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Comparative study between Clinical Assessment of Nutritional status score (CAN Score) and Anthropometry in the assessment of Fetal malnutrition

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Abstract

Fetal malnutrition is failure to obtain enough quantum of fat and muscle mass during intrauterine growth with significant postnatal outcome and unwholesomeness. A clinical assessment of nutritional status score (CAN score) was sophisticated to differentiate neonates with fetal malnutrition from those with suitable nourishment. The current study was done to reveal fetal malnutrition of term babies at birth by CAN score and to compare it with other anthropometric measures for realizing nutritional status of newborn babies. Two hundred and three term healthy newborns were assessed using CAN score. Weight, length, mid arm circumference/ head circumference ratio, ponderal index and body mass index were determined, and compared to CAN score during the period from 1st of January 2014 till the 30th of August 2014 at Babylon teaching hospital for gynecology and pediatrics. The results showed that the incidence of fetal malnutrition by (CAN score, ponderal index, body mass index, mid arm circumference/head circumference ratio) was (31%, 21.20%, 48.90%, 28.10%) respectively. The sensitivity of (CAN score, ponderal index, body mass index, mid arm circumference/head circumference ratio) was (53.1%, 31.7%, 69.8%, 34.9%) respectively and the specificity of (CAN score, ponderal index, body mass index, mid arm circumference/head circumference ratio) was (84.2%, 83.6%, 72.1%, 75.0%) respectively. There was direct mild significant correlation between CAN score with mid arm circumference/ head circumference ratio and ponderal index. Direct moderate significant correlation was observed between body mass index with CAN score.

Keywords: Fetal malnutrition, CAN score, ponderal index.

Introduction

Fetal malnutrition (FM) is failure to obtain enough quantum of fat and muscle mass during intrauterine growth. This term coined by Scott and Usher[1]. In severe FM, the neonate may look skinny (skin looks so large for the baby)[2]. FM can occur at any gestational age and birth weight[1,3]. Studies showing that around 40% of babies with FM had intellectual and neurological disability[4]. FM was analogous with small for gestational age (SGA), small for date, pseudo-premature, chronic fetal distress, intrauterine growth restriction (IUGR) and dysmature babies[1]. By intrauterine growth chart, the SGA baby or a baby with IUGR, the birth weight is below 10th percentile for gestational age[5]. Not all SGA babies have features of FM[6-9] .Placental dysfunction is used to describe a state of undernourished fetus[10]. Many post-term babies do not suffer placental inefficiency[11]. Many studies on fetal wasting adopted the nomenclature of FM[1,6,7,12,13]. Birth weight was the most common standard adopted by authors, the cut off levels used have been birth weight less than 2500 gms. These methods do not identify FM which indicates a clinical state that may be present at almost any birth weight[14-17]. Ponderal index, Body mass Index, mid-arm circumference/ Head circumference ratio, chest circumference and/or mid arm circumference to head circumference ratio and head circumference to length ratio are measurements used to identify neonatal malnutrition[18,19]. Ponderal index of less than 2.2 gm/cm3 was regarded as an index of malnutrition[20]. As In the assessment of Body Mass Index (BMI), the weight is affected by height and is therefore less biased than other indices[9]. Babies with CAN score below 25 is considered as having FM. This is a purely clinical score for gestational age. It is so easy to be done. It detects neonates with FM whether small, appropriate or large for gestational age. CAN score is used to distinguish malnourished from well nourished babies[6].

Aims of study: i. An attempt to develop a screening tool in identifying fetal malnutrition. ii. To identify FM by CAN score and to compare it with other anthropometric measures.

Material and Methods

A hospital-based cross-sectional study was carried out during the period from 1st of January 2014 till the 30th of August 2014 at Babylon teaching hospital for gynecology and pediatrics where two hundred three singleton term neonates with gestational age by (Lmp/u.s) had been enrolled. The newborns with congenital anomalies, requiring intensive care unit care and the products of mothers with gestational diabetes, hypertension had been excluded from the study.

The term neonates were assessed by measuring their weight, length, head circumference, mid-arm circumference, mid-arm circumference/ head circumference ratio, ponderal index , body mass index and CAN score.

The weight was measured using seca electronic weighing scale. The length was measured using an infantometer, head circumference and Left mid arm circumference were measured by non stretchable tape. Mid arm circumference/head circumference ratio (MAC/HC) was measured and a cut off value of 0.27 was used to detect malnutrition[21].

Ponderal index was measured using the formula: Weight (gms) x100 / (length cm)^3 and it was regarded as an indicator of malnutrition if it was less than 2.2 gm/cm3 was[20].

Body mass index (BMI) was calculated and a cutoff value of less than 11.2 kg/m^2 regarded as an indicator of malnutrition[18].

CAN score was determined within 24-48 hours after birth to detect signs of malnutrition in the newborn as described by Metcoff and it indicates FM if it was less than 25[6].

Data Analysis: Statistical analysis was carried out using SPSS version 20. Categorical variables were presented as frequencies and percentages. Continuous variables were presented as (Means ± SD). Independent sample t-test has been used to find the mean difference between two continuous variables. Pearson's chi square (X^2) test was used to find the association between the categorical variables. Pearson's Correlation Coefficient was used to find the correlation between two continuous variables. *P-value* of ≤ 0.05 was considered as significant.

Results and Discussion

The overall mean gestational age of neonates was (37.96± 1.21) weeks. 54.2% of respondents were females with male /female of 0.8/1. Around half of the neonates (55.7%) have been delivered by cesarean section**.** The overall mean MAC/HC was (0.30±0.03), and majority (71.9%) of the neonates had normal MAC/HC ≥0.27. The overall mean of PI was (2.48±0.34), and majority (78.8%) of the neonates had normal PI ≥ 2.2. The overall mean of BMI was (12.03±1.60), meanwhile the overall mean weight was (2.91± 0.58) kg and majority (59.1%) of the neonates had normal BMI ≥ 11.2. The overall mean of CAN score was (26.70±10.59), and majority (69.0%) of the neonates were well nutrient (CAN score ≥ 25). Table-1 shows that there was significant mean difference of neonatalgestational age by MAC/HC, PI, BMI, and CAN score, p value ≤ 0.05. Table-2 shows that there was no significant association of neonatal gender with MAC/HC, PI, BMI, and CAN score, p value ≤ 0.05. Table-3 shows that there were significant associations of CAN score with PI and BMI, (68.3%) neonates had PI ≥ 2.2, meanwhile, (69.8%) of neonates had BMI of <11.2 kg/m^2, p value ≤ 0.05. Table-4 shows the sensitivity, specificity, positive and negative predictive value for MAC/HC, PI and BMI with CAN score. The sensitivity, specificity, PPV and NPV of MAC/HC to detect malnourished neonates was 34.9%, 75.0%, 38.6% and 71.9% respectively.The sensitivity, specificity, PPV and NPV of PI to detect neonates with malnutrition was 31.7%, 83.6%, 46.5% and 73.1% respectively. The sensitivity, specificity, PPV and NPV of BMI to detect neonates malnutrition was 69.8%, 72.1%, 53.1% and 84.2% respectively. The sensitivity, specificity, PPV and NPV of CAN score to detect malnourished neonates was 53.0%, 84.2%, 69.8% and 72.1% respectively.

Table-5 shows the correlation of CAN score with MAC/HC, PI and BMI, there were direct mild significant correlation between CAN Score with MAC/HC and PI and there was direct moderate significant correlation between CAN score and BMI, p value <0.05.

Table-1
Mean difference of gestational age by MAC/HC, PI, BMI, and CAN score

Variables	N	Gestational age Mean ± SD	t-test	P value
MAC/HC				
Normal ≥ 0.27	146	38.13± 1.35	3.142	0.002*
Low < 0.27	57	37.54± 0.57		
P Index				
Normal ≥ 2.2	160	38.06± 1.32	2.349	0.020*
Low < 2.2	43	37.58± 0.54		
BMI				
Normal ≥ 11.2 kg/m^2	120	38.35± 1.39	5.977	<0.001*
Low <11.2 kg/m^2	83	37.40± 0.54		
CAN Score				
Well nutrient ≥ 25 Mal-nutrient < 25	140 63	38.22± 1.33 37.38± 0.55	4.832	<0.001*

*p value ≤ 0.05 is significant

Table-2
Association of neonatal gender with MAC/HC, PI, BMI, and CAN score

Variables	Neonatal gender		χ^2	*P* values
	Male (%)	Female (%)		
MAC/HC				
Normal ≥0.27	67 (72.0)	79 (71.8)	0.001	0.972
Low < 0.27	26 (28.0)	31 (28.2)		
P Index				
Normal ≥ 2.2	72 (77.4)	88 (80.0)	0.201	0.654
Low < 2.2	21 (22.6)	22 (20.0)		
BMI				
Normal ≥ 11.2 kg/m^2	57 (61.3)	63 (57.3)	0.337	0.562
Low <11.2 kg/m^2	36 (38.7)	47 (42.7)		
CAN score				
Well nutrient ≥ 25 Mal-nutrient < 25	63 (67.7)	77 (70.0)	0.120	0.729
	30 (32.3)	33 (30.0)		

*p value ≤ 0.05 is significant

Table-3
Association of CAN score with MAC/HC, PI and BMI

Variables	CAN score		χ^2	*P* values
	Mal Nutrient (%)	Well nutrient (%)		
MAC/HC				
Low < 0.27	22 (34.9)	35 (25.0)	2.117	0.146
Normal ≥ 0.27	41 (65.1)	105 (75.0)		
P Index				
Low < 2.2	20 (31.7)	23 (16.4)	6.106	0.013*
Normal ≥ 2.2	43 (68.3)	117 (83.6)		
BMI				
Low < 11.2 kg/m^2	44 (69.8)	39 (27.9)	31.687	<0.001*
Normal ≥ 11.2 kg/m^2	19 (30.2)	101 (72.1)		

*p value ≤ 0.05 is significant

Table-4
Sensitivity, Specificity, Positive and Negative Predictive Value for MAC/HC, PI and BMI with CAN score

Parameters	Sensitivity%	Specificity%	PPV%	NPV %
MAC/HC	34.9	75.0	38.6	71.9
P I	31.7	83.6	46.5	73.1
BMI	69.8	72.1	53.1	84.2
CAN score	53.0	84.2	69.8	72.1

Table-5
Correlation of CAN score with MAC/HC, PI and BMI

Parameters	r	P value
MAC/HC	0.418	<0.001*
P Index	0.439	<0.001*
BMI	0.527	<0.001*

*p value ≤ 0.05 is significant

Discussion: In the current study there was no significant association between FM and gender, this result was in concordance with Faheem M et al[22], Özgül Salihoglu et al[23], Zerrin Orbak et al[24] and Mahalingam Soundarya et al[25] studies. There was significant association between FM and gestational age, this result goes with Özgül Salihoglu et al[23] study but not with Zerrin Orbak et al[24] study who found no significant association between FM and gestational age. PI has been used by various authors[20,26] to detect FM, which depends on that the length is spared at the expense of weight during period of acute insult, so infants with deep-seated suffer in utero may be falsely categorized by PI. The other drawback of PI is that any error in calculating length is cubed in the calculation of the PI[1]. In our

study, FM by PI (<2.2) was 21.2%. It had a good specificity 83.3% with poor sensitivity 31.7% in detecting FM. This is in agreement with other study done by Adebami[27] and Vikram Singhal et al study[28] Haggarty et al[29] study indicates that PI is a poor predictor of in utero growth retardation. Abhay kumar Balajirao Dhanorkar et al[30] study found that FM by PI was 24.48% with a sensitivity of 61.29% and a specificity of 93.08%. The relation of MAC/HC with CAN score in our study, FM by MAC/HC (<0.27) was 28.1% with sensitivity of 34.9% and specificity of 75%. In Sanjay Mehta et al[31] study, MAC/HC (<0.27) was 49.76% with sensitivity 65.9% and specificity 85.6%.

In Mahalingam Soundarya et al study[25] the sensitivity was 41.6% and specificity was 77.6%. While in Naveen Sankhyan et al[32] study the sensitivity was 90.5% and specificity was 47.0%. and in Abhaykumar Balajirao Dhanorkaret al[30] study MAC/HC (<0.27) was 29.95% with sensitivity of 76% and specificity of 92%. This may be due to proportionate growth retardation that lead to the less measures in the current study which might indicate chronic stress that infants face in utero. In the current study FM by BMI (<11.2) was 48.90% with sensitivity of 69.8% and specificity of 72.1 %, so BMI is a sensitive index of FM. In Mahalingam Soundarya et al study[25], the sensitivity of BMI was 84.7 % and specificity was 73.6%.

Several recent studies namely by Mahalingam Soundarya et al[25],Vikram Singhal et al[28] , O. J. Adebami et al[27], Abhaykumar Dhanorkar et al[30], and Liladhar Kashyap et al[33] all have stressed the usefulness of CAN score in detecting fetal malnutrition. In the current study fetal malnutrition by CAN score was 31% with sensitivity of 53% and specificity of 84.2% which goes with Mahalingam Soundarya et al study[25] 24%, 50%, and 93% respectively. FM by CAN score in other studies like Sanjay Mehta et al[31], Kumari[34], Rao[35], Soundarya M et al[25], Naveen Sankhyan et al [32], Faheem. Metal etal[22], Abhay kumar Dhanorkar et al[30], Vikram Singhal et al[28], Adebami et al[27] and Metcoff[6] was 40%, 27.4%, 28%, 24%, 27.97%, 24%, 32.29%, 17.5%, 18.8%, 10, 9% respectively. In our study there was direct mild significant correlation between CAN score with MAC/HC and PI this mean positive correlation, (r) range from (0.3-0.5). Direct moderate significant with BMI this mean positive correlation, (r) range from (0.5-0.7). This means that when the value of MAC/HC, PI and BMI increased there is increment in value of CAN score too.

Conclusion

Around one third of full term neonates had FM by CAN score. BMI is a very sensitive index to identify malnutrition. CAN score is a good indicator for predicting of FM without the aid of any equipment. Combination of BMI with CAN score is very useful index of determining fetal malnutrition. Direct mild significant correlation between CAN score with MAC/HC and PI, direct moderate significant with BMI with CAN score.

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