

ORIGINAL ARTICLE

FINDING AN ASSOCIATION BETWEEN GASTROESOPHAGEAL REFLUX AND DELAYED GASTRIC EMPTYING USING SCINTIGRAPHIC METHOD

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Background – Scintigraphy remains the gold standard to study gastric emptying. We used this method to demonstrate the impact of delayed gastric emptying on gastroesophageal reflux disease (GERD), one of the most common gastrointestinal disorders.

Methods – Scintigraphy was performed for 16 patients with documented GERD and 16 asymptomatic normal volunteers. The test meal was composed of two labeled fried eggs with two slices of bread, and 150 mL of nonlabeled water. Images were obtained in anterior and posterior projections in 30-minute intervals for a total period of two hours. Gastric emptying curves, the estimated time required for the stomach to empty one-half of its original meal ($T_{1/2}$), and gastric retention activity at 120 minute (RA_{120}) were used for gastric emptying evaluation.

Results – Seven (44%) of patients had deviation in their gastric emptying curves compared to normal limits. The mean \pm SD of $T_{1/2}$ and RA_{120} of the patient group were 95.74 ± 54.00 minutes and 33.03 ± 15.92 percent, respectively; the corresponding figures for the asymptomatic control group were 64.94 ± 14.48 minutes, and 20.31 ± 8.41 percent. There was a significant difference between the means of the two groups ($p < 0.05$ for $T_{1/2}$ and $p < 0.01$ for RA_{120}) using Student *t*-test. Five (31.25%) patients demonstrated an abnormal $T_{1/2}$ and the same number revealed an abnormal RA_{120} . Relying upon at least one of these factors, 9 (56.25%) of the patients had evidence of delayed gastric emptying compared to the asymptomatic individuals.

Conclusion – We concluded that delayed gastric emptying could be considered as a predisposing factor of GERD. Therefore, we recommend gastric emptying study in all patients suffering from this disease.

Archives of Iranian Medicine, Volume 6, Number 3, 2003: 180 – 183.

Keywords • gastric emptying • gastric scintigraphy • gastroesophageal reflux disease (GERD)

Introduction

Gastroesophageal reflux disease (GERD) is one of the most common gastroesophageal disorders. High incidence, high therapeutic costs, and recurrent rates after medical or even surgical treatment emphasize the importance of this disease.^{1,2} The

mechanisms responsible for development of GERD have not been clearly explained; mechanisms such as decreased lower esophageal sphincter (LES) pressure, prolonged esophageal clearance of refluxed acid, inappropriate relaxation of LES, increased abdominal pressure, and delayed gastric emptying have been suggested³ while the role of delayed gastric emptying as a physiopathologic factor of GERD still remains controversial.^{4,5}

In the present study, we tried to investigate the association between GERD and delayed gastric

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emptying to demonstrate its possible role as a physiopathologic factor in GERD.

Patients and Methods

The study group comprised 16 patients (6 males and 10 females; mean \pm SD of age = 42.3 ± 13.1 years) with GERD, documented by upper GI endoscopy or ambulatory esophageal pH measurement, and referred to Taleghani Medical Center, along with 16 weight- and height-matched normal asymptomatic volunteers (equal number of males and females; mean \pm SD of age = 32.6 ± 10.4 years). None of the 32 cases had a clinical history of the predisposing factors related to delayed gastric emptying. We explained the procedure to the cases, and all of them signed a consent form. The patients were requested to discontinue their medications for at least 5 days. All the cases were studied in the morning to reduce the diurnal effect on gastric emptying, and after overnight fasting within at most 7 days of GERD documentation. The meal, which was composed of 2 labeled fried eggs and two slices of bread, was eaten as an egg sandwich with 150 mL of nonlabeled water in a period of 10 minutes. Both eggs were labeled with 0.5 – 1.0 mCi of ^{99m}Tc -phytate before cooking.⁶⁻⁸ The acquisition started immediately after meal ingestion, in standing position, in anterior and posterior projections which then sequentially continued in 30-minute intervals for 120 minutes. The patients were requested to sit, and not to eat anything during the acquisition intervals. The acquisitions were performed by ADAC (Pegasys, ADAC Laboratory, USA) single head gamma camera in outer room position, and with low energy general all purpose (LEGP) collimator. Each image was set for a fixed time of 60 seconds in $128 \times 128 \times 16$ matrix size.

All images were processed by Belgian workgroup software to calculate gastric emptying half time ($T_{1/2}$), and plot gastric emptying smoothed curve by geometric mean calculation.⁹

Considering the absence of a similar study in Iranians to provide normal limits, normal gastric emptying curve ranges were calculated from normal control group cases. For this purpose, interval method was utilized. First of all, the minimum and maximum values were calculated for each measured point of normal group cases, and then two curves, representing the upper and lower normal ranges of gastric emptying curves, were

plotted according to the maximum and minimum points values data. By this method, all normal data were fitted within the area surrounded by these two curves (Figure 1). Then, each patient's gastric emptying curve was compared to normal ranges by visual interpretation. The results were analyzed by Chi-square test.

Results

Amongst the 16 patients with gastroesophageal reflux manifestations, GERD was documented in 10 patients by upper GI endoscopy and in 6 by ambulatory esophageal pH measurement. Based on the endoscopic findings, two had reflux esophagitis of grade A, 7 of grade B, and one of grade C. For those patients who undertook ambulatory esophageal pH measurement, a DeMeester score of greater than 14.4, was considered as a positive test. The results of gastric emptying studies were also analyzed by Chi-square test and demonstrated significant difference in the shape of gastric emptying curves between the normal controls and patients ($p < 0.05$).

Figure 2 demonstrates the mean gastric emptying curves of the two groups. $T_{1/2}$ (the estimated time required for the stomach to empty one-half of its original meal) and RA_{120} (gastric retention activity at 120 min) were 95.74 ± 54.00 min, and 33.03 ± 15.92 percent for the patients and 64.94 ± 14.48 min, and 20.31 ± 8.41 percent for the controls, respectively. A significant difference was noted in $T_{1/2}$ ($p < 0.05$), and RA_{120} ($p < 0.01$) between the patients and controls using Student *t*-test.

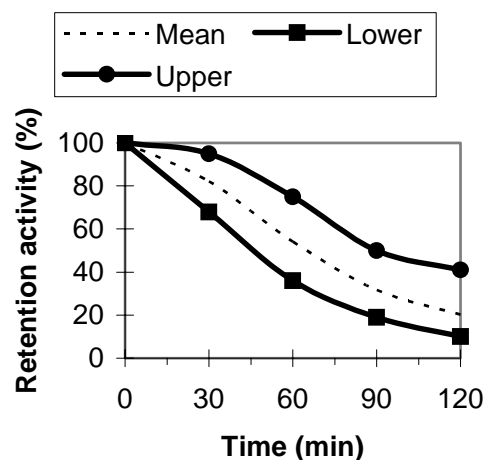


Figure 1. Normal limits of gastric emptying curve by interval method.

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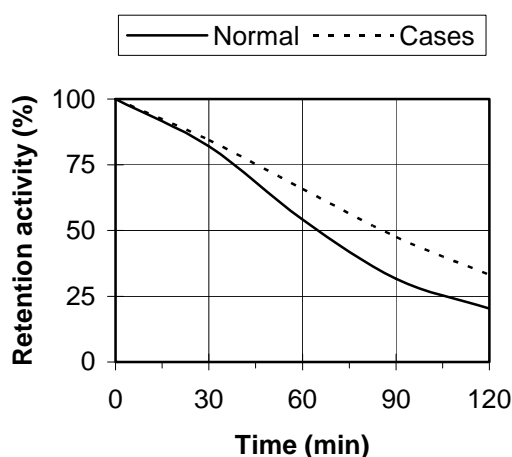


Figure 2. The mean gastric emptying curves of normals and patients.

Discussion

Two patients with clinical manifestations of GERD and reflux esophagitis, documented by upper GI endoscopy, had normal DeMeester scores, emphasizing that a normal ambulatory esophageal pH measurement cannot rule out GERD in all patients with clinical manifestations of the disease.

To minimize the possible effects of height and weight in gastric emptying study, we chose the control cases that had been matched with patients in terms of height and weight. Age is considered as a contributory factor in gastric emptying, however, in one study its effect was significant only for cases over 60 years of age, and limited to liquid phase study (not applying to the solid phase).⁴ In another study, the effect of age was significant only in males over 35 years (not the females). In our study, the only patient over 60 years, and more than half of male patients over 35 years had gastric emptying curves within the defined normal limits. Therefore, it seems that the difference in the mean age between the patient and control groups had no significant effect in our study. Moreover, the mean $T_{1/2}$ of males and females in the control cases did not differ significantly.

$T_{1/2}$ is a commonly used parameter for scintigraphic gastric emptying studies. It ranged from as low as 36 minutes to as high as 169 minutes as the upper limit according to different ingested meal types in various studies.¹⁰

We used the mean value plus two standard deviations for defining the upper limit for $T_{1/2}$ and RA_{120} .¹⁰ On the basis of our own data, we calculated 94.0 min for the upper normal limit of

$T_{1/2}$ and 37.0% for the upper normal limit of RA_{120} . Based on these criteria, 5 (31.25%) of patients had abnormally prolonged $T_{1/2}$, and the same number had abnormally increased RA_{120} .

The comparison between the patients' gastric emptying curves, and the defined normal ranges revealed 7 (43.75%) abnormal curves. Considering the normal "sigmoid" shaped gastric emptying curve, these patients showed a less steep slope in the linear portion of their gastric emptying curves, compared with the upper limit of normal curve.

Taking into account at least one of these three factors, 9 (56.25%) patients had evidence of delayed gastric emptying compared to the asymptomatic normal individuals.

The results of this study are in accord with those of previous investigations, which demonstrated the contributory role of delayed gastric emptying in GERD^{4, 11 - 18} whereas they contradict the findings of some other studies, which found no relationship between delayed gastric emptying and GERD.^{3, 5}

We didn't use modified power exponential fitting function to calculate T_{lag} (the inflection point of the total gastric emptying curve, which is corresponding to the peak antral filling), however, the initial shoulder of the gastric emptying curves in 15 (93.75%) patients were within normal ranges. Moreover, gastric retention activity at 30 min (T_{30}) did not significantly differ between the two groups. These findings suggest that there is not a significant change in emptying of proximal functional stomach, which is contrary to that indicated by Stacher et al in which the role of proximal stomach emptying was considered to contribute with the number of reflux episodes per hour.⁴

The results of gastric emptying scintigraphic studies along with the visual interpretation of gastric emptying curves and calculation of $T_{1/2}$ and RA_{120} showed a significant relationship between delayed gastric emptying and GERD, particularly related to distal gastric function. Therefore, delayed gastric emptying can be considered as a physiopathologic predisposing factor of GERD.

With respect to the absence of a similar study in Iran, this research offers the normal limit values for gastric emptying curves as well as upper normal limits for $T_{1/2}$ (94 min) and RA_{120} (37%) in Iranians.

We recommend scintigraphic gastric emptying study in all patients suffering from GERD, and we believe that it can be helpful in better management

of GERD patients. Nevertheless, more investigations should be performed to elucidate the role of such a study in GERD patients.

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