significantly low in malnourished term SGA babies except length.

Table No.2: Adverse perinatal events in term SGA subgroup by CAN Score

Adverse perinatal event	CAN< 25 (309) SGA (FM)	CAN≥ 25 (594) SGA	RR	95% C.I.	p-value
Birth asphyxia	83 (26.86%)	21(3.53%)	10.02	5.96 – 17.41	0.0000,HS
Septicemia	74(23.94%)	9(1.5%)	20.46	9.97 – 47.12	0.0000,HS
Hypoglycemia	46(14.88%)	8(1.34%)	12.81	5.86 – 31.54	0.0000,HS
Hypocalcemia	41(13.26%)	8(1.34%)	11.20	5.08 – 27.98	0.0000,HS
Hyperbilirubinemia	40(12.94%)	8(1.01%)	9.61	4.55 – 20.27	0.0000,HS
Hypothermia	35(11.32%)	12(2.0%)	6.19	3.07 – 13.29	0.0000,HS
Respiratory distress	28(9.06%)	03(0.5%)	19.62	5.96 – 101.42	0.0000,HS

(Table No.2) clearly reveals that adverse perinatal events occurred significantly high number in SGA babies with fetal malnutrition.

Table 3: Comparison of Anthropometric indicators of growth using CAN score

Birth weight (kg)	CAN Score		Chi square	p.value
	<25(309) SGA (FM)	≥ 25(594) SGA		
< 1.5 (55)	51(92.72%)	04(7.2%)	89.06	0.000 ,HS
1.5 – 2.0 (455)	172(37.80)	283(62.19)	5.23	0.0225,S
2.0 – 2.5 (393)	86(21.88)	307(78.11%)	47.68	0.000 HS

There is a significantly higher occurance of fetal malnutrition (p-value <0.05) in term SGA babies with birth weight < 1.5 kg (Table 2).

Table 4: Comparison of term SGA babies in terms of length and head circumference with CAN score

LENGTH	CAN Score		RR	95% C.I	p-value
	<25(309) SGA (FM)	≥ 25(594) SGA			
<3rd centile(139)	64 (46.04%)	75 (53.95%)			
≥ 3rd centile(764)	245(32.06%)	519(67.93%)	1.64	1.21-2.22	0.0014,HS
HEAD CIRCUMFERENCE					
< 3rd centile(258)	134(51.93%)	124(48.06%)			
≥ 3rd centile (645)	175(27.13%)	470(72.86%)	2.07	1.69-2.54	0.0000HS

When mean length of babies is used for comparison, there is no significant statistical difference, however, when length is considered in terms of being <3rd centile, there is a very significant statistical difference (p value <0.0014) (table 3). It also shows that babies with birth

length < 3rd centile are at 1.64 times higher risk for fetal malnutrition (95% confidence interval 1.21-2.22). Further analysis of data shows that babies with head circumference (HC) <3rd centile is 2.07 times higher risk for fetal malnutrition than those with head circumference >3rd centile. (Relative risk - 2.07, 95% confidence interval 1.69-2.54 p.value <0.000).

Table No.5: Multivariate logistic regression analysis of effect of length, ponderal index & CAN Score expressed as continuous variables on overall neonatal morbidity

FINAL MODEL	Odd Ratio	95% CI	p.value
Length	2.24	1.33 – 3.76	0.002,S
PI	0.68	0.47 – 0.99	0.047,S
CAN score	0.61	0.56 – 0.66	0.000,HS

(Table No.5) On multivariate analysis of effect of length, ponderal index and CAN Score on neonatal morbity.CAN Score proved to be highly significant variable.

Discussion

Not many studies reporting fetal malnutrition in term SGA neonates. Few studies reported fetal malnutrition in preterm infants and its impact on neonatal outcome. Large number of studies have reported fetal malnutrition in term AGA babies. This study aims to evaluate relationship between neonatal morphometrics and adverse neonatal outcome resulting from fetal malnutrition. The study comprised of 903 term SGA babies, comprising of 309 babies who had fetal malnutrition according to CAN Score and remaining 594 babies had no fetal malnutrition.

Present study reported significantly high occurrence of adverse perinatal events in SGA with fetal malnutrition as compared to SGA well nourished babies. In our study reported significantly high occurrence of Birth asphyxia, Septicemia, Hypoglycemia, Hypocalcemia, Hyperbilirubenemia, Hypothermia, and Respiratory distress (Table no.2).

Walther et al[9] in his study reported significantly high occurrence of hypoglycemia, hypocalcemia, asphyxia in babies with Ponderal index and birth weight less than 10th centile.

Preliminary studies[10,11,12] all based on small sample sizes, support the differential morbidity pattern reported here for the IUGR subgroups. The IUGR-low PI group experienced higher rates of meconium stained amniotic fluid, meconium aspiration, fetal distress, perinatal asphyxia and low Apgar score and as also observed here, increased risk for intrapartum interventions[9,13]. Jarai et al[14] investigated a mixed group of preterm, term, and postterm SGA infants using different indices of body proportions and pointed to the significance of soft tissue wasting rather than low birth weight for gestational age itself in the development and diagnosis of FM. His data also shows that hypoglycemia occurred often in overweight infants (P.I. > 75th percentile and birthweight > 90 th percentile).The study done by **Haas J et al[15]** found that in two populations from developing countries, infants with disproportionate IUGR had between 2.0 and 2.8 times higher risk of early neonatal mortality. Similarly asymmetrically formed infants from Norway had 4 times greater perinatal mortality than those with appropriate weight and length[16]. **Robert M. Patterson et al[17]** studied the relationship between birth weight and perinatal outcome. They classified neonates as small appropriate, or large for gestational age[18,19]. They reported despite the fact that such classification implies only proximity to a mean weight, small infants are commonly referred to as "growth retarded". If neonates are classified by birth weight for gestational age only many growth retarded neonates are nutritionally normal and are at no increased perinatal risk[17]. Walther et al[9], reported that small for gestational age (S.G.A.) infants (whose birth weight is below the 10th percentile for gestational age) have a higher

incidence of Asphyxia, hypoglycemia[20] hypothermia[21] in the neonatal period.

The incidence of fetal malnutrition in different weight-for-gestational age groups of term newborn infants have been reported in a few studies. In the original article of Metcoff 1, the incidence of fetal malnutrition was 5.5% in AGA infants and 54.0% in SGA infants. Deodhar et al.4 reported an incidence of 12.9% in AGA infants and 84.2% in SGA infants, while Sankhyan et al.28 found that 3.8% of AGA and 57.1% of SGA infants were malnourished. Present study reported significantly high occurance of adverse perinatal events in term SGA with fetal malnutrition as compared to term SGA normal babies.

Prevalence of FM in Preterm neonates (40%) was documented by B.N. Ezenwa[22] and 48.9% as reported by Almarzoki et[23] from Iraq. It is however, higher than the 26.59 % documented from India by Kamath et al [24]. There is a significant difference in mean birth weight, head circumference and ponderal index in SGA with Fetal malnutrition (p-value-0.0000, HS), SGA neonates with increasing birth weight have less fetal malnutrition. The body weight in relation to gestational age reflects only total body mass at the stated gestational age,but does not reflect how the mass is distributed over the linear surface area. Infants with loose skin and clinical soft tissue wasting have presumably actually lost weight in utero, rather than simply failed to grow[8]. Study by Adebami et al[25] reported that, The mean weight , mid arm circumference, and Ponderal index of babies with FM were significantly lower than those of babies without FM ($p<0.0001$). Though the mean head circumference and the length of the babies with FM were also lower, the differences was statistically significant ($p=0.50$ and 0.79). However, in present study using growth standard alone, 41(49.4%) of the 83 babies with fetal malnutrition would have been missed, Ponderal index would also have missed 51 (61.4%) of the babies with FM. If Neonates are classified by birth weight alone, many growth retarded neonates are nutritionally normal and are not at increase of perinatal risk. Although mean length of term SGA babies in both groups did not differ significantly but when length less than 3rd centile is taken into consideration data analysis showed that term SGA babies with birth length < 3rd centile are at 1.64 times at high risk of fetal malnutrition. When birth length is assessed as a predictor for FM, it is found that birth length less than the 3rd centile proved to be a very significant predictor of FM . It also suggests that intra uterine growth ceases 4 to 6 weeks before delivery in these malnourished infants or progresses at a subnormal rate for a longer period at time. Jarai et al[26] investigated a mixed group of preterm, term, and post term SGA infants using different indices of body proportions and pointed to the significance of soft tissue wasting rather than low birth weight for diagnosis of FM. Mehta S, Tandon et al[2] reported that, CAN score < 25 separated 60% of the babies as well nourished and 40% as malnourished. Weight for age and Ponderal index classified 70-75% of babies as well nourished (AGA) and 25-30% as malnourished. Also MAC/HC classified nearly half the babies as well nourished and half as malnourished. **Deodhar et al[28]** reported fetal malnutrition in 19.6% of all term neonates (84.2%) of the SGA,12.9% of AGA babies while Metcoff reported FM in 5.5% of AGA and 54% of SGA babies. Study by **Preeti Waghmare et al[29]** reported that CAN score identified overall 37.1% babies as malnourished and 84.8% of SGA babies were malnourished. Study by **(Leeladhar[30]** reported FM in 8.3% of AGA 25/373 and (54.89%) 112/187 SGA babies. Study by Naveen Sankhyan[8] reported FM in 4% of AGA and (57.1%) of SGA babies a overall occurrence of FM was 28% of all newborn. Study by **Ayse Korkmaz[31]** reported that preterm infants with gestational age between 28-34 of total 93 preterm incidence of fetal malnutrition was 54.8% based on CAN score. The Present study shows babies with ponderal index <2.2 are at 4.27 times higher risk for developing fetal malnutrition as compared to babies with ponderal index ≥2.2 (relative risk -

4.27,95% confidence interval 3.5-5.19 p-value 0.0000, HS. This also suggested that ponderal index failed to detect fetal malnutrition in 91 babies with ponderal index ≥2.2,when CAN Score is compared with ponderal index, it yielded following results: Sensitivity=70.5%, Specificity= 83.5%, Positive predictive value=68.9%, Negative predictive value=84.5%, for detecting fetal malnutrition, making it is a good screening tool for FM. Study by Sankhyan et al[9] reported ,when CAN Score was compared to standard, weight for gestation and Mid arm circumference (MAC)/ Head circumference(HC) had the highest sensitivity to identify malnourished neonates (92.5% and 90.5%).

Conclusion

Fetal malnutrition is common in SGA babies.CAN Score is a simple clinical index for identifying fetal malnutrition and may have the potential to predict neonatal morbidity associated with it, without the aid of any sophisticated equipments. Perinatal problems are known to occur in SGA babies with FM. There is a need for prompt identification of babies with FM anticipatory management of such newborn at birth may decrease morbidity and mortality and improve the survival of SGA babies. These infants should also be followed for long term complications and "fetal programming" effects such as growth failure, hypertension, insulin resistance, and disorders of glucose metabolism and hyperlipidemia, and identification of the incidence and characteristics of fetal malnutrition in term infants carries great importance from the points of short- and long-term neonatal morbidity and mortality.

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