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Assessment of Echocardiographic Changes in Malnourished Children in Saladdin General Hospital

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ABSTRACT

Malnutrition usually occurs when the person is not receiving the enough nutrients, this may result from an inadequate or unbalanced food, gastrointestinal troubles and absorption difficulties ,or other medical situations. Earlier concepts that the heart is spared in malnutrition have been shown to be incorrect. Inadequate intake of protein and energy results in proportional loss of skeletal and myocardial muscle. As myocardial mass decreases, so does the ability to generate cardiac output. while cardiac function is impaired, the reduction is appropriate and proportional to the decrease in body surface area, which is an indicator of overall metabolic demand and cardiac function is impacted pathologically in the malnourished child and decreases disproportionally to body surface area. Malnourished children suffer several alterations in body composition, with loss of heart and skeletal muscle mass, complicated by electrolyte abnormalities and mineral or vitamin deficiencies that could produce cardiac abnormalities, including hypotension, cardiac arrhythmias, cardiomyopathy, cardiac failure and even sudden death.

The total number are 100 cases,50 cases were malnourished and 50 cases were considered as control cases, Show most of study cases resident in rural 31 (62%), 19 (38%)urban, while in control 50, 35 (70%) urban and 15 (30%) rural. Regarding the time of introducing solid diet in study cases 50, most of them 31 (62%) take solid food in age 7-12months, 6 (12%) before 6 months, and 13 (26%) without solid food. But in control cases 50, most of them 41 (80%) take food below 6 months, and only 6 (12%) without solid diet. Distribution of cases according to the stroke volume in regard to the control cases. There is significant decrease in the stroke volume in the malnutrition cases 14 (28%) as compared to the control cases (0%).decrease in ejection fraction in case study 14 (28%) in compared to control group, while 35 (70%) of study cases have normal ejection fraction in compared to control 49 (89%).w decrease in left ventricular volume in case study 14 (28%) in compared to control group while 35 (70%) of study cases have normal left ventricular volume in compared to control 49 (89%).decrease in ejection fraction in severe type in about12(80%) and in 2(9.1%) of moderate type of malnourished children from the total number 50. decrease in stroke volume in severe type of malnutrition in about12(80%). cardiac thickness decrease in severe type in about 10(66.7%) of severe type of malnourished children.

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Introduction:

Protein-energy malnutrition is the condition that refer to deficient or excessive supply of nutrients, that interfere with the growth, development, and protection of an person's health. [1] Malnutrition is one of the major public health troubles associated with increased risk of morbidity and mortality, [2]which affects about one third of children in worldwide and it is frequently seen in the less developed countries because of inadequate food intake, socioeconomic factors or sometimes due to of natural disaster. [3,4]

This condition is complicated by electrolyte disturbance with mineral, and vitamin deficiencies as an add-on effect contribute to the heart problems such as hypotension, cardiac arrhythmias, cardiosympathy with cardiac failure, and sometimes also sudden death. [5]

Severe Acute Malnutrition, it affects tissue protein throughout the whole body and causes pronounced wasting of skeletal muscles, the heart muscle is affected in-patient with protein energy as like any muscle in the rest of body but less severely. Although the heart is usually normal or small radiologically. [6] In the other hand ,stroke volume with ejection fraction where also affected in malnourished patient, heart rate is increase in most of patient with malnutrition due to anemia ,although sometimes bradycardia might occur as part of hypothyroidism or cardiogenic shock.[7]

Aim of The Study

Is to decrease morbidity and mortality among malnourished patient by early detection of cardiac changes using echocardiography.

Patient And Method

A case control study was done on patient attending the outpatient and inpatient departments at Saladdin General Hospital during the period from first of April to the last of July 2018 selected randomly. Each patient

included in the study will assessed by prepared questionnaire that include name, age, sex, etc… Total number of cases are 100, divided into 50 cases as malnourished patients and 50 as controls. The patient where divided into 2 groups(Malnourished and Control group) .Both groups where assessed for echocardiographic changes done at echocardiographic unit at Saladdin General Hospital by experienced pediatric cardiologist. After obtaining informed written consent from the parents, patients and control groups were assessed with relevant history thorough clinical examination with special emphasis on the anthropometric measurements. To find the nutritional status of the child, standing height and weight were taken as per the standard protocols. The patient diagnosed as mild, moderate and severe malnutrition according to the Waterlow classification using Wt\Ht parameter. All cases underwent transthoracic echocardiographic examination using M-mode echo is a standard method for assessment of LV function in the absence of segmental wall motion abnormalities ,and therefore Mmode, 2-dimensional echocardiography, pulsed and continuous wave Doppler and color flow mapping were performed in every patient using the standard views as parasternal long axis, short axis, apical four chamber and subcostal views to assess the following parameters;

Left ventricular thickness, Stroke volume ,the systolic function indices like ejection fraction was measured, LV internal dimensions measurement in end-systole(LVESD)and end diastole(LVEDD)are made at the level of the mitral valve leaflet ,the LVESD and LVEDD measurements can be used to calculates the LV ejection fraction which give further indications of LV systolic function.

Inclusion Criteria

1- Study cases: Age 2 months- 5 years whose weight for height where mild, moderate, severe malnutrition.
2- Control cases: Apparently, healthy children of same age

range above who were not complain from any disease and come as relatives to the patient with normal Wt. /Ht.

Exclusion Criteria

1- Patient with CHD, preterm, low birth weight.
2- Patient with chronic illness that affect the cardiac function like SLE, CRF, HF, DM excluded by history and examination.
3- Age < 2 months and >5 years as these ages not included in the WHO target to ages and definition of malnutrition.

Statistical And Analysis

The result of the study presented by tables and figures, chi square, degree of freedom, P value calculated from measurements using SPSS program version18, and Microsoft excel 2010 system. P-value < 0.05 considered as significant.

The total number are 100 cases, 50 cases were malnourished and 50 cases were considered as control cases.

1- distribution of study cases according to residence

Show most of study cases resident in rural 31 (62%), 19 (38%) urban, while in control, 35 (70%) urban and 15 (30%) rural. So there is strong significant association between residence and malnutrition. As shown in table (1).

Table (1) distribution of study cases according to residence in regarded to control cases.

residence	Malnutrition		Control		Total
	No	%	No	%	
Urban	19	38	35	70	54
Rural	31	62	15	30	46
Total	50	100	50	100	100

Chi square=10.3
Degree of freedom=1
P value=0.001
Correlation=0.3
Strong significant association

2- distribution of study cases according to mother education in regarded to control cases

Regarding use of mother education in distribution of study cases, most of cases 34 (68%) have not educated mother, 11 (22%) primary educated, 4 (8%) secondary education and1 (2%) high education. While in control cases, 17 (34%) have primary school and only seven (14%) not educated. Therefore, there is significant association (strong) between maternal education and malnutrition. As shown in table (2).

Table (2) distribution of study cases according to mother education in regarded to control cases.

Mother education	Malnutrition		Control		Total
	No	%	No	%	
Primary	11	22	17	34	28
Secondary	4	8	14	28	18
High education	1	2	12	24	13
Not educated	34	68	7	14	41
Total	50	100	50	100	100

Chi square=33.92
Degree of freedom=3
Correlation=0.5
P value=0.001
Significant association (strong) between maternal education and nutritional state

3- distribution of study cases according to type of feeding

Show study cases, most of them on bottle feeding 18 (36%). While in control cases most of them on mixed 23(46%). So there is no significant association between type of feeding and malnutrition. As shown in table (3)

Table (3) distribution of study cases according to type of feeding in regarded to control cases.

Type of feeding	Malnutrition		Control		Total
	No	%	No	%	
Breast	1	2	3	6	28
Bottle	18	36	11	22	18
Mixed	17	34	23	46	13
Just solid	14	28	13	26	41
Total	50	100	50	100	100

Chi square=3.62
Degree of freedom=3
Correlation=0.187
P value=0.07
No significant association between Type of feeding and nutritional state

4- distribution of study cases according to time of introducing solid diet

Regarding the time of introducing solid diet in study cases, most of them 31 (62%) take solid food in age 7-12months, 6 (12%) before 6 months, and 13 (26%) without solid food. But in control cases, most of them 41 (80%) take food below 6 months, and only 6 (12%) without solid diet. So there is significant association between time of introducing solid diet and nutritional state. As shown in table (4).

Table (4) distribution of study cases according to Time of introducing solid diet in regarded to control cases.

Time of introducing solid diet in months	Malnutrition		Control		Total
	No	%	No	%	
<6	6	12	41	80	47
7-12	31	62	3	6	34
13-	0	0	0	0	0
No solid diet	13	26	6	12	19
total	50	100	50	100	100

Chi square=51.7
Degree of freedom=3
Correlation=0.57
P value=0.01
Significant association between time of introducing solid diet and nutritional state

5- distribution of study cases(male and female) according to type of malnutrition according to waterlow classification in regard to gender

Show 29 male and 21 female, 12 (41.4%) of male suffer from moderate malnutrition and 10 (47.6%) of female suffer from moderate malnutrition, 10 (27.6%) of male severely malnourished and 5 (23.8%) of female severely malnourished. As shown in table (5).

Table (5) Distribution of study cases (male and female) according to type of Malnutrition according to waterlow classification about gender.

Type of malnutrition according to waterlow Classification	Malnutrition				Total
	Male	%	Female	%	
Mild	7	27.6	6	28.6	13
Moderate	12	44.8	10	47.6	22
Sever	10	27.6	5	23.8	15
Total	29		21		50

Chi square=1.7
Degree of freedom=3
Correlation=0.1
P value=0.07
No Significant association between gender and type of malnutrition according to waterlow classification

6- stroke volume changes among study cases in regarded to control cases

Distribution of cases according to the stroke volume about the control cases. There is significant decrease in the stroke volume in the malnutrition cases 14 (28%) as compared to the control cases (0%). As shown in table (6).

Table (6) stroke volume changes among study cases in regarded to control cases.

Stroke Volume	Malnutrition		Control		Total
	No	%	No	%	
Increase	1	2	1	2	2
Normal	35	70	49	98	84
Decrease	14	28	0	0	14
Total	50	100	50	100	100

Chi square=18.2
Degree of freedom=2
Correlation=0.39
P value=0.001
Significant association (strong) between stroke volume changes among malnutrition cases in regard to control group

7- cardiac thickness changes among study cases in regarded to control cases

Show decrease in cardiac wall thickness in case study 10 (20%) in compared to control group, while 39 (78%) of study cases have normal cardiac thickness in compared to control 49(98%). As shown in table (7).

Table (7) cardiac thickness changes among study cases in regarded to control cases.

Cardiac thickness	Malnutrition		Control		Total
	No	%	No	%	
Increase	1	2	1	2	2
Normal	39	78	49	98	88
Decrease	10	20	0	0	10
Total	50	100	50	100	100

Chi square=11.9
Degree of freedom=2
Correlation=0.32
P value=0.001
Significant association (strong) between cardiac thickness changes among malnutrition cases in regard to control group.

8- ejection fraction changes among study cases in regarded to control cases

Show decrease in ejection fraction in case study 14 (28%) in compared to control

group, while 35 (70%) of study cases have normal ejection fraction in compared to control 49 (98%). As shown in table (8).

Table (8) ejection fraction changes among study cases in regarded to control cases.

Ejection fraction	Malnutrition		Control		Total
	No	%	No	%	
Increase	1	2	1	2	2
Normal	35	70	49	98	84
Decrease	14	28	0	0	14
Total	50	100	50	100	100

Chi square=18.2
Degree of freedom=2
Correlation=0.39
P value=0.001
Significant association (strong) between ejection fraction changes among malnutrition cases about control group

9- left ventricular volume(thickness and dimentions)changes among study cases in regarded to control cases

Show decrease in left ventricular volume in case study 14 (28%) in compared to control group while 35 (70%) of study cases have normal left ventricular volume in compared to control 49 (98%). As shown in table (9).

Table (9) left ventricular volume changes among study cases in regarded to control cases.

Left ventricular Volume	Malnutrition		Control		Total
	No	%	No	%	
Increase	1	2	1	2	2
Normal	35	70	49	98	84
Decrease	14	28	0	0	14
Total	50	100	50	100	100

Chi square=18.2
Degree of freedom=2
Correlation=0.39
P value=0.001
Significant association (strong) between left ventricular volume changes among malnutrition cases about control group

10- ejection fraction changes among study cases in regarded to waterlow classification

Show decrease in ejection fraction in severe type in about12 (80%) and in two (9.1%) of moderate type of malnourished children from the total number 50, as shown in table (10).

Table (10) ejection fraction changes among study cases.

Ejection fraction	Malnutrition (waterlow classification)						Total
	Mild		Moderate		Severe		
Increase	1	7.7%	0	0%	0	0%	1
Normal	12	92.3%	20	90.9%	3	20%	35
Decrease	0	0%	2	9.1%	12	80%	14
Total	13		22		15		50

Chi square=31.4
Degree of freedom=4
Correlation=0.6
P value=0.001
Significant association (strong)

11- stroke volume changes among study cases in regarded to waterlow classification

Show decrease in stroke volume in severe type of malnutrition in about 12 (80%) and in two (9.1%) of moderate type of malnourished children from the total number 50, as shown in table (11).

Table (11) Stroke volume changes among study cases.

Stroke volume	Malnutrition (waterlow classification)						Total
	Mild		Moderate		Severe		
Increase	1	7.7%	0	0%	0	0%	1
Normal	12	92.3%	20	90.9%	3	20%	35
Decrease	0	0%	2	9.1%	12	80%	14
Total	13		22		15		50

Chi square=31.4
Degree of freedom=4
Correlation=0.6
P value=0.001
Significant association (strong)

12- cardiac thickness changes among study cases in regarded to waterlow classification

Show decrease in cardiac thickness in severe type in about 10(66.7%) of severe type of malnourished children. From the total number of 50 patient there is 39 cases with normal cardiac wall thickness especially in mild and moderate cases as shown in table (12).

Table (12) Cardiac thickness changes among study cases.

Stroke volume	Malnutrition (waterlow classification)						Total
	Mild		Moderate		Severe		
Increase	0	0%	1	4.5%	0	0%	1
Normal	13	100%	21	95.5%	5	33.3%	39
Decrease	0	0%	0	0%	10	66.7%	10
Total	13		22		15		50

Chi square=20.5
Degree of freedom=4
Correlation=0.4
P value=0.001
Significant association (strong)

13- left ventricutar volume changes (thickness and dimensions) among study cases in regarded to waterlow classification

Show decrease in left ventricular volume in severe type in about 12(80%) and in 2(9.1%) of moderate type of malnourished children from the total number 50,in mild and moderate cases show normal ventricular volume measurement as shown in table (13).

Table (13) left ventricular volume changes among study cases.

Stroke volume	Malnutrition (waterlow classification)						Total
	Mild		Moderate		Severe		
Increase	1	7.7%	0	0%	0	0%	1
Normal	12	92.3%	20	90.9%	3	20%	35
Decrease	0	0%	2	9.1%	12	80%	14
Total	13		22		15		50

Chi square=31.4
Degree of freedom=4
Correlation=0.6
P value=0.001
Significant association (strong)

Discussion

The current study revealed that place of residence was strongly associated with acute malnutrition and children living in rural, were more likely to be acutely malnourished than children living in urban. This goes with study in Northeast Ethiopia by Anwar Seid (2017).[8] This finding was in agreement with study conducted in Nghệ An, Vietnam, which revealed that children in rural areas were 7.1 times more likely to be malnourished when compared with children in urban areas.[9] Also another study show the higher prevalence of malnutriton was found among children living in rural areas of Bangladesh.[10] This is due to women in urban areas are more likely to have formal schooling than women in rural areas, Moreover, availability of water and sanitary facilities and better socioeconomic status and child health care facilities in urban areas results into less risk of being malnourished among children living in urban areas than their rural counterparts.

In this study revealed that most of cases have non educated mother which affect the nutritional state of children. This is go with Bantamen G(2014)study show mother without education was significantly associated with the risk to develop malnutrition in children under the age of five, [11]which support our study. Similar finding was observed in India by Kirtisudha Mishra, et al,(2013)and also Baitun Nahar, et al (2010)in Bangladesh.[12,13] Also a study in west Ehiopia by Amsalu Bokore Ayana(2015)support current study.[14] The study show that maternal level of education may effect on looking for health performances such as immunizations, modern health care uses, and reproductive activities, in addition to maternal education. mothers usually have less information of suitable childbearing practices, and best environmental and individual hygiene and sanitation, also they mostly have less status in the family.

Both case and control have the least exclusively breast fed 2%, 6% respectively. This supported by study in Malaysia in which there was no

significant association between duration of exclusive breast feeding and nutritional status. The benefits of exclusive breastfeeding have been wildly approved. They are identified to encourage sensory and cognitive growth,

This variety may correlated to mother health education, provide access to locally available age appropriate food, and improving water source and sanitation systems and hygiene practices to protect children from existing communicable diseases.

Malnutrition more prevalent among those who time of introduction of food at age (7-12) months. This is goes with Amsalu S, Tigabu Z (2008)study[15] and Abuka T, et al study (2017)[19] in Ethiopia, this is due to the fact that introduction of diet especially diet with large protein particles like egg white or fresh cow milk might precipitate allergic reaction that manifest as chronic diarrhea or repeated chest infection contribute to the pathogenesis of development of malnutrition. In addition, introduction of diet with poor sanitation leads to repeated gastroenteritis that might leads to development of malnutrition. When complementary foods are started, there is a reduction in breast milk consumption, which can lead to a loss of protective immunity. This causes a higher morbidity when unhygienic foods are used, due to the development of diarrhea.

On the other hand, the fact that earlier introduction of diet is usually beneficial and it is recommended by the WHO as milk only after the age of four months is considered as not complete diet that need added solid to provide the required energy for rapid growth in the first year of life.

Moderate type of malnutrition where the most frequent type of malnutrition according to waterlow classification. The reason why moderate malnutrition where the more frequent is that due to that the study sample where taken from the rehabilitation ward from those who come for follow up in which they were of moderate type. Severe malnutrition usually admitted to the general ward

and mild malnutrition where not in included program.

Parameter of the LV systolic function (EF) were significantly affected in case patients than in the controls, this goes with Nagla Hassan Abu Faddan,et al(2010),[16] same results were been obtained in previous studies by Ocal et al (2001)(5) they found mean LV mass, left ventricular septal diameter and posterior wall thickness were to be decrease in malnourished children. There is significant decrease in the ejection fraction in malnutrition cases as compared to the control cases. This similar to the findings by Yadav [17] and Alanee [18] study which shows that there is significant decrease in ejection fraction of the heart. This may be due to the same reason above in which there is significant cardiac muscle atrophy in patient with malnutrition.

Stroke volume may be decreased as part of dehydration associated with malnutrition. This may be due to that acute protein-calorie malnutrition causes significant cardiac atrophy that is reflected in decreased cardiac output and slightly reduced contractility but not in intrinsic properties of the myocardium. The reason why for these significant changes among malnourished cases is due to the effect of malnutrition on the heart functionally and structurally. The heart is usually affected in malnutrition either directly by deficiency of some essential elements that lead to heart failure like selenium(shekhan syndrome)or iodine deficiency (cardiomyopathy)or Beriberi disease(B1 deficiency),or the heart might affected by anemia that leads to tachycardia, cardiac dilatation, heart failure.The element that causing anemia among malnourished case were in B12, foliate, zinc, iron, copper and vitamin C. On the other hand, the heart might affected by other mechanism like loss of the cardiac thickness due to wasting of cardiac muscle as part of generalized wasting that affect the skeletal muscle of malnourished patient due to hypoprotenemia.

Regarding classification of patient according to waterlow, there was a significant result regarding the

association between stroke volume changes, cardiac thickness, ejection fraction and left ventricular volume among the malnourished cases. In this study cardiac dimensions including LV diameter, cardiac wall thickness were decreased in malnourished children, this goes with Phornphatkul c,et al study.[19] The pattern of changes in measurement of left ventricular function and cardiac dimension are consistent with a relatively decreased preload and poor ventricular function in an atrophic heart, most likely due to a combination of abnormalities, such as low tissue mass and electrolyte and intravascular volume deficits. The study showed that the parameter of the LV systolic function (EF) were significantly affected mainly in severe type of malnourished patients, this goes with Saad M. Al-Aaraji[20] that show decrease in ejection fraction and LV measurements ,this may be due to the same reason above in which there is significant cardiac muscle atrophy in patient with malnutrition. stroke volume decreased mainly in severe type of malnourished cases, this is goes with Alanee A. H. study (2010) [18] and Nagla Hassan abu faddan , [16] that related to the dame reason as discussed previously.

Conclusions And Recommendations

conclusions

1. There was significant correlation between maternal education and time of introduction of solid diet with malnutrition among the study cases.
2. There was strong significant association between residence and the occurrence of malnutrition.
3. There was significant association between stroke volume, cardiac thickness, ejection fraction and left ventricular volume among the study cases.

recommendations

1. To the Ministry of Health: More concentration is needed on patient with malnutrition by early diagnosis of patients in their

early malnutrition stages at the PHC center to prevent the occurrence of cardiac problem if the diagnosis and treatment delayed.

2. To the physician: It is recommended that every patient with malnutrition especially sever type should be checked frequently by echocardiography to pick up the early cardiac changes to deal with it properly.
3. To the Ministry of Higher Education and Researchers: More studies for longer period and larger sample size are needed to provide us with good view regarding the real problem among the whole Iraqi population.
4. To the family: Early introduction of solid diet is mandatory to ensure proper growth with the consternation on avoiding non healthy food like tanned juices or these food which induce allergy like fresh cow milk, with proper sanitation at all stages of food preparation. The family should be frequently check the weight of her baby at PHC center or during vaccination to pick up the development of malnutrition early and those with malnutrition should have echocardiography assessment during their rehabilitation.

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