Original Article

Comparison of Sonographically Evaluated Pre and Postprandial Gastric Antral Area in Type 2 Diabetics and Healthy Control Subjects

Taher MAa, Sultana Ub, Mohiuddin ASC, Sharif MMd, Shegufta Fe, Rahman MTf, Alam MMUg

Abstract

Background: Gastric motility associated with delayed gastric emptying occurs frequently in patients with diabetes mellitus. Ultrasonography play an important role by which the structure and function of the stomach can be assessed in an accurate and reproducible manner. Ultrasonographic measurement of antral cross sectional area provides a valid, cheap alternative to other costly modalities for early measurement of gastric emptying. Increased gastric antral area reflects delayed gastric emptying and gastroparesis in type 2 diabetic. Post prandial antral area is also increased in healthy subjects. But there is a significant difference in sonographically measured postprandial gastric antral area in type 2 diabetics and healthy control subjects. No such study was done previously with Bangladeshi diabetic subjects.

Aims & Objective: This study was performed to compare pre and postprandial gastric antral area in type 2 diabetics and in healthy controls by ultrasonography in Bangladeshi subjects.

Materials and methods: A total number of 45 consecutive type 2 diabetic subjects referred in the Department of Radiology and Imaging, BIRDEM, Dhaka, for ultrasonography of whole abdomen as routine check-up and 45 healthy subjects who underwent ultrasonography for whole abdomen for the period of one year, were enrolled in this study and were considered as group I and group II respectively. Smokers, snuff users, patients with connective tissue, cerebrovascular & endocrine diseases, receiving any drug affecting gastrointestinal motility, any previous gastrointestinal tract surgery except appendicectomy were excluded from the study. All the selected subjects underwent B mode ultrasonogram of whole abdomen before and 90 mins after solid breakfast (two slices of bread and an egg). Unpaired t-test was done to compare pre and postprandial gastric antral area between type 2 diabetics and healthy controls and a P value <0.05 was taken as significant. Paired t-test was done to compare pre and postprandial gastric antral area of type 2 diabetic subjects and healthy controls and a P value <0.05 was taken as significant.

Results: Majority (40.0%) of patients were in 5th decade in group I and most (31.1%) of the healthy subjects were in 4th decade. Females were predominant in both groups, which was 64.4% in group I and 66.7% in group II and female to male ratio was almost 2:1 (in the whole study subjects). In this present series it was observed that the mean preprandial gastric antral area (measured by ultrasonography) was 392.29±70.48 mm² with range from 220 to 569 mm² in group I and 245.27±60.59 mm² with range from 115 to 387 mm² in group II. On the other hand, the mean post-prandial gastric antral area (measured by ultrasonography) was 551.71±190.04 mm² with range from 305 to 1134 mm² and 307.82±80.87 mm² with range from 159 to 545 mm² in group I and group II respectively. The mean pre-prandial and post-prandial gastric antral area were significantly (P<0.05) higher in type 2 diabetic subjects and healthy control subjects.

Conclusion: This study concluded that there is statistically significant difference between pre and postprandial gastric antral areas measured by B-mode ultrasonography in type 2 diabetics and healthy control Bangladeshi subjects which is similarly found in other studies. Thus ultrasonography may be routinely used to detect gastroparesis earlier in type 2 diabetics. However, whether duration of diabetes mellitus is a factor should be studied with larger population.

Key words: Gastric antral area, ultrasonography, type 2 diabetes mellitus, healthy adult.

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a. Dr. Md. Abu Taher, MBBS, M.Phil, MD, Professor, Department of Radiology and Imaging, BIRDEM, Dhaka.
b. Dr. Unan Sultana, MBBS, M. Phil. Assistant Professor, Agarbad Ma O Shishu Medical College Hospital, Chittagong.
c. Prof. A S Mohiuddin, MBBS, DMRD, MD, Professor and head, Department of Radiology and Imaging, BIRDEM, Dhaka.
d. Dr. Md. Mofazzal Sharif, MBBS, MCPS, MD, Consultant, Department of Radiology & Imaging, North Bangal Medical College, Sirajgonj
e. Dr. Farzana Shegufta, MBBS, MD, Assistant Professor, Department of Radiology and Imaging, BIRDEM, Dhaka.
f. Dr. Md. Towhidur Rahman, MBBS, Assistant Professor, Department of Radiology and Imaging, BIRDEM, Dhaka.
g. Dr. Md. Muhit Ul Alam, Senior medical officer, Department of Radiology and Imaging, BIRDEM, Dhaka.

Address of correspondence: Dr. Md. Abu Taher, MBBS, M.Phil, MD, Professor, Department of Radiology and Imaging, BIRDEM, Dhaka, E-mail: mataherdr67@gmail.com

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Introduction

Diabetes Mellitus (DM) is now recognized as a global health challenge of the 21st century. Current projections estimate that prevalence of DM worldwide may double over the next two decades. Asia is emerging as the epicenter of diabetes epidemic. Like all other developed and developing countries prevalence and incidence of type 2 DM is also increasing in Bangladesh. The incidence rate of type 1 and particularly type 2 diabetes are increasing in all societies and in all countries. Type 2 diabetes accounts for more than 90% of all diabetes. Type 2 diabetes reduces remaining lifespan by 5-10 years and constitute the fourth or fifth leading cause of death.

Several studies were done on the prevalence of gastrointestinal symptoms in diabetic patients. Upper gastrointestinal symptoms more common in patients with type 2 diabetes than in well matched control subjects. Gastroparesis is a syndrome characterized by delayed gastric emptying in absence of mechanical obstruction. The cardinal symptoms include postprandial fullness (early satiety), nausea, vomiting and bloating. The prevalence of delayed gastric emptying in patients with diabetes in between 28% to 65%. Women constitute the majority of patients with a female: male ratio of 4:1 and the mean age of onset is 34 years.

Methodology

This case-control study was carried out in the Department of Radiology and Imaging, BIRDEM (Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders) General Hospital from January to December 2012. A total of 45 consecutive type 2 diabetic subjects, referred for ultrasonography of whole abdomen as routine check-up and 45 healthy subjects who underwent ultrasonography of whole abdomen, were enrolled in this study and were considered as group I and group II respectively. Smokers or snuff users, patients with psychiatric, connective tissue, cerebrovascular or endocrine diseases, and patients receiving any drug affecting gastrointestinal motility, any previous gastrointestinal tract surgery except appendisectomy were excluded from the study.

All the selected subjects underwent B mode ultrasonogram of whole abdomen before and 90 minutes after solid breakfast (two slices of bread and an egg). Proper counseling and reassurance to the patients regarding the examination procedure was done to reduce their apprehension and to get full cooperation. Informed consent was taken from each of the patient. No other specific preparation was required. The examinations were performed using standard gray-scale B-mode imaging with a 3.5-MHz curvilinear transducer. For obese subjects 2.5 MHz transducer was used. The examination was done by the researcher at first and then confirmed by consultant radiologist of the Department of Radiology and Imaging of BIRDEM.

At first the subjects were examined after an 8 hour fast. Gastric antral area was measured by determining the longitudinal (D1) and antero-posterior (D2) diameters of a single section of the gastric antrum, using the abdominal aorta and the left lobe of the liver as internal landmarks to obtain the same standardized scanning level consistently. At each observation three measurements were done. Using the mean values of the longitudinal (D1mean) and antero-posterior (D2mean) diameters the antral area was calculated. The measurements of the gastric antrum (on average lasting between 1 and 3 min) were taken from the outer...
profile of the wall and obtained between antral contractions to provide a measure of the relaxed width of the antrum. Depending on what would optimize the quality of the image in each subject, the subjects consistently either held their breaths in inspiration or breathed normally (during all measurements, to avoid changes in antral diameters related to inspiration and expiration). In all subjects, measurements were taken before and 90 min after the end of meal ingestion.

Results
The mean age was 52.64±8.59 years in group I and 48.13±10.68 years in group II. In group I, 18 (40.0%) patients age belonged to 51-60 years and in group II 14 (31.1%) subjects age belonged to 40 years. The mean duration of diabetes was 13.16±5.64 years with range from 6 to 26 years. In 20 (44.4%) patients duration of diabetes was 11-20 years.

The mean pre-prandial gastric antral area measured by ultrasonography was found 392.29±70.48 mm² with range from 220 to 569 mm² in group I and 245.27±60.59 mm² with range from 115 to 387 mm² in group II. The mean post-prandial gastric antral area measured by ultrasonography was 551.71±190.04 mm² with range from 305 to 1134 mm² in group I and 307.82±80.87 mm² with range from 159 to 545 mm² in group II. The mean difference was statistically significant (p < 0.05) between two groups (Table I). In type 2 diabetic subjects, the mean pre-prandial gastric antral area was 392.29 mm² and post-prandial antral area was 551.71 mm² and the mean difference was statistically significant (p < 0.05) (Table II). In healthy control subjects, the mean pre-prandial gastric antral area was 245.27 mm² and post-prandial antral area was 307.82 mm² and the mean difference was statistically significant (p < 0.05) (Table III).

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<tr>
<th>Parameters</th>
<th>Group I (n=45)</th>
<th>Group II (n=45)</th>
<th>P value</th>
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<tr>
<td>Pre Prandial (mm²)</td>
<td>392.29±70.48</td>
<td>245.27±60.59</td>
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<td>Range (min-max)</td>
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Group I= Type 2 Diabetes; Group II= Healthy subjects
s= significant
P value reached from unpaired t-test

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Group I= Type 2 Diabetes
s= significant
P value reached from paired t-test.
Discussion
Several recent developments have come to enrich our clinical acumen and technical expertise, among which Osgood is the most popular one. Present study was limited to type 2 diabetics and healthy subjects and comprises of 90, who had undergone ultrasonography of abdomen as routine check-up. In this current study, it was observed that the mean age was around 50 years. Darwiche et al. showed the mean age of patients with diabetes was 55±9 years with range from 40 to 71 years and 37±18 years with range from 18 to 77 years in healthy subjects, which is consistent with the current study. On the other hand, Berry et al. observed higher mean age of patients having insulin dependent diabetes mellitus, which was 72.1±1.9 years. The higher age range may be due to increased life expectancy and geographical influences may have significant impacts on DM.

It was observed that female was predominant in both groups, which was 64.4% in group I and 66.7% in group II and female to male ratio was almost 2:1 in the whole study subjects. Darwiche et al. showed female to male ratio was 1.3:1 in DM and 1.4:1 in healthy subjects. Akhter et al. and Kim et al. found female to male participants ratio was 1:1.3 and 1:3 respectively. In this current series it was observed that majority (44.4%) patients had duration of diabetes 11-20 years and the mean duration of diabetes was 13.16±5.64 years with

Fig. 1a and 1b: Sonographic Image of gastric antrum of type 2 diabetics before meal 90 minutes after breakfast

Fig. 2a and 2b: Sonographic Image of gastric antrum of healthy subject before meal and 90 minutes after breakfast
range from 6 to 26 years. Darwiche et al enrolled patients’
diabetes mean duration varied from 20 to 51 years with
mean duration of diabetes was 34 ± 10 years, which is
higher with the current study.24
The mean pre-prandial gastric antral area in this present
study was 392.29±70.48 mm² with range from 220 to 569
mm² in group I and 245.27±60.59 mm² with range from
115 to 387 mm² in group II. The mean pre-prandial gastric
antral area was significantly (P<0.05) higher in type 2
diabetic subjects. On the other hand, the mean post-
prandial gastric antral area was 551.71±190.04 mm² with
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respectively. The mean pre-prandial and post prandial
gastric antral area were significantly (P<0.05) higher in
type 2 diabetic subjects. The mean pre-prandial and post-
prandial gastric antral area were also significantly
(P<0.05) higher in healthy control subjects. Darwiche et
al. obtained mean pre-prandial and post-prandial gastric
antral area of diabetes patients were 301.0±137.0 mm²
(range: 114 to 432 mm²) and 514.4±294.3 mm² (range: 188
to 1052 mm²) respectively.24 On the other hand the mean
pre-prandial gastric antral area of healthy subjects was
203.6±71.7 mm² (range: 97 to 293 mm²) and post-prandial
gastric antral area 186.9±89.6 mm² (range: 68 to 389 mm²).
Pre-prandial and post-prandial gastric antral area was
significantly higher in diabetes patients, which is closely
resembled with the current study. Moldovan et al26
mentioned in their study that fasting antral areas were
larger in diabetes mellitus than in controls without
reaching statistical significance (p>0.05). Post-prandial
antral areas were significantly larger in diabetes than in
controls (p<0.05). Where the authors found mean pre-
prandial gastric antral area in diabetes was 4.2±3 cm²
and 3.4±0.9 cm² in healthy subjects. Similarly, mean post-
prandial antral area were 17.5±6.3 cm² and 10.7±4.4 cm² in
diabetes and healthy subjects respectively, which
support the current study.

This study was carried out in our department by
ultrasonography with small number of cases and healthy
control Bangladeshi subjects. Duration of diabetes was
not included in the study. It could be concluded that
the cheap and easily available ultrasonography may be
routinely used to detect early gastroparesis in type 2
diabetics than by other costly methods. However, further
study can be carried out by including large number of
population and duration of diabetes mellitus.

References
1. Hussain A. Diabetes prevention in Bangladesh. Institute
of Health and Society, UiO, Published. 2011; 10, 09:22.
3. Kim JH, Park HS, Ko SY, Hong SN, Sung I, Shim CS et al.
Diabetic factors associated with gastrointestinal
symptoms in patients with type 2 diabetes . World J
4. Haans JIL, Masclee AAM. The diagnosis and management
37-46.
5. Horowitz M, Su YC, Rayner CK, Jones KL. Gastroparesis:
prevalence, clinical significance and treatment. Can J
8. Camilleri M, Bharucha AE,Farrugia G. Epidemiology,
Mechanisms and Management of Diabetic Gastroparesis.
Clinical Gastroenterology and Hepatology 2011; 9(1):
5-12.
9. Bielefeldt K. Gastroparesis: Concepts, Controversies and
10. Waseem S, Moshiree B, Draganov PV. Gastroparesis:
Current diagnostic challenges and management
25–37.
11. Szarka LA, Camilleri M. Stomach Dysfunction in Diabetes
Mellitus: Emerging Technology and Pharmacology. J
12. Kashyap P, Farrugia G. Diabetic gastroparesis: what we
have learned and had to unlearn in the past 5 years. Gut
356: 820-29.
14. Ajumobi AB, Griffin RA. Diabetic Gastroparesis:
Evaluation and Management. Hospital Physician 2008;
2: 27-35.
15. Horowitz M, Su YC, Rayner CK, Jones KL. Gastroparesis:
prevalence, clinical significance and treatment. Can J
16. Buckles DC, McCallum RW. New Approaches for
17. Samsom M, Vermeijden Jr, Smout AJPM, van Doorn E,
Roelofs J, van Dam PS et al. Prevalence of Delayed
Gastric Emptying in Diabetic Patients and Relationship
to Dyspeptic Symptoms. Diabetes care 2003; 26(11):
3116-22.


