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Original Article

Disturbed electrogastrographic functions in protein energy malnutrition patients

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SUMMARY

Background & aims: This work was designed to detect changes in the gastric electrical activity in protein energy malnutrition (PEM) and correlate them to the disease severity and gastrin levels.
Methods: The current study was conducted on 14 non-edematous PEM and 14 edematous PEM patients in comparison to 14 clinically healthy infants and young children. Enrolled cases were subjected to history taking, clinical examination, assessment of total serum gastrin hormone and electrogastrographic (EGG) recording. Patients were reevaluated after nutritional rehabilitation.
Results: Initial serum gastrin was high in PEM patients compared to the controls with significant decrease after nutritional rehabilitation. Significantly higher initial power ratio of EGG was detected in patients compared to controls while the dominant frequency didn't show any significant difference. Additionally, in the initial analysis of the EGG, 12 (42.9%) of the PEM patients were normogastric compared to bradygastria in 16 (57.1%). After nutritional rehabilitation, 22 (78.6%) of the PEM patients were normogastric and only 6 (21.4%) were still bradygastric.
Conclusion: PEM patients show EGG changes predominantly bradygastria which is affected by the severity of the condition and is reversible upon nutritional rehabilitation. The disturbed gastrin levels in PEM could be considered among the responsible factors.

1. Introduction

Malnutrition continues to be a major public health problem throughout the developing world, particularly in Southern Asia and Sub-Saharan Africa.[1]

Protein energy malnutrition (PEM) is manifested primarily by inadequate dietary intake of protein and energy. However, PEM is almost always accompanied by deficiencies of other nutrients. For this reason, the term severe childhood undernutrition (SCU), which more accurately describes the condition, is preferred.[2] These nutrient deficiencies could easily alter the autonomic function and consequently cause delay in gastric emptying time (GET) as previously reported by Shaaban et al.[3]

The delay in gastric emptying found in PEM patients points to the presence of underlying derangements in gastric electrical activity which can be accurately recorded and analyzed by cutaneous electrogastrography (EGG). While gastric emptying time evaluates the efficiency of gastric emptying, EGG focuses on the underlying myoelectrical activity.[4] EGG might define a subgroup of patients with electrical rhythm disturbances that may have a different approach to treatment than patients with normal gastric electrical activity.[5]

This work was thus designed to highlight the underlying EGG changes in PEM patients and correlate them to the disease severity and gastrin levels with special emphasis on the effect of nutritional rehabilitation on the detected changes.

2. Patients and methods

2.1. Patients

The current study was conducted on 28 infants and young children diagnosed to have protein energy malnutrition (PEM) based on the criteria of Wellcome.[6] Their ages ranged between 6–24 months, with mean and SD of 13.57 ± 5.47 months. They were 14 males and 14 females. None of the patients had any chronic liver, renal, neurological or chromosomal anomaly and they were not receiving any drug that affects gastric motility in the month prior to enrollment nor did they suffer from reflux, dehydration or any electrolyte disturbance. The PEM patients were recruited for the inpatient department of the Children's Hospital; Faculty of

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The patients were diagnosed to have severe childhood undernutrition (SCU) and classified on the basis of presence or absence of edema according to Heird,[2] and according to *Z* score of weight for length according to the classification of Gernaat and Voorhoeve[7] into non-edematous PEM group which included 14 infants and young children, their *Z* score of weight for length was <-2SD with no edema. The second group was the edematous PEM group which included 14 infants and children, their *Z* score of weight for length was <-2SD with edema.

A group of clinically healthy infants and young children of normal anthropometric measurements was included as the control group. This group comprised 14 healthy infants and young children, age and sex matched whose mean age was 14.29 ± 4.76 months. They were 8 males and 6 females. The controls were recruited among those attending the hospital for minor surgical procedures.

2.2. Methods

After the approval of the ethical committee of the Children's Hospital, Faculty of Medicine, Ain Shams University, an informed consent was obtained from the parents or legal guardians.

All enrolled cases were initially subjected to complete history taking with special emphasis on dietetic history taking. Physical examination was done for each case and included anthropometric measurements from which the percentage from median for age was calculated according to Ogden et al.[8] *Z* score for weight for length was calculated according to Gernaat and Voorhoeve.[7] General and systemic clinical examinations were also done laying stress on hair and skin changes, presence and absence of edema and signs of vitamin deficiencies.

Routine laboratory procedures were performed including complete blood count, total protein and serum albumin as well as total serum gastrin hormone by ELISA using the Kit supplied by BIOHIT plc. (Biohitplc. Laippatie 1 Fin-0088 Helsinki, Finland). Venous blood samples were collected under complete aseptic conditions from all enrolled subjects. The samples were divided into two halves; the first was taken on EDTA for the complete blood count and the remaining part was kept in a dry sterile tube from which serum was separated by centrifugation. Samples for gastrin hormone were stored at -70 °C freezers till the time of test procedures.

Electrogastrographic recording for gastric electrical activity was done for all subjects upon enrollment. Recording was done from five disposable pre gelled silver/silver chloride surface electrodes placed on the upper abdomen after the skin had been carefully abraded to decrease resistance to obtain a good signal to noise ratio.[9] Infants and young children under examination were kept in a reclining position to minimize motion artifact. Four electrogastrography (EGG) signals were recorded bipolarly from these five electrodes as the potential differences between each of the four electrodes. A reference electrode was placed at the left clavicle. The electrical signal was recorded with appropriate amplification and filtering. Filtering was needed to exclude cardiac and small intestinal electrical activity artifacts as well as respiratory and movement artifacts.[10]

One hour recording was done while the patients were fasting then they were given a standardized test meal and post prandial recording was done for 1 h.[11] The test meal was a semisolid one (milk, rice and high protein additive) which was adjusted to provide a volume of 20 cm^3/kg/feed and a caloric value of one-eighth of the daily needs that are approximately 100 kcal/kg/day for the control group and 120–150 kcal/kg/day for the patients.

Table 1
Comparison between initial anthropometric measurements and laboratory parameters of protein energy malnutrition patients and those of the controls.

Studied parameter	Group					
	Non-edematous group I ($n = 14$) Mean ± SD [Median (interquartile range)]	Edematous group II ($n = 14$) Mean ± SD [Median (interquartile range)]	Control group III ($n = 14$) Mean ± SD [Median (interquartile range)]	Group I vs III t/z^a (p)	Group II Vs III t/z^a (p)	Group I vs II t/z^a (p)
Weight (%)	48.21 ± 8.64 [53.00 (19.00)]	51.64 ± 9.18 [53.00 (21.00)]	101.03 ± 11.52 [97.50 (19.00)]	-4.51^a ($p < 0.001$)	-4.51^a ($p < 0.001$)	-1.02^a ($p > 0.05$)
Length/height (%)	77.66 ± 3.74 [79.00 (6.00)]	87.26 ± 7.38 [85.00 (9.00)]	99.29 ± 4.02 [98.00 (7.00)]	-4.54^a ($p < 0.001$)	-3.61^a ($p < 0.001$)	-3.60^a ($p < 0.001$)
Skull circumference (%)	88.71 ± 6.85 [89.00 (7.00)]	91.41 ± 5.14 [90.90 (10.00)]	99.29 ± 2.81 [100.00 (6.00)]	-3.52^a ($p < 0.001$)	-3.69^a ($p < 0.001$)	-1.30^a ($p > 0.05$)
Mid arm circumference (cm)	9.93 ± 1.53 [9.00 (3.00)]	10.50 ± 1.71 [10.50 (3.50)]	14.71 ± 1.10 [14.00 (2.00)]	-4.56^a ($p < 0.001$)	-4.54^a ($p < 0.001$)	-0.84^a ($p > 0.05$)
Skin fold thickness (mm)	5.03 ± 0.83 [4.80 (1.70)]	4.429 ± 0.63 [4.50 (1.20)]	8.91 ± 0.70 [9.00 (0.90)]	-4.52^a ($p < 0.001$)	-4.52^a ($p < 0.001$)	-1.94^a ($p > 0.05$)
Z score	−1.46 ± 1.88 [-2.50 (3.50)]	−3.06 ± 1.49 [- 2.60 (2.80)]	−0.06 ± 0.83 [0.00 (1.10)]	-2.55 ($p < 0.05$)	-6.57 ($p < 0.001$)	2.48 ($p < 0.05$)
Hemoglobin (gm/dL)	9.57 ± 1.04 [10.20 (1.90)]	8.89 ± 1.81 [8.30 (3.50)]	10.67 ± 0.44 [10.50 (0.70)]	-2.78^a ($p < 0.01$)	-2.49^a ($p < 0.05$)	-1.48^a ($p > 0.05$)
Albumin (gm/dL)	3.66 ± 0.73 [3.90 (0.70)]	2.43 ± 0.49 [2.30 (1.00)]	4.44 ± 0.43 [4.50 (1.00)]	-3.13^a ($p < 0.01$)	-4.52^a ($p < 0.001$)	-4.25^a ($p < 0.001$)

$p < 0.05$ is significant, $p < 0.01$ is highly significant, $p < 0.001$ is very highly significant and $p > 0.05$ is non-significant.
vs means versus.
[a] Non-parametric data detected by Shapiro–Wilk test. The test of significance used here is Mann–Whitney test.