Research Article

BUN and creatinine in Severe Acute Malnutrition in Infants and Children

Mohammed F. Afifi, Mohamed H. M. Mahgoub, Mohammed F. Abdel Baki and Mai G. Mohammed
Department of Pediatrics, El-Minia Faculty of Medicine

Abstract
Introduction: Severe acute malnutrition is defined by a very low weight for height (below -3 z scores of the median WHO growth standards), by visible severe wasting or by the presence of nutritional edema. **Aim of the work:** To evaluate the effect of nutritional rehabilitation on the kidney of infants and children with severe acute malnutrition. **Subjects and Methods:** This is a prospective cross-sectional study that included 50 patients suffering from SAM who were admitted to the pediatric departement, Minia University Children Hospital. **Results:** This table showed that there is statistically significant difference in residence ,social class and weaning time**. Discussion**: Sever acute malnutrition (SAM) is a common contributing factor for childhood morbidity and mortality. It accounted for more than 53% of under five mortalities due to pneumonia, diarrhea, malaria and perinatal illnesses. **Summary:** Severe acute malnutrition (SAM) is a global public health problem that results from reductions in food intake or diet quality and is often combined with pathological causes.
Keywords: Mid Upper Arm Circumference, Weight -For- Height, Protein Energy Malnutrition

Introduction
Severe acute malnutrition is defined by a very low weight for height (below -3 z scores of the median WHO growth standards), by visible severe wasting or by the presence of nutritional edema. (WHO, 2013)

In 2017 globally, 51 million children under five years were wasted of which 16 million were severely wasted. This translates into a prevalence of 7.5 percent and 2.4 percent, respectively (WHO and UNCEF, 2018)

Malnutrition, chronic and acute, may result from a combination of inadequate nutrient intake, increased losses (diarrhoeal episodes, vomiting) and increased energy expenditure (usually due to infections). (Walton and Allen, 2011)

The formation of nephrons is complete by 35-36 weeks of gestation,but glomerular and tubular growth continues in the first eighteen months of post natal life (Girish and Premalatha, 2014).

Studies on visceral organ growth and role of malnutrition are scarce. We found few studies which reported that most severely malnourished children had smaller kidneys than normal ones (Ece et al., 2007)

One of the most important factors identified in the growth of the kidneys is the nutrition of the child. (Ece et al., 2007)

Malnutrition in addition to its effect on renal growth, is also known to affect the functioning of the kidney and may result in the reduction of glomerular filteration rate and renal plasma flow (Girish and Premalatha, 2014)

The gold standard in measuring GFR (mGFR) utilizes the urinary plasma clearance of exogenous filtration markers such as inulin or iothalamate; however, this is not routinely performed because of the complexity of measurement, and is usually only advised as a confirmatory test (Stevens and Levey, 2009)

More often, GFR is estimated in laboratory setting using readily avalible information, including age, sex, race and measurement of serum creatinine as the biomarker of filtration (Levey et al., 2009)

However, serum creatinine is an imperfect biomarker ,as it is known to be affected by diet, muscle mass, certain medications, rapidly changing kidney function, and active secretion by the kidney (Tangri et al., 2012).

Cystatin C has been suggested as a potential alternative to serum creatinine, as it potentially has fewer non-GFR determinants (Filler et al., 2005)

Aim of the work

To evaluate the effect of nutritional rehabilitation on the kidney of infants and children with severe acute malnutrition

Subjects and Methods

This is a prospective cross-sectional study that included 50 patients suffering from SAM who were admitted to the pediatric department, Minia University Children Hospital. They were randomly selected during the period of May 2018 July 2018. Informed written consents were obtained from the patient's legal guardians before enrollment in the study.

In addition to 20 apparently healthy children matching age & sex with the malnourished group were included as a control group.

Inclusion criteria:

1- Severe acute malnourished children.
2- Age ranged from 2-60 months.

Exclusion criteria:

Children with diagnosed renal problem at the time of admission whatever acquired or congenital anomlies

All included children were subjected to the following:

a- ***Careful history taking including:***

Name, age, sex, residence, socioeconomic standard, vaccination, order in the family, delivery, maturity, birth weight, nutritional history, complications of malnutrition .

b. ***Full clinical examination and anthropometric measures:*** including

Vital data: Respiratory rate (R.R), heart rate (H.R), blood pressure, temperature, full chest, cardiac and abdominal examinations.

Anthropometric measurements: Height, weight and middle upper arm circumference were also measured 3 times and the mean was recorded. The patient took off his heavy clothes before measuring the weight. Measurements were placed on WHO Growth Charts and Z-score Growth Charts to determine the percentiles for each parameter**.**

Children were classified according to WHO classification of protein energy malnutrition using Z score as follow: (WHZ)

Results

Table (1): Comparison between Malnourished and Control Group as Regard Some Demographic Data

		Malnourished Group (n=50)	Control group (n=20)	P value
Age	**Mean ± SD**	1.2±0.6	1.1±0.5	0.704
Sex	**Male** **Female**	19(38%) 31(62%)	8(40%) 12(60%)	0.877
Residence	**Rural** **Urban**	40 (80%) 10 (20%)	12 (60%) 8 (40%)	**0.029***
Type of delivery	**SVD** **CS**	15(30%) 35(70%)	9 (45%) 11(55%)	0.123
Maturity	**Full term** **Preterm**	19 (38%) 31 (62%)	8(40%) 12(60%)	0.877
Social class	**I** **II** **III**	1(2%) 24(48%) 25(50%)	4(20%) 15(75%) 1(5%)	**<0.001***
Order	**First** **Second** **Third** **Forth** **Fifth** **Eighth**	16(32%) 15(30%) 10(20%) 4(8%) 4(8%) 1(2%)	3(15%) 9(45%) 5(25%) 3(15%) 0(0%) 0(0%)	0.398
Vaccination	**Non vaccinated** **Vaccinated**	50(100%) 0(0%)	20(100%) 0(0%)	1.000
Feeding	**Bottle** **Breast**	30(60%) 20(40%)	10 (50%) 10 (50%)	0.448
Weaning	**Delayed** **Proper**	35 (68%) 15(32%)	6(30%) 14(70%)	0.004*

- **Significant**

This table showed that there is statistically significant difference in residence ,social class and weaning time

Table (2): Renal function and GFR before and after nutritional rehabilitation in malnourished children.

	Malnurished group (before) n=50	Malnurished group (after) n=45	p-value
Cr (mg/dl)	0.53±0.13	0.56±0.08	0.458
Cystatin c(ml/l)	1.58±0.74	0.94±0.11	**0.002***
GFR (schwartez) mL/min/1.73 m^2	105.01±40.8	115.1±18.2	0.442
GFR (CYS) mL/min/1.73 m^2	74.9±33.9	105.2±16.2	**<0.001***

This table showed significant decrease of serum cystatin C in malnourished group after nutritional rehabilitation in comparsion with pre rehabilitation values, with statistically significant increase in Cystatin C based GFR after nutritional rehabilitation.

No statistically significant change in serum creatinine and creatinine based GFR before and after nutritional rehabilitation (3 cases were missed, 2 cases died ,hence the total follow up number become 45)

Table (3): Ultra sound of kidney diameters before and after nutritional rehabilitation in malnourished children.

	Malnuorished group (before) n=50	Malnuorished group (after) n=45	p-value
Longitudinal diameter(mm)	5.63±0.48	5.85±0.59	0.127
Transverse diameter(mm)	2.94±0.51	3.05±0.32	0.221
Antero-posterior diameter(mm)	2.77±0.45	3.03±0.26	0.113

This table showed no statistically significant difference between the cases before and after nutritional rehabilitation as regarding kidney diameters (3 cases were missed, 2 cases died, hence the total follow up number become 45)

Discussion

The results of our study revealed that 62% female, 38% male in malnourished children .About 50% of children with SAM were categorized as very low social standard and 48% moderate social standard . 80% of rural area. 62% preterm babies (Table 1).

These results may be due to the strong relationship between malnutrition and the low income and social standard and also, it is related with the rural conditions. Our results agreed with those of Black et al., (2013) who reported that maternal and child under nutrition is highly prevalent in low-income and middle-income countries, resulting in substantial increases in mortality and overall disease burden (Black et al., 2013).

Also was in consistent with (Britto et al., 2017) who found that parental income and education are strongly related to child survival, health, nutrition, cognition and education, under nutrition leads to an intergenerational transmit-ssion of disadvantage and a perpetuation of the poverty cycle.

The results of our study revealed that there is a significant affection of cystatin c, with signifi-cant decrease in cystatin c based GFR ,no statistical significant difference of serum creatinine or creatinine based GFR between the cases and control group. (Table 4)

This may be explained by the affection of serum creatinine by diet ,muscle mass, certain medication ,and active secretion by the kidney which was in consistent with (Tangri et al., 2012) who reported. That serum creatinine is an imperfect biomarker, as it is affected by diet, muscle mass, certain medications, rapidly changing kidney function, and active secretion by the kidney (Tangri et al., 2012).

Our study revealed that serum cystatin C is potential alternative to serum creatinine as it has fewer non GFR determinat and early detect the abnormality in GFR this was in consistent with (Shlipak et al., 2013). Who reported that GFR may be more effectively estimated using cystatin C as a supplement or replacement for serum creatinine

This was also in consistent with (Filler et al., 2005).who repoted that cystatin C based equation may be more useful in detecting kidney disease in children, the elderly, and individuals with conditions affecting muscle composition because of the independence of cystatin C from many factors that affect serum creatinine, including age, sex, race, and muscle mass (Filler et al., 2005).

Against our result was (Martini, et al., 2003). who reported that GFR is better assessed by the Haycock-Schwartz formula than by Pcys C or Pcreat alone. It is therefore concluded that when urine collection is not possible, simply measuring the child's Pcreat and height is the best, easiest and cheapest way to assess GFR.

Conclusion

From this study, we concluded that:

1. Malnutrition can affect the function of the kidney and may result in the reduction of glomerular filtration rate and renal plasma flow.
2. Malnourished children are susceptible to infection in particular, pneumonia, frequent gastroenteritis dehydration and, sepsis which often are the most common cause which hinders a child's growth.
3. Early and proper nutritional rehabilitation reverse the dangerous effect of malnutrition on the kidney function.

Recommendation

- Early detection of malnutrition and proper management
- Not to depend on serum creatinine as the only biomarker for kidney function
- Introduce simple cystatin c based equation for accurate and proper measuring the kidney function
- Avoid nephrotoxic drugs or to be used with caution in severely malnourished children
- Serial follow up of the kidney function of all malnourished children for early detection of renal problem
- The findings of this study need to be confirmed by future research, so I recommend further work up in this field

References

1. Black R E, Victora C G, Walker S P, Bhutta Z A, Christian P, De Onis M and Uauy R (2013). Maternal and child under nutrition and overweight in low-income and middle-income countries. The lancet, 382(9890): 427-451.
2. Britto P R, Lye S J, Proulx K, Yousafzai A K, Matthews S G, Vaivada T and MacMillan H (2017). Nurturing care promoting early childhood development. The Lancet, 389(10064): 91-102
3. Ece A., Gözü A., Bükte Y., Tutanç M., and Kocamaz H (2007). The effect of malnutrition on kidney size in children. Pediatric Nephrology, 22(6): 857-863.
4. Filler G, Bökenkamp A , Hofmann W , Le Bricon T, Martínez-Brú C and Grubb A (2005). Cystatin C as a marker of GFR—history, indications, and future research. Clinical biochemistry, 38(1): 1-8.
5. Gopal G and Premalatha R (2014). Effect of malnutrition on kidney size and incidence of urinary tract infection in malnourished children. Int j pharm biomed res, 5(1): 29-35.
6. Levey A S, Stevens L A, Schmid C H, Zhang Y L, Castro A F, Feldman H I and Coresh J (2009). A new equation to estimate glomerular filtration rate. Annals of internal medicine,150(9): 604-612.
7. Stevens LA, and Levey – AS (2009). Measured GFR as a confirmatory test for estimated GFR. J Am Soc Nephrol, 20: 2305-2313.
8. Tangri N, Inker L A, Tighiouart H, Sorensen E, Menon V, Beck G and Sarnak M J (2012). Filtration markers may have prognostic value independent of glomerular filtration rate. Journal of the American Society of Nephrology, 23(2): 351-359.
9. Walton E and Allen S (2011). Malnutrition in developing countries. Paediatrics and Child health, 21(9): 418-424.
10. WHO (2013). Updates on the Management of Severe Acute Malnutrition In Infants And Children:14-22.
11. WHO and UNCEF. (2018). UNICEF, WHO, World Bank Joint Child Malnutrition dataset,