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Feeding Intolerance and Gastric Acid Levels of the Neonates

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Abstract

Aim: The aim of this study is to investigate the relationship between feeding intolerance, a common problem at neonatal intensive care units, and gastric pH levels. The gastric fluid pH levels of the preterm and term infants with feeding intolerance has been measured and compared with those of a control group.

Material and Methods: A total of forty-one preterm and term infants were included in the study (17 females, 24 males). There were 12 newborns (six preterms and six terms) in the study (patient) group and 29 newborns (six preterms and twenty-three terms) in the control group. The gastric fluid of the infants with feeding intolerance was received by way of a feeding tube and acidity was measured by using a pH-meter. The gastric pH was measured three times a day in the both groups and thirty minutes prior to feeding in the control group.

Results: There was statistically no significant difference between pH1, pH2 and pH3 levels of the two groups ($p<0.05$). There were significant differences, however, between pH2 levels of the preterm and term infants in the patient group ($p=0.007$). Some other differences were also marked between pH1 and pH3 levels though they were of little importance as far as statictics are concerned ($p=0.08$ for pH1, $p=0.14$ for pH 3).

Conclusion: We concluded that gastric pH was sufficient for gastric digestion. The gastric pH levels of the preterm infants with feeding intolerance were found to be lower than gastric pH levels of the term infants with feeding intolerance.

Key Words: Newborn; Feeding Intolerance; Gastric Ph.

Yenidoğanlarda Beslenme İntoleransı ve Gastrik Asit Düzeyleri

Özet

Amaç: Çalışmamızın amacı, yenidoğan yoğun bakım ünitelerinde sık karşılaşılan bir sorun olan beslenme intoleransı ile mide sıvısı pH değerleri arasındaki ilişkinin araştırılmasıdır. Bu amaçla intolerans bulguları olan preterm/term bebeklerde, gastrik pH değerleri eş zamanlı ölçülerek kontrol grubu ile karşılaştırıldı.

Gereç ve Yöntemler: Çalışmaya preterm-term 41 yenidoğan (17 kız, 24 erkek) dahil edildi. Çalışma grubundaki (hasta) 12 yenidoğanın altısı preterm, altısı term ve kontrol grubundaki 29 yenidoğanın altısı preterm ve yirmi üçü term idi. Beslenme intoleransı olan bebeklerin mide pH değerleri, nazogastrik sonda ile alınan gastrik sıvının pH-metre ölçümü sonucu elde edildi. Beslenen bebeklerde, gastric pH değerleri beslenmeden 30 dakika önce; hasta grubunda ise intolerans nedeniyle beslenmesi kesilmek zorunda kalan yenidoğanlarda üç farklı günde (pH1, pH2, pH3) gastrik sıvı pH değeri ölçüldü.

Bulgular: Hasta ve kontrol grupları pH1, pH2, pH3 değerleri arasında istatistiksel açıdan anlamlı farklılık bulunmadı ($p<0.05$) Hasta grubundaki preterm ve term bebeklerin pH değerleri karşılaştırıldığında, pH2 değerleri arasında istatistiksel açıdan anlamlı farklılık bulundu ($p=0.007$). Ayrıca pH1 ve pH3 değerleri arasında istatistiksel olarak anlamlı bir farklılık bulunmamasına rağmen, önemli bir farklılık olduğu görüldü (pH1 için $p=0.08$, pH3 için $p=0.14$).

Sonuç: Elde ettiğimiz sonuçlara göre, gastrik pH değerleri sindirim için yeterlidir ve intoleransı açıklamamaktadır. Çalışmamızdan elde edilen önemli bir diğer sonuç da, intoleransı olan preterm bebeklerin gastrik pH değerleri, term bebeklere göre istatistiksel olarak anlamlı daha düşük bulunmasıdır.

Anahtar Kelimeler: Yenidoğan; Beslenme İntoleransı; Gastrik Ph.

INTRODUCTION

Nutritional requirement of the newborn is met by breast milk which is crafted only for the baby, useful in every aspect and easy to digest. Breast milk is the gold standard for the babies and it is tolerated very well. However, some term infants, and preterm infants in particular, may develop feeding intolerance. The smaller the week of birth, the risk of developing feeding intolerance increases. This is more common with formula fed infants. Feeding intolerance can manifest itself with nutrition reluctance, vomiting, abdominal distension, gastric residual, diarrhea, constipation and accompanying episodes of apnea and bradycardia. Anatomical development of the gastrointestinal tract is usually completed in the twentieth week of pregnancy though functional maturation is mostly expected to start after the twenty-sixth week; coordination of peristaltic movements, however, starts in the thirty-second week (1).

However, due to the thin layer of stomach muscles, the maturation is not complete even in newborn infants. Postnatal nutrition is the most important factor that accelerates maturation. In recent years especially, feeding intolerance associated with prematurity is becoming more common due to the increasing number of premature infants with low birth weights at neonatal intensive care units. Gastric residual is one of the first signs of necrotizing enterocolitis (NEC) and can threaten the lives of premature babies, should be carefully

monitored (2,3). The aim of our study is to investigate the relationship between feeding intolerance, which has become a common problem at neonatal intensive care units, and pH values of gastric fluid.

MATERIAL AND METHODS

The study was conducted on the newborns at the neonatal intensive care unit. A total of 41 neonates (17 female, 24 male) were included in the study. 12 newborns (7 female, 5 male) who have been monitored in service due to various reasons (jaundice, vomiting, prematurity, etc.) and diagnosed with feeding intolerance constituted the patient group while 29 newborns (10 female, 19 male), who were monitored at the service due to jaundice but did not have feeding intolerance, made up the control group. Before the study commenced, we obtained consent from patients' relatives and Hospital Ethics Committee approval (12/06/2013-305). In our study, the average age of was 8 days for the control group and 15 days for the patients.

Those with congenital diseases, diagnosed sepsis and necrotising enterocolitis; those on gastrointestinal irritation medication (corticosteroids, aminophylline, etc.), and those taking ventilator treatment have been excluded in the study. Six of the patients were preterm neonates (with 2 patients under 1000 g) while the other six were full term babies. Only six of the control group of were preterm neonates while the remaining twenty-three were term newborns. Feeding intolerance criteria has been accepted to observe at least one of the following: distention, vomiting more than half of the feeding amounts repeatedly, half of the feeding amount as the residual before the next feeding. The pH values of the stomach were obtained by measuring the gastric fluid, which has been optained with a nasogastric probe, with a pH-meter (pH Spears, Oakton® Eutech Instruments, Singapore).The device is based on electrometric measurements of the potential of a galvanic cell formed of two electrodes immersed into a solution. One of the electrodes is the reference electrode while the other is the indicator electrode. Immersed in the solution, indicator electrode shows a potential depending on the concentration of electroactive ions (H+). Gastric fluid pH was measured in three different times 30 minutes before feeding in feeding infants, and on three different days (PH1, PH2, PH3) for patient group newborns because of discontinued feeding due to feeding intolerance.

We made statistical analyses on demographic characteristics of the groups, pH values of each group, and evaluated the patient group as preterm and term. Statistical data were processed in IBM SPSS Statistics 20.0 (August 2011 version) by using the t-test for independent variables, and chi-square for dependent variables.

RESULTS

Studying the demographic characteristics of the patients, it has been observed that there are similarities in terms of birth weeks and gender, while the average postnatal age between the two groups was statistically different (p=0.001) (Table 1).

Between the study and control groups, we have not found statistically significant differences in terms of PH1, PH2, PH3 values (p<0.05) (Table 2). We have found, however, statistically impotant differences between preterm and term infants in the patient group concerning the pH values when their pH2 values were studied (p=0.007). Although there was no meaningful statistical difference between pH1 and pH3 values (p= 0.08 for pH1, pH 3, p= 0.14), we have observed higher pH values in term infants (Table 3).

Table 1. Demographic charachteristics of the patients

		Patient n=12)	Control n=29	p
Age, mean (days)		15±4	8±6	0.01
Preterm, n		6	6	
Term, n		6	23	0.12
Gender, n	**Girl**	7	10	0.18
	Boy	5	19	

p < 0,05

Table 2. Comparing the pH values of the two groups

	Patient	Control	p
pH 1, mean	4.14±1.08	4.47±0.99	0.33
pH 2, mean	4.25±0.93	4.43±0.81	0.50
pH 3, mean	4.61±1.17	4.45±1.02	0.64

p < 0,05

Table 3. Comparing the pH values of preterm ve term babies in the study group

	Preterm	Term	p
pH 1, mean	3.57±1.32	4.69±0.585	0.08
pH 2, mean	3.60±0.83	4.96±0.51	0.007
pH 3, mean	4.03±1.08	5.06±1.16	0.14

p < 0,05

DISCUSSION

Feeding intolerance is common in the neonatal period, and there are different approaches and several, still ongoing drug treatments to solve this problem. It has been observed that physical approaches such as pacifier use, positioning of the baby, feeding the baby in small but frequent portions or with continuous infusion, reduction of formula osmolality, hydrolysed proteins, probiotics and prebiotics have yielded positive results (4-7). Meanwhile the debates and researches are still in progress concerning approaches like cisapride, domperidone, oral erythromycin, lactase-treated formulas, amylin peptide, enteral insulin (8-13).

Gastric digestion capacity is mainly affected by gastric acid. Gastric acid secretion, in turn, is controlled by gastrin release. It was Rogers et al who discovered that gastrin levels in the cord blood is very high when compared to maternal serum for the first time, and, in time, subsequent studies also found similar results (14-16). This increase in the gastrin level in the cord blood

continues up to four months and is independent of nutrition (15). Gastrin is metabolized in liver and kidney and this metabolism is thought to be insufficient in newborns (17,18). Within the first four hours after birth, gastric pH levels, influenced by amniotic fluids and secretions, is around 5-6 though they reach to pH 2-3 with a quick decrease within a week. Infants younger than three months have lower gastric pH levels in contrast to those who are older (19).

Gastric pH decreases in preterm infants after the first week (20). Preterm basal gastric acid secretion, however, increases progressively up to a month. Thus, preterm gastric acid secretion provides pH=4 level and less allowing bacteria formation (21). Gastric pH is lower than in the term than preterm infants (22). In our study, there was a statistically significant difference concerning the ages of the patient and the control groups, though the average age was above a week in both groups. It has been assumed that such a difference would not effect the result of the study because it is known that the lowest gastric pH levels is reached after a week in neonates.

Normal gastric acidity can be effected by various factors such as food in digestion process, mouth and stomach secretions, and duodenal contents getting mixed up with the stomach fluid. The average gastric pH level for proteolytic activity of should be between 2-3. It is known that proteolytic activity slows down when the pH level is above four. Lingual lipase shows the best activity when it is between pH 3.5 and pH 6. It has been observed that gastric pH levels fell down to four and below within the 24%-42% of the gastric acid monitoring time in fed term infants. In such studies, pH value has been reported as minimum 2 (prior to feeding) and maximum 8 (post-feeding) (23,24). We have not encountered a substantial gastric pH level difference between the two groups in pre-feeding periods. The average gastric pH levels was 4. According to our results the mean gastric pH 4 is sufficient for digestion and does not disclose intolerance.

Another result observed in our study was that the mean gastric pH values in the preterm patient group were significantly lower than those of term infants. As noted in the studies, gastric acid secretion was not insufficient in preterm babies. Preterm babies, too, can reach necessary and sufficient levels for proteolytic activity over time. One of the key points of our study was the complicated gastric intolerance in preterm babies as it has been expected. This can be explained by hemorrhagic gastric residue which was also seen in our patient group. To prevent stress induced gastric bleeding especially in preterm babies, H2 receptor antagonist has widely been used and often proved beneficial (25). By this method, the aim is to maintain gastric pH level above four (26). In asymptomatic preterms, nine of the 17 preterm infants were identified with hemorrhagic gastritis through endoscopic diagnoses and the issue has been successfully come over through ranitidine treatment (27).

The downside of our study was the fact that the average age of patients with feeding intolerance was more than that of the control group and that the patient group included less cases compared to the control group. Therefore, it is safe to state that there is need for more studies with more cases involved.

Consequently, it can be concluded that gastric digestive capacity is not only dependent on the gastric pH though factors like gastric emptying time, the amount and the acid level of saliva, gastric mucous secretion and duodenal-gastric reflux have an effect on gastric digestive capacity.

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