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Estimation of Dry Weight in Children with Oedematous Nephropathy

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ABSTRACT
Nephrotic syndrome (NS) and acute glomerulonephritis (AGN) are two leading childhood renal disorders in the tropics that present commonly with oedema and therefore increased weight. Knowledge of the dry weight of oedematous patients will provide more objective assessment of the degree of fluid retention and would also guide fluid electrolyte and drug management.

All children admitted for NS and AGN to the Paediatric Nephrology Unit of University of Ilorin Teaching Hospital, Ilorin between 2004-2008 were recruited for the study. For each child, the oedematous weight was recorded at admission and the dry weight was determined when the oedema became clinically undetectable. The oedema and dry weight were computed and compared. The weight differential and percentage losses for each patient were also computed. A formula for estimation of dry weight in the oedematous nephropathy was then derived. A total of 37 children were recruited for the study comprising 31 males and 6 females giving a male /female ratio of 5.2:1. Thirty-three children were diagnosed as NS; the other four children had AGN. The weight range among all the NS children was 12.0-68.0 kg while that among the AGN was 12.0-33.7 kg. Oedematous weight of the children with NS ranged from 12.0-68.0 kg while that of children with AGN ranged from 12.0-33.7 kg. Dry weight among children with NS was10.0-53.1kg, while that among children with AGN was 11.5-30.0kg. Weight loss among children with NS ranged from 1.2-21.0kg (percentage weight loss 4.8-43.5%) and among children with AGN, weight loss was 0.5-5.2kg (percentage weight loss 4.2-26.4%). Based on the mean weight loss, a formula (n-0.18n or n-0.2n) was proposed for children with NS while the formula (n-0.13n or n-0.1n) was proposed for children with AGN. The formula for the estimation of dry weight among children with NS and AGN was (n-0.2n) and (n-0.1n) respectively where n is the oedematous weight. The formula for the estimation of dry weight in all children with oedematous nephropathy was (n-0.176n or n-0.2n).

INTRODUCTION

Nephrotic syndrome and acute glomerulonephritis are two leading childhood renal disorders in the tropics that present commonly with oedema and increase in weight [1-3]. The weight gain which is due to fluid retention makes accurate drug dosing and estimation of fluid and electrolyte requirements difficult. Most times, we have had to resort to the use of the oedematous weight or the formula estimated weight for age with the risk of either overdosing or

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underdosing of drugs. Dry weight would be more useful for pharmocological prescription and fluid and electrolyte management because the presence of oedematous nephropathy implies some degree of renal dysfunction, hence drugs excreted by the renal route, fluids and electrolytes should be administered with caution. Furthermore, some oedematous nephropathies can progress to either acute or chronic renal failure. Hence, every proactive measure should be put in place at the earliest possible time. This is pertinent in resource poor countries like ours, where renal replacement therapy are either not readily available or if available, not affordable by most of our teeming population.

Accurate estimation of the dry weight of patients and consequently the degree of fluid retention will have bearing on drug dosage, fluid and electrolyte management of patients. This study attempts to determine the dry weight in children with AGN and NS.

MATERIALS AND METHODS

All oedematous children with diagnosis of NS and AGN who were admitted to the Paediatric Nephrology unit of the University of Ilorin Teaching Hospital, Ilorin between 2004-2008 were recruited for the study. Patients undergoing haemodialysis or who have oedema due to other causes other than NS and AGN were excluded. Patient who became dehydrated when oedema was not clinically detectable were also excluded. Nephrotic syndrome was diagnosed by the presence of anasacar, massive proteinuria >2gms/24hours, hypoalbuminaemia-serum albumin <2.5g/dl and hypercholestrolaemia- >5.17 mmol/l while AGN was diagnosed by the presence of haematuria, hypertension, proteinuria and azotaemia. The patients with NS were managed with either of frusemide or thiazide diuretics and spironolactone depending on the severity of the oedema.They were also managed with oral steroid therapy in form of prednisolone at 2mg/kg up to a maximum of 60 mg daily in three divided doses after achieving dryness. The duration of the steroid therapy in each patient varied depending on the response. Those who were steroid responsive received the drug for 8 weeks on alternate day after an initial one month daily dosage therapy to induce remission. For those who were steroid resistant, renal biopsy was done before introduction of cytotoxic drug. The AGN patients were placed on diuretics to control the oedema, parenteral hydralazine if there was severe hypertension or captopril or nifedipine if the hypertension was less severe. An antibiotic was offered for the throat or skin infection, while the acute renal insufficiency was managed conservatively.

Patient's oedematous weight was determined on admission while the dry weight was determined when oedema became clinically undetectable. The age, sex and estimated weight for age in kilogramme using (the formula 2n+8 if the child is less than 5years and 7n-5/2 if the child is > 5years, where n is age in years) [4] were noted.

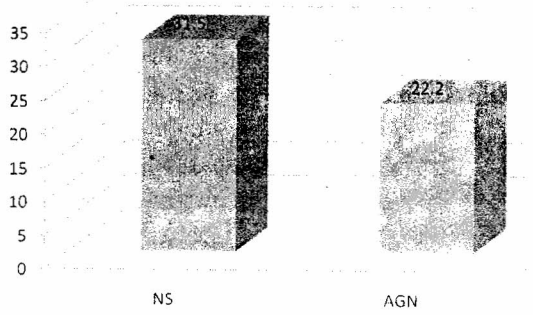
The oedema weight and dry weight were computed and compared with estimated weight for age. The weight differentials were also computed for each patient and percentage losses were derived.

Table 1: Clinical characteristics of all the children with oedematous nephropathy

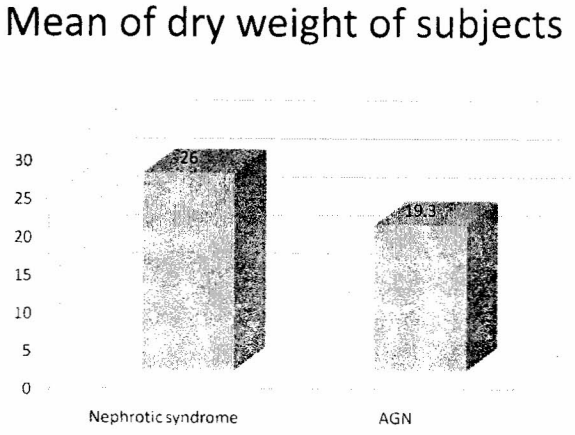
Clinical characteristics	Study population N=37
Age (years)	
Range	2.0-15.0
Mean (SD)	8.9±4.0
Wt. at adm.(Kg)	
Range	2.0-68.0
Mean(SD)	30.5±14.6
Dry wt.(Kg)	
Range	10.0-53.1
Mean(SD)	25.2±12.4
Estimated Wt.for age(Kg)	
Range	12.0-50.0
Mean (SD)	30.1±12.3%
Estimated wt. for age	
Range	54.3-123.4
Mean(SD)	83.9±15.8%
Dry weight	
Range	81.0-184,0
Mean(SD)	124.7±24.8
Duration of oed. (days)	
Range	5.0-35.0
Mean(SD)	14.1±7.2
Wt. loss(Kg)	
Range	0.5-21.0
Mean(SD)	5.3±4.2
% Wt.loss	
Range	4.2-43.5
Mean(SD)	17.6±9.8

RESULTS

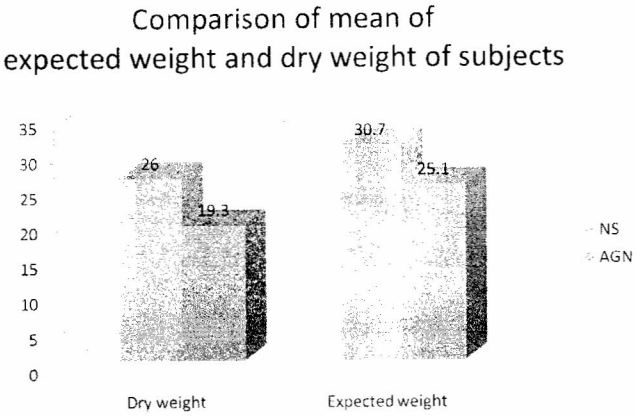
A total of 37 patients were recruited for the study. There were 31males and 6 females giving a male/ female ratio of 5.2: 1. The ages ranged from 2-15



years with a mean (SD) of 8.9±4.0 years. The children with nephrotic syndrome were aged 2-15 years with a mean of 9.1±4.1 years. The age range for patients with AGN was 3-13 years with a mean of 7.3±4.4 years. A total of 33 children were diagnosed as NS, while the other 4 patients had AGN.



The children weighed 12.0-68.0kg (mean of 30.5±14.6kg) on admission, while the dry weight for all the patients was 10.0-53.1kg (mean of 25.2±12.4kg). Weight loss among all the children



ranged from 0.5-21.0kg (mean of 5.3±4.2kg) giving a percentage weight loss of 4.2-43.5% with a mean of 17.6±9.8%.The duration of oedema while on admission ranged from 5-35 days with a mean of 14.1±7.2 days (Table 1).

Children with NS weighed 12.9-68.0 kg (mean 31.5± 14.9kg), while the patients with AGN weighed 12.0-33.7kg (mean 22.2±9.0kg) Fig.1. Dry weight among children with NS was 10-53.1 kg (mean 26.0±12.7kg), among children with AGN, dry weight was 11.5-30.0 kg (mean19.3±8.2kg) Fig. 2. Weight loss among the children with NS ranged from 1.2-21.0 kg (mean 5.5±4.3kg) giving percentage weight loss of 4.3-43.5% (mean18.1±9.8%). Weight loss among children with AGN was 0.5-5.2kg (mean 3.0±2.0kg) with percentage weight loss of 4.2-26.4% (mean 13.1±9.4%). In view of the 18.1% mean weight loss among the nephrotic children, a formula for dry weight estimation of (n-0.18n) was proposed where n is the oedematous weight at admission. Similarly, a formula (n-0.13n) was proposed for the dry weight in children with AGN since their mean percentage weight loss was 13.1%. With approximation to the nearest whole figure the formula is (n-0.2n) for Children with NS and (n-0.1n) for children with AGN (Table 2).

The duration of oedema in the children with NS ranged from 5-35 days with a mean (SD) of 14.2±7.4 days, while the duration in the children with AGN ranged from 8-21 days with a mean (SD) of 12.8±5.7 days.

The estimated weight for age of the study population was 12.0-50.0 kg with a mean of 30.1±12.3kg compared to dry weight range of 10.0-53.1 kg with a mean of 25.2±12.4kg (Fig. 3). The difference was not statistically significant. Furthermore, only 11 (33.3%) of the study population had their dry weight below 80% of estimated weight for age, while 32 (86.4%) had the dry weight below the estimated weight for age.

Table 2: Clinical characteristics of children with nephrotic syndrome and acute glomerulonephritis

Clinical characteristic	NS n=33	AGN n=4	P-value
Age (year)			
Range	2.0-15.0	3.0-13.0	
Mean (SD)	9.1±4.1	7.3±4.4	
Wt. at adm.(Kg)			
Range	12.9-68	12-33.7	
Mean(SD)	31.5±14.9	22.2±9.0	>0.05
Dry wt.(Kg)			
Range	10.0-53.1	11.5-30.0	
Mean(SD)	26.0±12.7	19.3±8.2	>0.05
Estimated Wt. for age(Kg)			
Range	12.0-50.0	14.0-43.0	
Mean (SD)	30.7±12.3	25.1±12.8	
% Estimated wt. for age			
Range	54.3-123.4	69.8-85.7	
Mean(SD)	84.4±16.6	79.6±6.9	
% Dry weight			
Range	81.0-184.0	121.0-143.0	
Mean(SD)	124.4±26.1	127.5±10.4	
Duration of oed. (days)			
Range	5.0-35.0	8.0-21.0	
Mean(SD)	14.2±7.4	12.8±5.7	
Wt. loss(Kg)			
Range	1.2-21	0.5-5.2	
Mean(SD)	5.5±4.3	3.0±2.0	
%Wt.loss			
Range	4.3-43.5	4.2-26.4	
Mean(SD)	18.1±9.8	13.1±9.4	

%Dry weight =Estimated weight for age divided by the dry weight multiplied by 100
%Estimated weight=Dry weight divided by the estimated weight for age multiplied by 100
%Weight loss=Oedematous weight minus dry weight divided by the oedematous weight multiplied by 100.

DISCUSSION

Oedema in children with nephropathy contributes to false weight gain, making it difficult to determine the actual weight in such children. The mean oedema weight in our cohort of children was expectedly greater than the mean dry weight (30.5.vs 25.2 kg). The mean weight increase from oedema was as much as 5.5Kg in children with NS compared to 3.0kg in children with AGN. This indicated that oedema was a source of appreciable weight gain in children with NS. Most of this oedema fluid is extravasated fluid to the interstitium which is thought to result in decrease in intravascular volume[5]. Some workers have however found that intravascular volume may remain normal or occasionally reduced, irrespective of the magnitude of the oedema [6].

The mean oedema weight was greater in the children with NS than the children with AGN. This disparity may be accounted for by the differences in pathophysiology of oedema in both conditions. The oedema in NS was related more to reduced oncotic pressure as a result of profound hypoproteinaemia [5] unlike in AGN where the effect was as a result of reduced glomerular filtration rate from deranged renal function [7]. Similarly, the loss of weight was greater in the NS patients than the AGN patients (31.5 vs. 26.0 kg and 22.2 vs19.3kg) and percentage weight loss was 18% in NS compared to 13% in children with AGN.

The dry weight was less than the mean estimated weight for age in both conditions, with mean % estimated weight for age in all the patients of 83.9%. Furthermore, 86% of the patients had dry weight below the estimated weight, while 33% of the patients had their dry weight below 80% of estimated weight for age indicating that NS and AGN may interfere with growth or that the patients had background malnutrition and growth retardation before the onset of the illness. Unfortunately, the pre-morbid weights of these patients are not known, making it difficult to determine the effect of oedematous nephropathy on the pre-morbid weight

in these children. It should be noted that growth impairment due to urinary losses of growth stimulating hormone occurs in children with NS. They also have low plasma insulin like growth factor (IGF-1) and (IGF-II) which is associated with a urinary loss of the carrier proteins [8]. Urinary loss of growth stimulating hormone and the low IGF-I and IGF-II may have contributed to the nutritional status of patients with NS.

In view of the fact that oedema contributes significantly to the increase in weight in children with NS and AGN, there is need for a formula to predict or estimate the actual weight in such children. Therefore, in view of the 18.15% mean weight loss among the nephrotic children, a formula for dry weight of (n-0.18n) was proposed for children with NS where n is the oedematous weight at admission. Approximated to one decimal place, the formula is (n-0.2n) for NS. Similarly, in view of 13.1% mean weight loss in children with AGN, a formula (n-0.13n) was proposed for their dry weight. With approximation to the nearest one decimal place, the formula is (n-0.1n) for children with AGN. On the other hand, since the weight loss for all the 37 patients with oedema was 17.6%, the formula for dry weight of (n-0.17n) was proposed. Approximated to one decimal place, the formula is (n-0.2n) for children with oedematous nephropathy.

These formulae are recommended for the estimation of dry weight in children with oedematous nephropathy particularly those with NS and AGN. We are not unaware of the shortcomings/limitations of this study, such as the apparent small sample size and lack of statistical significance of all the clinical indices. Inspite of all these, we are still of the opinion that our findings will be a starting point in deriving a plausible formula for the determination of dry weight in children with oedematous nephropathy.

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