GASTRIC MYOELECTRICAL ACTIVITY IN NEONATES OF DIFFERENT GESTATIONAL AGES BY MEANS OF ELECTROGASTROGRAPHY

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PURPOSE: to describe the patterns of the gastric myoelectrical activity, pre-and postprandially, in clinically stable neonates of different gestational ages, during their first two weeks of life by means of Electrogastrography.

PATIENTS AND METHODS: Electrogastrography was recorded in forty-five clinically stable neonates of different gestational ages (group I: 15 neonates of > 37 weeks, group II: 15 premature neonates of 32-37 weeks; Group III: 15 premature neonates of 28-31 weeks) receiving intermittent enteral feedings during their first two weeks of life. Electrogastrography recordings were performed for 1 hour pre-and postprandially. The Electrogastrography signal was recorded using the portable MicroDigitrapper Electrogastrography recording device and after motion artifacts were deleted, the remaining Electrogastrography data were submitted to quantitative analysis based on the “Running Spectrum Analysis”.

RESULTS: The percentages of normogastria, pre-and postprandially were greater than the percentages of gastric dysrythmias in all three studied groups. Furthermore, all neonates had the mean values of the Electrogastrography dominant frequency predominantly within the normogastria range, in both periods analyzed. There were no significant differences in the relative change of the Electrogastrography dominant power among the groups.

CONCLUSION: This study demonstrates that the Electrogastrography patterns are similar between premature and full term neonates during the pre-and postprandial periods. The results of this study also indicate that the gastric myoelectrical activity in premature and full term neonates is immature, as compared to that described for older neonates, children and adults.

DESCRIPTORS: **Electrogastrography. Gastric myoelectrical activity. Neonates. Different gestational ages. Pre-and postprandial periods.**

INTRODUCTION

The need to provide the newborn with adequate nutrition in order to ensure survival has long been recognized[1]. The use of enteral nutrition in very-low-birth-weight neonates, however, is associated with a significant morbidity related to immaturity of gastrointestinal motor function[2,3].

A renewed interest in using early enteral nutrition in neonates has developed based on the morbidity associated with the use of parenteral nutrition and its expense. In order to achieve successful enteral feedings in premature and full term neonates, investigators have tried to better understand the developmental patterns of gastrointestinal motor activity[4-21].

Despite several gastrointestinal motility studies have been made in adults during the last decades, the knowledge derived from systematic scientific observation in this area in neonates remains scarce. To a large extent, this is due to the fact that invasive and unpleasant investigations are required to study the contractile activity of the gastrointestinal tract via the lumen. In neonates and in children, such invasive investigations are less acceptable to patients and consequently put severe limitations on systematic studies.

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Due to its non-invasive quality the Electrogastrography (EGG) technique has received more and more attention among investigators and clinicians as an attractive method for physiological and pathophysiological studies of the gastric myoelectrical activity by electrodes placed on the abdomen. The surface recording obtained with the use of electrogastrographic technique has been called the electrogastrogram[22-25].

During the past decades the EGG has been performed extensively in adult population. It has been used to study patients with abnormalities in gastric function such as gastroparesis[26,27] and functional dyspepsia and delayed gastric emptying[28]. In addition, the EGG has been used to evaluate the effects of compositions of feedings, gut hormones and prokinetic agents on gastric motility[29-32].

The use of the EGG technique in neonates and children began in the late 1980s. It has been basically used to investigate the development of gastric motor activity in neonates and children[33-38] and to describe the gastric myoelectrical activity in different diseases as idiopathic intestinal pseudo-obstruction[39], non-ulcer dyspepsia[40], disorders of the central nervous system[41], and anorexia nervosa[42]. However, there is a lack of EGG data among neonates of different gestational ages. Therefore, the objective of this study was to describe the patterns of the gastric myoelectrical activity, pre-and postprandially, in clinically stable neonates of different gestational ages, during their first two weeks of life by means of EGG.

PATIENTS AND METHODS

Subjects

Forty-five clinically stable neonates of different gestational ages receiving intermittent enteral feedings during their first two weeks of life were assigned into 3 study groups: Group I: 15 full term neonates of >37 weeks; Group II: 15 premature neonates of 32-37 weeks; Group III: 15 premature neonates of 28-31 weeks. The gestational age used for enrollment into study groups was based on maternal dates, confirmed by prenatal ultrasonographic assessment (if available) and by physical exam using the method of Ballard [43]. In case of a discrepancy of less than 2 weeks between maternal dates and other methods, the maternal dates were used. In case of a discrepancy greater than 2 weeks, the average value between ultrasonographic and clinical assessment was used.

All neonates were enrolled in this study based on inclusion and exclusion criteria. Inclusion criteria: clinically stable premature and full term neonates ready to receive intermittent enteral feedings during their first two weeks of life. Exclusion criteria: inherited/congenital anomalies, intrauterine growth retardation, medical instability with contraindications to enteral feedings, respiratory distress requiring mechanical ventilation, muscle paralysis, gastrointestinal, hepatic, metabolic or infectious diseases, conditions requiring the use of drugs known to affect EGG signals and gastrointestinal motility such as: paralytic agents (pancuronium); opioids (morphine, enkephalin); hormones (secretin, insulin, prostaglandins); prokinetic agents (cisapride, metoclopramide); and antibiotics (erythromycin). Neonates with hyperbilirubinemia who require phototherapy were also excluded based on the necessity to swaddle the infant during the study.

This scientific investigation was approved by the Institutional Review Board at the Children's Hospital of Philadelphia and the Hospital of the University of Pennsylvania prior to infant's enrollment into the study. Signed written consent was obtained from the neonates' parents or guardians before the study. National Institute of Health (USA) guidelines for inclusion of patients using unbiased selection according to gender and ethnicity were followed.

Preparation of the patient for an Electrogastrography study

Gastric myoelectrical activity in each subject was measured using the Electrogastrography technique during the pre-and postprandial periods. Before the electrodes were attached, the abdominal skin at the recording sites was gently cleaned using sandy skin-preparation paste to reduce the impedance [36,43]. Three pediatric disposable silver-silver chloride electrodes filled with EGG redux (Signa creme-conducter electrode creme) gel were placed on the abdominal skin accordng to Liang[36] and Chen's studies[38]. One active electrode was placed at the midpoint between the xiphoid and the umbilicus; a second active electrode was placed at 3 cm to the left and 3 cm above this point; and a reference electrode was placed in the lower quadrant close to the left costal margin. The two active-epigastric electrodes were connected to yield a bipolar EGG signal, while the other electrode was used as a reference.

The EGG signal was recorded using the portable MicroDigitrapper EGG recording device (Synectics Medical, Irving, TX), with low and high cutoff frequencies of 1 and 18 cpm, respectively[45]. The EGG signal was digitized with a sampling frequency of 4 Hz[45]. The EGG recording device was operated by a new 9-V battery in each study. The EGG recording device was brought to the neonatal unit in which the infant was located and all neonates were studied at their bedside.

Experimental study

All infants were fasted (for 3 hours) before the study and received either formula or breastfeeding. An 1-hour EGG recording time, before and after feeding were obtained. All were studied in the supine position but lying slightly on their left side on a bed with the head elevated to a 30° angle. They were also gently swaddled to reduce the occurrence of motion artifacts on the EGG signal.

Electrogastrography data analysis

At the end of each study, the EGG recording device was connected to a personal computer (Hewlett-Packard 9826) and the EGG data were uploaded in the Clinical Motility Center at the Hospital of University of Pennsylvania. Before quantitative and statistical analysis, the EGG recording was first displayed on the computer screen and the portions contaminated by motion artifacts were deleted. Motion artifacts were characterized by an abrupt increase in amplitude and usually reached maximum values of the digitization. All data within one hour before the meal were considered as preprandial and all data within 1 hour after the meal were considered as postprandial. After motion artifacts were deleted, the remaining "cleaned" EGG data were submitted to quantitative analysis performed by the "Electrogastrogram Software for EGG analysis" (Synectics Medical-Gastrosoft, version 6.30, 1995), which is based on the "Running Spectrum Analysis".

The pattern of the EGG was characterized by several quantitative parameters, including: a) percentage of normogastria (or percentage of 2.4 to 3.7-cpm gastric slow wave) defined as the percentage of time in which a rhythmic gastric myoelectrical activity of 2.4 to 3.7-cpm is present over the entire observation period[46]; b) percentage of bradygastria defined as the percentage of time in which an abnormally slow gastric myoelectrical activity of 0.5 to 2.4-cpm range is present over the entire observation period[46]; c) percentage of tachygastria defined as the percentage of time in which an abnormally fast gastric myoelectrical activity of 3.7 to 9.9-cpm is present over the entire observation period[46]; d) EGG dominant frequency defined as the frequency that the power of the EGG signal has at its peak value in the range of 0.5 to 9.0-cpm[46]; and e) EGG dominant power (Relative change of the EGG dominant power). The EGG dominant power is defined as the power at the dominant frequency and it reflects the amplitude and regularity of gastric low wave[46]. The relative change of the EGG dominant power is defined as the ratio of postprandial and preprandial powers of the EGG dominant frequency[47,48].

Statistical analyses

Analysis of variance (ANOVA) was used to assess the difference in the EGG data among patients from the 3 gestational age groups. ANOVA was also used to assess the difference in the "EGG difference score" (preprandial minus postprandial values) regarding to all EGG parameters analyzed among patients from the 3 gestational age groups. Paired t-test was applied to study the difference between the preprandial and postprandial EGG data for each of the gestational age groups. All EGG data in this study is presented as "Means ± Standard Error of Mean (SEM)". Statistical significance was assigned for p value of less than 0.01.

RESULTS

Group I of subjects was composed of 15 clinically stable full term neonates. The Apgar scores at one and at five minutes of life were (Mean±SEM) 8.3±0.2 and 8.9±0.1, respectively. The gestational age at birth and at the time of the study were: (Mean±SEM) 39.1±0.3 weeks (range: 37 to 40 5/7 weeks) and 39.5±0.4 weeks (range: 37 2/7 to 41 3/7 weeks), respectively. The weight at birth and at the time of the study were (Mean±SEM) 3.3±0.2 kg (range: 2. to 4.50 kg) and 3.3±0.2 kg (range: 2.36 to 4.53 kg). Three neonates (20%) were White and 12 (80%) were Afro-Americans. Four neonates (26.7%) were male and 11 (73.3%) were female. Ten neonates (66.7%) were appropriate for gestational age and 5 (33.3%) were large for gestational age. Six neonates (40%) were on breastfeeding and nine (60%) were on formula (Similac-20 or Enfamil-20). Based on the milk volume that could be measured, the volume, the amounts of calories, protein, carbohydrate, and fat per kilogram body weight per day among the full term neonates were (Mean±SEM): Volume: 81.5±11.5 ml/kg/day; Calories: 55.2±7.8 kcal/kg/day; Protein: 1.1±0.2 g/kg/day; Carbohydrate: 5.9±0.8 g/kg/day; Fat: 2.9±0.4 g/kg/day. The EGG preprandial study period recorded and analyzed among these neonates were: (Mean±SEM) 56.7±3.2 and 38.3±2.3 minutes, respectively. The EGG postprandial study period recorded and analyzed in this group was (Mean±SEM) 56.3±3.9 minutes and 37.2±2.7 minutes, respectively. The time that the EGG study was performed in this group was (Mean±SEM) 3.3±0.8 days of life.

Group II of subjects was composed of 15 clinically stable premature neonates (32-37 weeks). The Apgar scores at one and five minutes of life were (Mean±SEM) 7.3±0.6 and 8.8±0.1, respectively. The gestational age at birth and at the time of the study were (Mean±SEM) 34.5±0.3 weeks (range: 33 1/7 to 36 weeks) and 35.1±0.3 weeks (range: 33 5/7 to 36 5/7 weeks), respectively. The weight at birth and at the time of the study were (Mean±SEM) 2.14±0.1 kg (range: 1.45 to 2.90 kg) and 2.04±0.1 kg (range: 1.40 to 2.76 kg), respectively. Five neonates (33.3%) were White, 9 (60%) were Afro-Americans, and 1 (6.7%) was Hispanic. Six neonates (40%) were male and 9 (60%) were female. Among these premature neonates 14 were appropriate for gestational age and 1 was large for gestational age. Thirteen neonates (86.7%) were on formula (Enfamil Premature Formula-20, or Enfamil-20, or Similac Neocare-22, or Similac Special care, or Similac 20) and two (13.3%) were on breastfeeding. Based on the milk volume that could be measured the volume, the amount of calories, protein, carbohydrate, and fat per kilogram body weight per day among these premature neonates were (Mean±SEM): Volume: 116.8±15.2 ml/kg/day; Calories: 78.97±10.57 kcal/kg/day; Protein: 1.95±0.24 g/kg/day; Carbohydrate: 8.49±1.15 g/kg/day; Fat: 4.22±0.55 g/kg/day. The EGG preprandial study period recorded and analyzed among these preterm neonates were (Mean±SEM) 64.5±2.9 and 43.9±3.4 minutes, respectively. The EGG postprandial study period recorded and analyzed in this group was (Mean±SEM) 58.7±2.6 minutes and 38.6±2.9 minutes, respectively. The time that the EGG study was performed in this group was (Mean±SEM) 4.4±0.6 days of life.

Group III of subjects was composed of 15 clinically stable premature neonates (28-31 weeks). The Apgar scores at one and at five minutes of life were (Mean±SEM) 6.8±0.5 and 8.2±0.2, respectively. The gestational ages at birth and at the time of the study were (Mean±SEM) 29.6±0.3 weeks (range: 28 1/7 to 31 weeks) and 30.8±0.3 weeks (range: 29 to 32 3/7 weeks), respectively. The weight at birth and at the time of the study were (Mean±SEM) 1.3±0.07 kg (range: 0.93 to 1.70 kg) and 1.2±0.08 kg (range: 0.79 to 1.83 kg), respectively. Seven neonates (46.7%) were White and 8 (53.3%) were Afro-Americans. Seven neonates (46.7%) were male and 8 (53.3%) were female. All 15 premature neonates were appropriate for gestational age. Twelve neonates (80%) were on formula (Enfamil Premature care-20, or Similac Special care-20, or Similac Neocare-22) and three (20%) were on breastfeeding. Based on the milk volume that could be measured the volume, the amount of calories, protein, carbohydrate, and fat per kilogram body weight per day among these preterm neonates was (Mean±SEM): Volume: 87.5±11.07 ml/kg/day; Calories: 60.55±8.6 kcal/kg/day; Protein: 1.57±0.3 g/kg/day; Carbohydrate: 6.55±0.9 g/kg/day; Fat: 3.26±0.5 g/kg/day.The EGG preprandial study period recorded and analyzed among these preterm neonates were (Mean±SEM) 58.7±2.6 minutes and 38.5±3.2 minutes, respectively. The EGG postprandial study period recorded and analyzed in this group were (Mean±SEM) 58.4±1.5 minutes and 38.9±2.7 minutes, respectively. The time that the EGG study was performed in this group was (Mean±SEM) 8.7±0.9 days of life.

Effect of gestational age on the gastric myoelectrical activity

Percentage of Normogastria, Bradygastria, and Tachygastria

Normogastria (or normal gastric slow wave or normal 2.4 to 3.7cpm gastric myoelectrical activity) as well as gastric myoelectrical dysrhythmias (bradygastria and tachygastria) were recorded in all neonates in groups I, II, and III (Table 1).

The percentages of normogastria, pre-and postprandially were: Group I: (Mean±SEM) 47.4±5.5% (range: 7.7 to 100%) and 53.4±3.8% (range: 19.4 to 76.1%); Group II: (Mean±SEM) 41.9±2.9% (range: 26.7 to 67.5%) and 52.7±4.9% (range: 17.4 to 90.2%); and Group III: (Mean±SEM) 43.8±3.3% (range: 16.7 to 62.8%) and 51.8±4.8% (range: 22.7 to 78.9%)

As shown in table 1 there were no significant differences in the percentage of normogastria among the three groups of neonates during the preprandial (p= 0.6) and postprandial (p=0.9) periods. Furthermore, there were also no significant differences in the normogastria difference score (postprandial values minus preprandial values) among the three groups of patients (p=0.8). The results of this study showed a percentage of normogastria activity lower than 70% during the pre-and postprandial periods for pre-

Table 1 - Percentage of Bradygastria, Normogastria, and Tachygastria in full term and premature neonates during their first two weeks of life (Mean±SEM).

Subjects	% of Bradygastria		% of Normogastria		% of Tachygastria	
	preprandial	postprandial	preprandial	postprandial	preprandial	postprandial
Group I (N=15) full term infants)	28.8±4.9	22.8±4.0	47.4±5.5	53.4±3.8	23.7±5.9	23.7±3.3
Group II (N=15) >32 and < 37 wk	27.3±3.8	17.9±2.6	41.9±2.9	52.7±4.9	30.4±2.9	29.5±4.5
Group III (N=15) >28 and <32 wk	28.4±3.5	20.7±2.8	43.8±3.3	51.8±4.8	27.8±2.9	27.5±4.7
(Mean±SEM) among groups	28.2±2.3	20.5±1.9	0.4±2.3	52.7±2.6	27.3±2.4	26.9±2.4
P value among groups	0.9	0.6	0.6	0.9	0.5	0.6

mature and full term neonates. Other investigators [36,38] have also demonstrated this finding.

Gastric myoelectrical dysrhythmias (bradygastria and tachygastria) were recorded in all neonates as well. The percentage of time in which bradygastria and tachygastria were present among these neonates also varied widely. The percentages of bradygastria and tachigastria, pre-and postprandially, were respectively : Group I: percentage of bradygastria: (Mean±SEM) 28.8±4.9% (range: 0 to 56.3%) and 22.8±4.0% (range: 0 to 54.8%), percentage of tachygastria: (Mean±SEM) 23.7±5.9% (range: 0 to 92.3%) and 23.7±3.3% (range: 0 to .7%): Group II: percentage of bradygastria: (Mean±SEM) 27.3±3.8% (range: 4.1 to 57.1%) and 17.9±2.6% (range: 2.4 to 37.5%), percentage of tachygastria: (Mean±SEM) 30.4±3.4% (range: 10.0 to 57.1%) and 29.5±4.5% (range: 4.9 to 65.2%); and Group III: percentage of bradygastria: (Mean±SEM) 28.4±3.5% (range: 11.4 to 56.9%) and 20.7±2.8% (range: 7.5 to 41.7%), percentage of tachygastria: (Mean±SEM) 27.8±2.8% (range: 10.3 to 58.3%) and 27.5±4.7% (range: 2.8 to 61.5%).

This study has also demonstrated that no significant differences were observed in the percentage of bradygastria (preprandial p=0.9, postprandial p=0.6) and tachygastria (preprandial p=0.5, postprandial P=0.6) among the three groups of neonates (Table 1). There were also no significant differences among the three groups of neonates regarding to the bradygastria (P=0.9) and tachygastria difference scores (P=0.9).

In this study as well as in the studies by Liang[36] and by Chen[38] enteral feedings (milk) did not induce significant changes in the percentage of normogastria, bradygastria, and tachygastria during the postprandial period. Nevertheless, changes in these parameters were noted individually.

EGG Dominant Frequency (cpm)

All neonates in the three groups studied had the mean values of the EGG dominant frequency predominantly within the normogastria range (2.4 to 3.7-cpm), during the pre-and postprandial periods. The mean values of the EGG dominant frequency for groups I, II, and III are presented in the table 2. As shown in table 2, no significant differences were observed in the EGG dominant frequency among neonates in groups I, II, and III during the preprandial (p=0.3) and postprandial (p=0.2) periods. There were also no significant differences in the EGG dominant frequency difference score (p=0.9) among the three groups.

Relative Change of the EGG Dominant Power

Despite EGG dominant power has varied widely among the neonates in the three groups, there were no significant differences in the relative change of the EGG dominant power among the groups: Group I and Group II (p=0.5); Group I and Group III (p=0.6), and Group II and Group III (p=0.4) (Table 3).

DISCUSSION

The Electrogastrography technique (EGG) was recorded successfully in 45 neonates of different gestational ages. This study has demonstrated that EGG is a safe procedure to be performed in neonates since none of the potential risks involved in this procedure occurred. Those included skin irritation caused by placement of the electrodes on the abdominal skin and electric shock related to the use of electric equipment.

Beside being a safe procedure, the EGG technique has further characteristics which make it an attractive clinical tool to study gastric myoelectrical activity in neonates as follow: the EGG is a non-invasive technique that can be repeated on many occasions both before and after possible gastric stimuli such as different feeding regimens or use of prokinetic agents. Furthermore, it can be used to assess the gastric myoelectrical activity during systemic diseases; and the EGG device is a portable machine of the size and shape of a “walkman” which can be placed at bedside and, therefore, the

Table 2 – Electrogastrography dominant frequency (cpm) in full term and premature neonates during their first two weeks of life (Mean±SEM).

Subjects	Preprandial Electrogastrography dominant frequency (cpm)	Postprandial Electrogastrography dominant frequency (cpm)
Group I (N=15,full term infants)	2.89±0.2	2.76±0.2
Group II (N=15, >32 and < 37 wk)	2.48±0.2	3.21±0.2
Group III (N=15,>28 and <32 wk)	2.59±0.2	2.96±0.2
(Mean±SEM) among groups	2.65±0.1	2.98±0.2
P value Among groups	0.3	0.2

Table 3 - Relative changes of Electrogastrography dominant power in full term and premature neonates during their first two weeks of life (Mean±SEM).

Subjects	Relative changes of Electrogastrography dominant power
Group I (N=15,full term infants)	1.4±0.4
Group II (N=15, >32 and < 37 wk)	2.4±1.4
Group III (N=15,>28 and <32 wk)	1.2±0.2

neonate does not have to be replaced out of his bed to undergo the procedure, which could contribute to deteriorate his clinical status.

The relatively poor quality of the EGG signal, however, makes it imperative that the acquisition of the EGG signal in neonates be even more accurate. The EGG signal is described as being of poor quality because it is a combination of the gastric signal and noises [29]. Noises are composed of respiratory and motion artifacts, the electrical activity of the heart and the electrical activity of the small intestine. Among these noises motion artifacts are the most important to be considered in performing EGG studies in neonates. Motion artifacts can disturb the EGG signal for several reasons [49]: they may be strong and completely obscure the myoelectrical signal of the stomach; they have a broad-band spectrum and their frequencies may overlap with that of the gastric myoelectrical activity making it difficult to separate them even with the use of spectral analysis; and no effective methods are available for the cancellation of motion artifacts as the EGG signal is being recorded. In this study some measures were adopted in order to obtain satisfactory EGG recordings in neonates. The measures that seemed to be effectively were: to swaddle and not manipulate the neonate during the whole study period; to study the neonate in a silent room with little or no light or auditory stimulation. Light and auditory stimulation may keep the infant awake, may promote crying, or even trigger the Moro reflex, thus, contributing to an unsatisfactory acquisition of the EGG signal, to change the infant's dippers before the EGG study starts and after the neonate is fed. The EGG meal period, i.e., between the pre-and postprandial periods, is not submitted to quantitative analysis, although the gastric myoelectrical activity is continuously recorded. Therefore, this period of the study is the appropriate time for manipulating the neonate, if it is necessary; and to record the EGG signal for at least 1-hour during the pre-and postprandial periods to obtain around 30 minutes of clean data after EGG segments contaminated by noises are deleted. Despite the measures to avoid motion artifacts, it was impossible to have an EGG recording absolutely free of artifacts. Therefore, these artifacts had to be deleted visually before quantitative analysis of the EGG data was performed.

The Eletrogastrogram for EGG analysis software (Synectics Medical-Gastrosoft, version 6.30) was used to perform the quantitative analysis of the EGG signal. This software is based on the "Running Spectrum Analysis" which results in overlapping the analysis of 75% of the data available. Due to the overlapping, ignoring a segment of data, ends up affecting the frequency analysis of data that starts about five minutes before and ends about five minutes after the ignored segment [45] . This results in loss of clean EGG data as well. For these reasons the EGG study period analyzed was shorter when compared to the total EGG study period recorded during the pre-and postprandial periods in all three groups of neonates. This is the main reason for performing "prolonged" EGG studies in neonate.

Regarding to the EGG parameters analyzed, this study has shown that normal gastric myoelectrical activity as well as gastric myoelectrical dysrhythmias (bradygastria and tachygastria) are similarly present after birth in premature and full term neonates during the pre-and postprandial periods. This finding suggests that the development of gastric myoelectrical activity is not strongly associated with the gestational age at birth. The similar EGG patterns between premature and full term neonates during the pre-and postprandial periods have also been demonstrated by other investigators[34,38]. Furthermore, manometric studies performed in neonates[4,9] have demonstrated no significant differences in the gastric activity between premature and full term neonates during their first weeks of life.

It is interesting to note that the dominant frequency of the EGG signal among the three study groups was within the normogastria range (2.4-3.7 cpm), however, the percentage of time in which normal gastric myoelectrical activity was recorded in premature and full term neonates was lower than those described in the literature for neonates older than 2 months, children, and adults[38,46,48,50-52]. Data from the literature has demonstrated a percentage of normal gastric slow waves greater than 70% in older children and neonates. Although the percentage of normal gastric slow wave varied widely among all infants described in this study, it seems reasonable to consider 30 to 60% of the percentage of normal gastric myoelectrical activity as an acceptable range for healthy premature (> 28 weeks of gestation) and full term neonates during their first two weeks of life.

Another interesting finding in this study was that the percentages of bradygastria and tachygastria in premature and full term neonates were higher than those described in the literature for healthy adults[48,50]. In fact, this finding was expected since these parameters are inter-dependent and the neonates that were studied had low percentages of normogastria. Although increases in the percentage of bradygastria[39,53-64] and tachygastria[53,55,57,59-75] in adults have been associated with a wide range of diseases and disorders associated with nausea and vomiting, and also with gastric hypomotility, its occurrence in neonates suggests a normal developmental process.

Among all the EGG parameters described in this study, the power of the EGG signal is the one associated with major controversies in the literature. This is due to the fact that the power of the EGG signal is related to many factors[45]. For that reason it has been speculated that the absolute values of the EGG dominant power may not provide useful information[46,76] and only relative changes of the EGG dominant power would have clinical significance[44,46,76,77]. The most important factors known to affect the power of the EGG signal are[46]: thickness of the abdominal wall of the subject; skin preparation (skin electrode impedance); position of the electrodes (motion artifacts); distance between polar electrodes; characteristic of the recording equipment; the propagation velocity of the gastric slow wave (which varies from person to person); the method of spectral analysis and type of feeding. Among the factors known to interfere with the amplitude (or power) of the EGG signal, motion artifacts were the most evident in this study. Despite the fact that all infants were swaddled during the entire study period, slight movements of the arms and legs still occurred. Even the slightest movements were enough to disturb the power of the EGG signal. Besides motion artifacts, there were no significant differences in the relative change of the EGG dominant power among the three groups.

While motion artifacts had a definitive interference on the power of the EGG signal, the interference caused by the type of feeding was less evident. Despite a similar volume and nutritional composition of the milks ingested by the neonates, there were no consistent responses of the EGG power to enteral feedings. Interestingly, controversial findings in adults have also been reported regarding the effect of milk on the EGG power. Some investigators reported that whole milk and yogurt meals increase the power of the EGG signal[54,78], whereas others[79] have reported a decrease in the power of the EGG signal after ingestion of a test meal of milk with a fat content of 10%.

In conclusion, this study demonstrates that gastric myoelectrical activity can be successfully recorded in clinically stable premature and full term neonates by means of EGG. This study also demonstrates that the EGG patterns are similar between premature and full term neonates, pre-and postprandially, during their first two weeks of life. Furthermore, the volume and the type of feeding as well as the day of life that the EGG analysis were performed in this study did not seem to interfere with the gastric myoelectrical activity. However, as the objective of this study was not to analyse the influence of volume and composition of milk on the gastric myoelectrical actvity, further studies addressing these issues are necessary. Lastly, the results of this study indicate that the gastric myoelectrical activity in premature and full term neonates is immature, as compared to that described for older neonates, children and adults. The EGG findings that suggest an immaturity of the gastric myoelectrical activity in neonates are: low percentage of time in which the EGG dominant frequency is within the normal 2.4 to 3.7-cpm gastric myoelectrical activity range, lack of trend of the EGG power in response to enteral feedings, considerably unstable EGG dominant power during the pre and postprandial periods, and no significant differences between pre-and postprandial periods regarding to all EGG parameters analyzed in this study. The EGG patterns described in this study may provide a physiological basis to explain the immaturity of gastrointestinal motor function in neonates. The normative values described by this study may be relevant in the use of Electrogastrography as a clinical tool for assessing gastrointestinal motility disorders in neonates.

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RESUMO

PRECIOSO AR e col. - Atividade mioelétrica gástrica em recém-nascidos de diferentes idades gestacionais através da eletrogastrografia. **Rev. Hosp. Clín. Fac. Med. S. Paulo 58**(2):81-90, 2002.

OBJETIVO: Descrever os padrões da atividade mioelétrica gástrica, durante os períodos pré e pós-prandial, em recém-nascidos de diferentes idades gestacionais e clinicamente estáveis, durante as duas primeiras semanas de vida, através da Eletrogastrografia.

PACIENTES E MÉTODOS: A Eletrogastrografia foi realizada em 45 recém-nascidos, de diferentes idades gestacionais e clinicamente estáveis (grupo I: 15 recém-nascidos > 37 semanas, grupo II: 15 recém-nascidos de 32-37 semanas; Grupo III: 15 recém-nascidos de 28-31 semanas) que estavam recebendo dieta enteral de forma intermitente durante as duas primeiras semanas de vida. Registros eletrogastrográficos foram realizados por 1 hora antes e por 1 hora após terem sido alimentados. O sinal eletrogastrográfico foi obtido com o aparelho portátil “MicroDigitrapper Eletrogastrografia recording device” e após eliminação de artefatos relacionados a movimentação corporal, o traçado eletrogastrográfico remanescente foi submetido à analise quantitativa baseada no método “Running Spectrum Analysis”.

RESULTADOS: As porcentagens de normogastria, pré e pós-prandial, foram maiores que as porcentagens de arritmias gástricas nos três grupos estudados. Além disso, todos os recém-nascidos apresentaram freqüência dominante do sinal eletrogastrográfico dentro do intervalo correspondente a normogastria, em ambos os períodos analisados. Não houve diferença estatisticamente significante nas mudanças relativas da amplitude dominante do sinal eletrogastrográfico entre os três grupos estudados.

CONCLUSÃO: Este estudo demonstrou que recém-nascidos prematuros e de termo apresentam padrões eletrogastrográficos semelhantes durante os períodos pré e pós-prandial. Os resultados deste estudo também demonstraram que a atividade mioelétrica gástrica em recém-nascidos prematuros e de termo é imatura quando comparada com a descrita para lactentes, crianças e adultos.

DESCRITORES: **Eletrogastrografia. Atividade mioelétrica gástrica. Recém-nascidos. Diferentes idades gestacionais. Períodos pré e pós-prandial.**

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