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Original Article

Comparison of the efficiencies of esophageal manometry, vector volume analysis and esophagus pH monitoring in the diagnosis of gastroesophageal reflux

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Abstract

Aim: In this study, we aimed to compare the superiorities of esophageal manometry, vector volume analysis and 24-hour pH meter studies in showing gastroesophageal reflux disease.

Material and Methods: The files of the patients who presented to pediatric surgery and pediatric gastroenterology outpatient clinics of our hospital with suspicious gastroesophageal reflux disease between 2011 and 2012 and who were investigated were examined and 21 patients whose investigations had been completed were included in the study. The patients were evaluated by treatment method and were divided into three groups as Group 1 who were followed up with medical treatment, Group 2 in whom surgical intervention was performed and Group 3 who were not treated. Chi-square test was used in evaluation of the categorical variables, Kruskal Wallis test was used in comparison of the mean values between the groups and Dunn test was used in subgroup analyses when Kruskal Wallis test was found to be significant. A p value of <0.05 was considered statistically significant.

Results: Thirteen of 21 patients included in the study were female and eight were male. The mean age of the patients was 5.71 years (one-16 years). In the 24-hour pH monitoring study, the mean reflux index was found to be 48.7% in Group 1, 42.4% in Group 2 and 28.3% in Group 3. In esophageal manometry studies, the pressure difference at lower esophageal sphincter (LES) was found to be 13,4 cm H_2O in Group 1, 31.8 cm H_2O in Group 2 and 4.3 cmH_2O in Group 3. In vector volume analyses, the mean vector volume was calculated to be 96.01 cm^3 in Group 1, 2 398.9 cm^3 in Group 2 and 196.3 cm^3 in Group 3. In the 24-hour pH monitoring study, a statistically significant difference ($p<0.05$) was found in terms of showing reflux, whereas statistical significance could not be shown in terms of need for surgical treatment or need for medical treatment in any other method ($p>0.05$).

Conclusions: Twenty-four-hour pH monitoring was found to be efficient in making a diagnosis of gastroesophageal reflux disease, whereas esophageal manometry and vector volume analyses were not found to be efficient. (Turk Pediatri Ars 2015; 50: 226-33)

Keywords: Lower esophageal sphincter vector volume analysis, gastroesophageal reflux, esophageal manometry, 24 hour pH monitoring

Introduction

Gastroesophageal reflux (GER) is one of the common problems in the childhood (1-3). In clinical practice, the most common methods used in making the diagnosis of GER are radiological and scintigraphic examinations (1). Twenty four hour pH montioring remains as one of the most reliable methods in making the diagnosis (4-9). Esophagus motility studies which have been applied since the second half of the 20th century were used primarily in adult patients and secondarily in pediatric patients, because they could be performed in a short time and identify the disease without leading to damage at the tissue level (10-15).

In patients who are being followed up because of gastroesophageal reflux disease, motility problems are directly related with the severity of the disease. Accompanying motility problems are observed with a rate of 25% in milder cases, while this rate increases up to 50% in cases of more severe GER (16, 17). It is controversial if this is a cause or outcome of the disease (18). In this study, it was aimed to demonstrate the efficiencies of 24-hour pH monitoring, esophagus manometer and lower esophageal sphincter vector volume analysis in making the diagnosis and in specifying the treatment option in pediatric patients with suspicious GER and the superiorities of these methods to each other, if present.

Material and Methods

Twenty four hour esophageal pH monitoring, esophageal manometer and lower esophageal sphincter vector volume analysis were performed in the patients who were referred to our clinic with a diagnosis or suspicion of GER

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between the years of 2011 and 2012. The files of 21 of these patients who were eligible for the study were examined. Ethics committee approval (04.10.2011/ B-14) was obtained from the Clinical Research Ethics Committee of our institution.

Twenty four hour pH monitoring included a mechanism which contained a catheter with two probes five cm distant from each other (Greenfield™-disposable catheter), two calibration fluids one acid (Reagecon© buffer solution pH 4.00±0.05) and one base (Reagecon© buffer solution pH 7.01±0.05), one recording device (MMS Orion II) and a computer containing a software (MMS) to analyse and assess data (Figure 1). Any drug which could affect the motility of the esophagus and stomach was discontinued five days before the procedure. The procedure was initiated after a fasting period of at least six hours to decrease the risk of vomiting and related aspiration. No invasive or surgical operation including endoscopy was performed for at least two weeks before the procedure.

The sociodemographic characteristics and clinical data were entered into the system before the procedure. Afterwards, calibration of the device was performed in water, acidic solution and basic solution. After the catheter was cleaned, it was proceeded through one of the nostrils up to the stomach while the patient was lying. After it was ensured that both probes were in the stomach by way of pH values stated on the device or after the catheter was proceeded at the appropriate length in the patients who were previously undergone manometer analysis as the distance between the lower esophageal sphincter (LES) and nostrils was known, the catheter's location was checked with plain graphy. When the probe at the lower end was located at the level of LES and the upper probe was located five cm above, the procedure was initiated. The patient's complaints were specified in the recording device in accordance with age and clinical complaints and the parent was given detailed information about the buttons to be used in different complaint conditions. The patient was allowed to continue daily life without using medications which could affect the esophageal motility. When it was thougth that the parents compliance would not be well, the test was performed after the patient was hospitalized. Three buttons which can be adjusted according to the complaints are found adjacent to the lying/sitting and feeding buttons on the recording device. The complaints of the patient appropriate for age were recorded in these buttons which could be adjusted by complaints. The time of onset of the test was recorded and the procedure was terminated after 24 hours. The information recorded were transferred to a computer and analyses were performed with a special software (MMS). All pH values obtained during the test, the clinical complaints of the patient and their relationship between each other could be reobserved by way of this software. Thus, it could be checked if a reduction in pH value accompanied when the patient had complaints, to what extent pH values were reduced, how long this reduction lasted and if reflux reached the upper level. DeMeester score and reflux symptom index were established by evaluating all these data. A DeMeester score above 17.96 was considered presence of reflux. The reflux symptom index was obtained by dividing the number of conditions where pH was reduced below four and the patient had complaints to the number of all complaints of the patient. When this value was above 50%, it was considered clinically significant.

Esophageal manometer analysis involves one catheter, one pneumohydrophilic capillary infusion system, water continuously flowing through this system, a device which provides conduction of pressure, a computer which records these values and a software which would evaluate these (Aymed Medikal Teknoloji San. Tic. Ltd. Şti.) (Figure 2).

There are eight thin catheters in the esophageal manometric catheter. Four of these catheters are found at a 90^0 angle to each other, while the other four are alined spirally in the upper part with a distance of five cm from each other. All medications which could affect the motility of the esophagus and stomach were discontinued five days before the procedure and the procedure was performed after a fasting period of at least six hours. The device was calibrated after the sociodemographic characteristics of the patient were recorded in the system. During calibration, each catheter was leached so that no air was left inside, because it would affect conduction of pressure. Subsequently, the catheter was placed when the patient was lying. After it was ensured that all probes were in the stomach, the patient was brought into a sitting position and waited to calm down, because initiation of the procedure without adequate quiescence would cause the patient to cry and swallow unnecessarily and thus the test would be misevaluated. Basal gastric pressure was measured when all probes were in the stomach and marked on computer. The catheter was withdrawn with a constant speed and the probes were made to pass from the stomach into the esophagus in order. Primarily, the area which was named high-pressure region was entered and the respiratory inversion point (RIP) was specified and this area was marked on the computer screen. After the location of the lower esophageal sphincter was specified, the patient was asked to swallow and then to drink five cc and 10 cc water, respectively. Thus, the relaxation pressure in the lower esophageal sphincter was measured. Care was taken to maintain a 30-second interval between each swallowing.



Figure 1. 24-hour pH monitoring recording device and calibration fluids



Figure 2. Esophageal manometer device and catheter

The catheter's location was kept constant and each swallowing was repeated more than once in order to obtain healthier data. During these procedures, the LES and the residual pressures during and after swallowing were recorded on computer. In light of all these data, the mean gastric basal pressure, the LES pressure at rest, the mean relaxation pressure in the LES during swallowing and the mean residual pressure in the LES after swallowing were calculated. A mean relaxation pressure in the LES higher than 15 mmHg during swallowing is considered significant in terms of indicating gastroesophageal reflux in adult patients (19).

The system used in manometer studies was utilized for esophageal vector volume analysis. The vectors of the esophageal areas where pressure measurements were performed were obtained with the assistance of the information obtained by way of the catheters. All medications which could affect the motility of the esophagus and stomach were discontinued five days before the procedure and the procedure was performed after a fasting period of at least six hours. The device was calibrated after the sociodemographic characteristics of the patient were recorded in the system. During calibration, each catheter was leached so that no air was left inside, because it would affect conduction of pressure. Subsequently, the catheter was placed when the patient was lying. After it was ensured that all probes were in the stomach, the patient was brought into a sitting position and waited to become tranquilized. The procedure was not initiated before quiescence occured considering patient compliance as in manometer applications. After the location of the LES was specified, four probes found at the very end of the catheter were withdrawn up to the LES and pressure measurements were made. While the probes were withdrawn at a constant speed along the LES, the measurements were obtained and than transformed to vector variables with the assistance of computer. The volume of the area formed was calculated using the following formula: $Area=\sin 360/nx[P_1P_2+P_3P_4...P_LP_n]$ and the vector volume value was obtained (n=number of channels, p=pressure value measured in each channel). This value is expected to be higher in healthy subjects compared to subjects with reflux. The radial asymmetry value is calculated from the same measurements with the assistance of computer. The radial asymmetry value is expected to be lower in healthy subjects compared to subjects with reflux (19).

Three patient groups were established as medical treatment (Group 1, n=7), surgical treatment (Group 2, n=7) and no treatment (Group 3, n=7) groups according to clinical complaints and the results of upper gastrointestinal system contrast imaging and pH meter studies. Nisses funduplication was performed with open technique in all subjects in Group 2. The patients whose clinical complaints did not regress despite medical treatment and who were referred to surgical treatment were not included in the classification.

Statistical Package for the Social Sciences 21 for Windows (SPSS, IBM, USA) program was used for statistical analyses. Chi-square tes was used for assessment of categorical varaibles and Kruskal Wallis test was used for comparison of the mean values between the groups. Dunn test was used in subgroup analyses when this test was found to be significant. A p value below 0.05 was considered significant in statistical analyses.

Results

Eight of 21 patients included in the study were male and 13 were female. The mean age of the patients was 5.71 (1-16 years, median four years) years. The mean age was 5.28 (1-16 years, median five years) in Group 1; 4.42 (1-16 years, median four years) in Group 2 and 7.42 (1-16 years, median 10 years) in Group 3. When the patients in all three groups were compared in terms of age and gender, no statistically significant difference was found (p>0.05). The

Tablo 1. Demographic characteristics and symptoms of the patients

Age (Years)	Gender	Complaint	Comorbidity	24 hour pH monitoring			Esophageal manometer			LESVVA					
				Reflux Index	Demeester	Prolonged reflux number	Gastric Basal	LES pressure	LES Relaxation Pressure	Radial Asymmetry					Vector Volume
1	F	Dysphagia	Esophageal atresia	33.3	46.61	3	29	35.9	30.7	132	97	84	159	97	26.6
5	M	Vomiting	ALL/esophagitis	21.9	2.61	0	37.8	73.3	46.6	97	77	549	0	0	58.2
8	F	Vomiting	LRTI	76.5	137.73	16	20.75	23.9	26.35	171	138	142	128	119	82.3
16	M	Dysphagia	Esophageal web	50	170.48	16	20.05	23.1	18.43	183	159	0	0	171	16.9
5	F	Bitter water in the mouth		50	215.61	21	38.9	36.5	34.5	82	135	73	27	133	46.4
1	M	Vomiting/ LRTI	Esophageal atresia	54.9	27.03	4	91.3	63.6	47	90	134	90	95	98	147.7
1	F	Vomiting/ LRTI	Esophageal atresia	54.3	25.46	0	63	63.3	22.1	69	50	32	78	60	293.7
1	M	Vomiting	Esophageal atresia	50	238.85	28	48.35	41.7	35.1	130	100	106	0	122	622.6
16	F	Vomiting / dysphagia	MMR	66.7	176.75	18	8	7.35	1.4	105	86	88	156	78	617.8
1	F	Dysphagia		15	221.27	12	166.3	183	82.3	248	195	0	54	58	14453
4	M	Dysphagia	Esophageal atresia	20	1.23	0	96.5	187	128.5	198	208	183	26	27	485.4
4	F	Dysphagia	Hiatal hernia	15	2.95	0	52.2	38.5	29.8	62	57	55	133	156	325.9
4	M	Dysphagia /LRTI	Esophageal atresia	80	213.5	67	51.6	34.4	20.6	162	117	83	54	121	60.88
1	F	Vomiting	Esophageal atresia	50	239.49	37	59.1	64.4	35.9	55	120	119	92	93	234.6
10	M	Growth retardation		23	11.21	1	12.4	13.2	15.7	128	61	128	81	52	22.8
11	F	Cough / hematemesis	Gastritis	33	2.36	0	88.7	56.3	43.8	67	57	58	302	77	97.6
16	F	Dysphagia		33	23.99	3	3.3	1.8	1.42	311	25	51	60	81	1.1
12	F	LRTI	Pneumonia	33	21.96	2	14.3	16.4	12.1	118	63	125	78	50	21.5
1	F	Dysphagia	Esophageal atresia	27.8	5.63	0	89.2	55.4	42.7	64	60	55	295	75	96.7
1	M	Vomiting/LRTI	TEF?	0	0.2	0	4.2	2.1	1.5	320	30	45	45	78	1.23
1	F	Stridor		48.5	57.15	4	13.6	12.1	10.1	134	46	115	20	76	24.5

ALL: acute lypmhoblastic leukemia; LES: lower esophageal sphincter; LESVVA: lower esophageal sphincter vector volume analysis; LRTI: lower respiratory tract infection; MMR: mental motor retardation; TEF: tracheoesophageal fistula

patients frequently presented with a complaint of vomiting (n=8, 26%) and dysphagia (n=9, 29%). The other complaints at presentation included bitter water in the mouth, mental motor retardation, abdominal pain, recurrent lower respiratory infections, cough, pain behind the sternum, recurrent aspiration attacks and hematemesis. The demographic characteristics and symptoms of the patients are summarized in Table 1.

In Group 1, the mean reflux symptom index was found to be 48.7% on 24-hour pH monitoring, whereas the De-Meester score was above 17.96 in all patients excluding the patient who had esophagitis secondary to acute lymphoblastic leukemia. The number of reflux longer than five minutes ranged between zero and 21. In Group 1, the mean gastric basal pressure of the patients was found to be 42.9 cm/H_2O, the mean LES pressure was found to be

45.6 cm/H_2O, the mean LES relaxation pressure was found to be 32.2 cm/H_2O and the mean pressure difference in the LES during swallowing was found to be 13.4 cm/H_2O on manometric analysis. In two patients in this group, the resting pressure of the LES was lower than the basal gastric pressure. In four patients the LES relaxation pressure was lower than the basal gastric pressure. The pressure difference in the LES was 26.7 cm/H_2O in one patient. In vector volume analysis of the lower esophageal syphincter, the mean radial asymmetry value was found to be 104.5 and the vector volume value was found to be 96.01 cm^3.

In Group 2, the mean reflux symptom index was found to be 42.4% on 24-hour pH monitoring, whereas the DeMeester score was above 17.96 in six patients. The number of reflux longer than five minutes ranged between zero and 67. On manometeric analysis performed in these patients, the mean gastric basal pressure was found to be 68.8 cm/H_2O, the mean LES pressure was found to be 79.4 cm/H_2O, the mean LES relaxation pressure was found to be 47.6 cm/H_2O and the mean pressure difference in the LES during swallowing was found to be 31.8 cm/H_2O. In four patients in this group, the LES pressure at rest was lower than the gastric basal pressure. In six patients, the LES relaxation pressure was lower than the gastric basal pressure. In only one patient whose lower esophageal syphincter relaxation pressure was higher than the gastric basal pressure, the pressure difference in the LES during swallowing was found to be 58 cm/H_2O. In vector volume analysis of the lower esophageal syphincter, the mean radial asymmetry value was found to be 104.2 and the vector volume value was found to be 2398.9 cm^3.

In Group 3, the mean reflux symptom index was found to be 28.3% on 24-hour pH monitoring, whereas the DeMeester score was found to be 17.5. The number of reflux longer than five minutes ranged between zero and three. The DeMeester score was above 17.96 in three patients and the reflux symptom index was below 50% in all patients. On manometeric analysis performed in these patients, the mean gastric basal pressure was found to be 32.2 cm/H_2O, the LES pressure was found to be 22.4 cm/H_2O, the LES relaxation pressure was found to be 18.1 cm/H_2O and the pressure difference in the LES during swallowing was found to be 4.3 cm/H_2O. In five patients in this group, the LES pressure at rest was lower than the gastric basal pressure. In six patients, the LES relaxation pressure was lower than the gastric basal pressure. In the patients in this group, the pressure difference in the LES was 12.7 cm/H_2O. In vector volume analysis of the lower esophageal syphincter, the mean radial asymmetry value was found to be 89.1 and the vector volume value was found to be 196.4 cm^3.

Table 2. Distribution of the patients who had undergone operation before the procedure by groups

	Operation		Total
	Yes	No	
Group 1	4	3	7
Group 2	5	2	7
Group 3	1	6	7
Total	10	11	21

The distribution of the patients who underwent operation in the esophagus before the procedure by groups is shown in Table 2. The patients were operated because of esophageal atresia. No complication was found in any patient in the post-operative period.

When the three groups were compared according to the results of 24-hour pH monitoring, no statistically significant difference was found between Group 1 and 2 in terms of the reflux symptom index, DeMeester score and prolonged reflux rates ($p>0.05$), whereas a statistically significant difference was found between Group 1 and 3 and between group 2 and 3 ($p<0.01$). Reflux could not be demonstrated in two patients in Group 1 and in three patients in Group 2 according to the reflux symptom index score. Considering DeMeester scoring, reflux could not be demonstrated in one patient in Group 1 and in two patients in Group 2. When we evaluated the numbers of prolonged reflux, reflux could not be demonstrated in four patients in Group 1 and in two patients in Group 2. Reflux was not found in any patient in Group 3. Accordingly, 24-hour pH monitoring had a positive predictive value of 78% and a negative predictive value of 100% in our study.

When we compared esophageal manometer analyses, most prominent difference between the gastric basal pressure and the pressure in the LES was found in Group 2 and least prominent difference was found in Group 3. The most prominent difference between the LES pressure and LES relaxation pressure was found in Group 2. When Group 2 and Group 3 were compared, a statistically significant difference was found ($p<0.01$) (Table 3). Manometer analyses had a positive predictive value of 74% and a negative predictive value of 57%.

When the groups were compared by radial asymmetry and vector volume values, the highest radial asymmetry and vector volume values were found in Group 2 (Table 4). While a statistically significant difference was found between the vector volume values of the patients in Group 2 and 3 ($p<0.05$), no statistically significant difference was found between Group 1 and 2 and between Group 1 and 3 ($p>0.05$). When the groups were compared in terms of

Table 3. Distribution of the mean esophageal manometer pressure values by groups

		Gastric basal pressure	LES pressure	LES relaxation pressure	Difference between LES pressure and LES relaxation pressure
Group 1	Mean	42.9714	45.6571	32.2400	13.4171
	Standard deviation	25.80213	20.65025	11.25296	15.73003
Group 2	Mean	68.8571	79.4214	47.6571	31.7643
	Standard deviation	50.07345	73.89655	43.24792	35.51655
Group 3	Mean	32.2429	22.4714	18.1886	4.2829
	Standard deviation	38.98473	23.45689	17.91246	6.03302

LES: lower esophageal sphincter

Table 4. Distribution of the vector volume analaysis results by groups

		Radial asymmetry	Vector volume
Group 1	Mean	104.5428571	96.01200143
	Standard deviation	30.88488612	97.39813177
Group 2	Mean	104.2	2398.933624
	Standard deviation	12.96508131	5315.900172
Group 3	Mean	89.14285714	196.4749371
	Standard deviation	14.15801977	404.9291573

radial asymmetry values, no statistically significant difference was found (p>0.05). In our study, the vector volume analyses had a positive predictive value of 64% and a negative predictive value of 28%.

Discussion

The fact that 24-hour pH monitoring used for the diagnosis of gastroesophageal reflux disease lasts for 24 hours enables evaluation of the compatibility of daily activities with complaints and findings. Twenty four hour espohageal pH monitoring has a considerably high sensitivity (87-93%) and specificity (93%) (9). It is one of the most efficient methods in showing presence of reflux. However, it is not directive in terms of need for drug treatment or surgical treatment at the therapeutic stage (5, 6). In our study, no statistically significant difference was found between Group 1 and Group 2 in terms of identification of reflux by 24-hour pH monitoring (p>0.05). Both reflux symptom index and DeMester score and the number of prolonged reflux were not directive alone for selection of surgical treatment. Although there was an impression that a difference was present when the subjects were considered specifically, no statistically significant difference could be shown, when all subjects were analysed collectively. When Group 1 and Group 2 were compared with Group 3, a statistically significant difference was found in terms of identification of reflux by 24-hour pH monitoring (p<0.01). These findings are compatible with the literature (9).

There are many studies investigating the role of the LES pressure on the efficiency of the sphincter (19). Until the present time, the LES pressure has been found to be lower in individuals with reflux compared to the ones without reflux especially in the studies conducted with adults (20-22). In the study of Liebermann et al. (19), it was reported that the newborns who benefited from medical treatment had a higher LES pressure compared to the ones who needed surgical treatment (19).

In our study, the lowest LES pressure was found in group 3 and the highest LES pressure was found in Group 2 in manometric analyses. No statistically significant difference could be found (p>0.05). It was thought that the most important factor for this outcome was the fact that the mean age was higher in Group 3 compared to the mean age in Group 1 and 2. It was thought that difficulty of the smaller age group with the test and increase in the pressures along the whole esophagus especially with crying led to these results. Five cc and 10 cc water was given to all patients during the procedure. While all patients ingested the same amount of water, it was thought that the pressure values could be different in different age groups because of different esophageal dimensions. The differences between the LES pressure and the relaxation pressure of the LES were also taken into account in order to minimize the patient-dependent factors. Accordingly, the difference was 13.4 cmH_2O in Group 1, 31.7 cm H_2O in Group 2 and 4.2 cm H_2O in Group 3. No statistically significant difference was found (p>0.05). Studies with larger groups evaluating age groups seperately are needed to generalize these results and to decide between medical treatment and surgical treatment with esophageal manometer. Thus, a range can be established for each age group.

Lower esophageal sphincter vector volume analysis arised from the idea that the length and pressure of LES were not sufficient alone to define sphincter efficiency. In the literature, it has been reported that the vector volume value is lower in patients who are found to have reflux compared to the ones who are not found to have reflux and a symmetrical appearance can not be achieved on the three dimensional image obtained (20-25). In our study, the opposite was found in studies performed between groups. It was obsevred that the vector volume value was higher in the patients in Group 2 compared to the other two groups and the lowest radial asymmetry value was observed in Group 3. No statistically significant difference was found

between the groups (p>0.05). It was thought that poor compliance of the patients in the small-age group was a factor for this. When the patients in Group 1 and Group 3 were compared in terms of vector volume values, higher values were found in Group 3 in accordance with the literature. When the patients in Group 2 were compared with the patients in Group 1 and group 3, the highest vector volume value was observed in Group 2. No statistically significant difference was found (p>0.05). These results which were incompatible with the literature were thought to have arisen from the small age group and inability to enable patient compliance sufficently. When the groups were compared in terms of radial asymmetry values, the lowest values were found in Group 3 compatible with the literature. No statistically significant difference was found (p>0.05). When Group 1 (104.5%) and Group 2 (104.2%) were compared with each other, no statistically significant difference was found (p>0.05). Lower esophageal sphincter vector volume analysis was not shown to be efficient in demonstrating the presence of reflux and in directing its treatment.

It has been reported that lower esophageal sphincter vector volume analysis is superior to upper gastrointestinal system contrast imaging, 24-hour pH monitoring and conventional manometric methods in showing an insufficient sphincter (23, 24, 26). However, its utility in children is controversial when evaluated in terms of clinical use. Lack of a value range belonging to each age group and factors affecting intrathoracic pressure including crying and shouting may lead to problems in the stage of evaluation. Compliance problems in small age groups are one of the factors which render evaluation of the test difficult. Patients do not calm down for a long time and get irritated again every time the catheter is withdrawn. These prolong the test time and complicate obtaining the proper data.

Generally, the fact that the patients included in this study did not show a homogeneous distribution in terms of age and comorbidity both in the same group and in different groups was a significant factor in obtaining insignificant results in statistical analyses. We think that increasing the patient number in each group and enabling a homogeneous distribution in terms of age and comorbidity will make contribution to statistical assessment.

In conclusion, one of the methods with the highest diagnostic value in GER in the childhood is 24-hour pH monitoring. However, 24-hour pH monitoring can not differentiate between the necessity of medical treatment and the necessity of surgical treatment. The applicability of esophageal motility studies is difficult in the childhood because of compliance problems. In addition, increase in compliance problems as the age of the child decreases complicates evaluation of the results. In lower esophageal sphincter manometer studies, the relation of the LES resting and relaxation pressures with the gastric basal pressure and the difference between the resting and relaxation pressures give significant results in the diagnosis of reflux. However, lower esophageal sphincter manometer studies are not directive in identifying the necessity of medical treatment or surgical treatment. Lower esophageal sphincter vector volume analysis has not been shown to be efficient in showing reflux in the childhood and in the differentiation of the necessity of medical treatment and the necessity of surgical treatment.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Istanbul University (04.10.2011/B-14).

Informed Consent: Written informed consent was obtained from patients who participated in this study.
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