

ORIGINAL ARTICLE

SCINTIGRAPHIC EVALUATION OF GASTRIC EMPTYING IN DIABETIC PATIENTS WITH SUSPECTED GASTROPARESIS

Saima Seher, Mujahid Khalid Ali, Mohammad Ilyas, Mehdi Raza, Fida Hussain

Nuclear Medical Centre, Armed Forces Institute of Pathology, Rawalpindi, Pakistan

Background: Gastroparesis is a disorder characterized by a delay in gastric emptying of a meal in the absence of a mechanical gastric outlet obstruction. The purpose of this study was to determine the frequency of delayed gastric emptying in diabetic patients presenting with symptoms of gastroparesis.

Methods: This descriptive, cross-sectional study was done at Nuclear Medical Centre, Armed Forces Institute of Pathology, Rawalpindi, from March to August 2016. Patient with diabetes mellitus (type-1, type-2), with any of the symptoms of gastroparesis, e.g., vomiting, early satiety, postprandial fullness and bloating were included in the study. **Results:** Out of 95 patients, 30 (31.6%) were males and 65 (68.4%) were females. The mean age of all patients was 54.13 ± 10.39 years, with a range of 18–76 years. Delayed gastric emptying was seen in 33 (34.7%) patients with symptoms of gastroparesis.

Conclusion: High prevalence of delayed gastric emptying was observed in diabetic patients included in our study presenting with symptoms of gastroparesis.

Keywords: Diabetes mellitus, Gastroparesis, Nausea, Vomiting, Gastrointestinal motility

Pak J Physiol 2016;12(4):30–2

INTRODUCTION

The prevalence of diabetes mellitus (DM) has now reached epidemic proportions in both developed and developing countries. Diabetes and its complications are an increasing challenge to health care systems worldwide.¹ This number will increase in coming years as a result of an ageing global population, rising prevalence of obesity, sedentary lifestyles and urbanization. The study of gastroparesis, a gastrointestinal (GI) complication of diabetes, is a common association of diabetes. With latest management options it has assumed importance in current medical practice. Gastrointestinal complications of DM can present with oesophageal dysmotility, gastro-oesophageal reflux disease (GERD), gastroparesis, enteropathy, non-alcoholic fatty liver disease (NAFLD) and glycogenic hepatopathy. Severity of symptoms is inversely related to glycemic control. These complications are common in long standing diabetics. Early identification and appropriate management of GI complications is important for improving both diabetic care and quality of life of the affected patient.

Gastroparesis is a disorder characterized by a delay in gastric emptying of a meal in the absence of a mechanical gastric outlet obstruction.² Diabetes is a leading cause of gastroparesis, accounting for about one-third of cases. Diabetic gastroparesis manifests as early satiety, bloating, vomiting, abdominal pain and erratic glycemic control, which impact to varying degrees on the patient's quality of life.³ Fluctuating blood glucose level and poor glycemic control is also associated with gastroparesis. Malnutrition is another complication resulting from symptoms of disease like nausea, vomiting and reduced appetite. The gold

standard test to diagnose gastroparesis is scintigraphy⁴, it provides a non-invasive, physiological, and quantitative assessment of gastric emptying⁵. However, other techniques are also available, such as ultrasonography, ¹³C breath testing, magnetic resonance imaging (MRI), swallowed capsule telemetry, antroduodenal manometry, and electrogastrography.

Management of patients with diabetic gastroparesis requires a multidisciplinary approach, and involves gastroenterologists, dietitians, diabetologists, social workers, and diabetes educators. The main aim in the management of patients with diabetic gastroparesis is to maintain glycemic control, to correct fluid, electrolyte, and nutritional deficiencies, to reduce the upper GI symptoms; and provide medical management to improve gastric emptying.

Since accelerated gastric emptying (GE) and functional dyspepsia can also mimic gastroparesis, careful evaluation of symptomatic patients through the use of validated techniques to document delayed GE is essential to diagnose and manage patients with suspected diabetic gastroparesis.⁶ The purpose of this study was to determine the frequency of delayed gastric emptying in diabetic patients presenting with symptoms of gastroparesis.

MATERIAL AND METHODS

This descriptive, cross sectional study was carried out at nuclear Medical Centre, Armed Forces Institute of Pathology Rawalpindi, from March to August 2016. Sampling technique was non-probability, consecutive sampling. A total of 95 patients with diabetes mellitus (type-1, type-2), of 10–20 years duration with symptoms of gastroparesis, reporting at Military Hospital and Combined Military Hospital, Rawalpindi were included in the study. Cases were interviewed and symptoms

questionnaire was filled. Patients with history of gastric surgery, prior history of gastric outlet obstruction, achalasia, connective tissue diseases, suffering from endocrine or metabolic disturbances, with neuromuscular conditions, with history of irradiation or neoplasia were not included in the study. Ultrasound (USG) abdomen and upper GI endoscopy was performed to exclude any organic disease causing dyspepsia. Patients taking medications that alter emptying were asked to discontinue these medications. The study was performed in the morning after an overnight fast. Patients refrained from smoking on the morning of the test and throughout the time of imaging. Blood sugar was checked on the day of study. The Technetium (^{99m}Tc) sulfur colloid (0.5–1 mCi) radiolabelled meal consisting of two large eggs, two slices of bread and 30 grams jam with 120 ml of water was given to the patient. Imaging was performed using large field of view Siemens ECAM[®] gamma camera. Images were obtained in a format of at least 64×64 pixels using a low energy all-purpose collimator. The photopeak settings were 20% around the 140-keV peak for ^{99m}Tc . Anterior and posterior static planar images with the distal oesophagus, stomach, and proximal small bowel in the field of view were obtained for 1 minute, immediately after ingestion of the radiolabelled meal. Repeated images were obtained in the same projection(s) for 1 minute at hourly intervals up to 4 hours on the same camera. Region of interest (ROI) was drawn around the activity in the entire stomach in anterior and posterior views. All data was corrected for radioactive decay. The geometric mean activity of decay-corrected counts (square root of the product of the anterior and posterior counts) was determined at each imaging time. The final measurement of gastric emptying was based on the percentage of gastric retention at specific times after meal ingestion (e.g., at 2, 3, and 4 hours).

Data was stratified according to gender age and type of diabetes. Chi-square test was applied post stratification and $p \leq 0.05$ was considered significant.

Table-1: Normal limits for gastric retention

Time point	Upper limit (greater value suggests abnormally delayed gastric emptying)
1 hour	90%
2 hour	60%
3 hour	30%
4 hour	10%

RESULTS

Total of 95 patients were included in the study 30 (31.6%) males and 65 (68.4%) females with a ratio of approximately 1:2. The mean patient age was 54.13 ± 10.39 years, with a range of 18–76 years. The mean age for males was 55.2 ± 7.36 (35–70) years, and for females it was 53.59 ± 11.63 (18–76) years.

Type 1 diabetics were 10 (10.5%) and type 2 diabetics were 85 (89.5%). Frequency of different symptoms of gastroparesis in the included patients was also calculated. Postprandial abdominal distension was the most common symptom present in 73 (76.8%) patients, followed by nausea in 57 (60%) patients. Bloating was present in 41 (43.2%) patients. Early satiety was a presenting complaint along with other symptoms in 37 (38.9%) patients. Vomiting was the least frequent symptom with 10 (10.5%) patients.

According to Society of Nuclear Medicine (SNM) Guidelines delayed GE was determined to be present if gastric retention was >90% at 1 hour, >60% at 2 hours, >30% at 3 hours and >10% at 4 hours. In this study, the mean value of percentage retention observed at 1 hour was $71.61\% \pm 15.42$ (range=36–99), at 2 hours was 47.48 ± 14.23 (range=12–73), at 3 hours was $26.83\% \pm 11.35$ (range=2–69) and at 4 hours was $11.5\% \pm 8.52$ (range=1–35) (Table-2).

GE was delayed in 33 (34.7%) patients, while 62 (65.3%) patients showed normal rate of GE (Table-3). There was no significant difference in rate of gastric emptying, between different age groups, males or females and patients with type 1 or type 2 diabetes.

Table-2: Percentage retention at 1, 2, 3 and 4 hours post ingestion of radiolabelled meal

Percentage retention	Range (% retention)	Mean±SD
At 1 hour	36–99%	$71.61\% \pm 15.42$
At 2 hours	12–73%	$47.48\% \pm 14.23$
At 3 hours	2–69%	$26.83\% \pm 11.35$
At 4 hours	1–35%	$11.15\% \pm 8.52$

Table-3: Frequency of delayed gastric emptying in diabetic patients with symptoms of gastroparesis

Delayed gastric emptying	Frequency	Percent
Present	33	34.7 %
Absent	62	65.3 %
Total	95	100 %

DISCUSSION

Gastroparesis may have developed from a rare disorder to an increasingly common and frustrating problem with at times prolonged hospitalizations in the last two decades.⁷ Not being able to eat without experiencing symptoms impacts patients' quality of life. One third of cases have chronic symptoms with periodic exacerbations and one third has chronic worsening symptoms.⁸ Gastroparesis is a difficult problem as patients present with discomfort, nausea and vomiting with nutritional problems and only few prokinetics are available as first choice of therapy, with their limited efficacy to treat altered gastric motility.⁹ Assessment and correction of nutritional state, relief of symptoms, improvement of gastric emptying and, in diabetics, glycemic control are the main goals in management of gastroparesis. The first use of radionuclides to measure

GE was published in 1966. Since then, it has become the standard for the measurement of gastric motility in clinical practice.

In a study by Kojecy V *et al*¹⁰, 147 patients (76 women, 71 men) with type 2 diabetes, mean age 62.3±8.0 years treated with either oral hypoglycaemic drugs or insulin were studied. Results were based on gastric half-emptying time (T_{50}) which was defined as the time for the activity to fall by 50%. They reported delayed gastric emptying in 26 subjects (17.7%) and T_{50} was significantly prolonged in the whole group as compared to the control group. Our patients showed delayed gastric emptying in 34.7%. In our study postprandial satiety was the most common symptom, whereas in the study by Kojecy *et al*¹⁰, the most frequent symptom was bloating, followed by early satiety. Radiolabelled meal and imaging technique was also different in two studies. Our results are based on the cut-off values while their results were based on comparison with the controls.

In another study by Bharucha¹¹, normal gastric emptying was observed in 42% patients, and gastric emptying was delayed in 36% patients. Their results are comparable with the result of our study. In our study results are based on percentage retention of activity at different time intervals post meal ingestion and they measured the rate of emptying. In our study gender based difference in rate of gastric emptying is not statistically significant but in a study by Camilleri¹² gastric emptying in females on average was 15% slower than male subjects.

Rok Seon Choung *et al*¹³ conducted a study to estimate the frequency of and risk factors for gastroparesis among subjects with DM. It was a population based cohort study. In their study, a total of 1,226 Olmsted County residents were included in the study, 227 patients with type 1 DM, 360 with type 2 DM, 310 controls for type 1 DM, and 329 controls for type 2 DM. The Kaplan Meier (KM) estimate of the cumulative proportions (95% CI) developing gastroparesis by 10 years was 5.2% for Type 1 diabetics, 1.0% for Type 2 diabetics and 0.2% for controls. In the combined group of diabetics, the KM estimate for cumulative proportion developing gastroparesis by 10 years was 2.6%. They found that gastroparesis is relatively rare in the general population. However DM appeared to increase this risk substantially. Data regarding the frequency of delayed gastric emptying in diabetic patients with symptoms of gastroparesis in Pakistan is not available. This study will

help physicians to diagnose, monitor and treat patients with gastroparesis.

CONCLUSION & RECOMMENDATIONS

Scintigraphy technique is helpful for determining the abnormalities in gastric emptying function of diabetic patients with symptoms of dyspepsia. High prevalence of delayed gastric emptying in diabetic patients requires proper management as upper gastrointestinal motility disorders can increase the morbidity in diabetic patients and can adversely affect their quality of life.

REFERENCES

1. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract* 2010;87(1):4–14.
2. Chaudrey KH, Patel R, Alam M, Avashia K, Khan SI, Titarenko N, *et al*. Idiopathic gastroparesis: case report and literature review of diagnostic and treatment modalities. *Am J Ther* 2013;20:111–7.
3. Alam U, Asghar O, Malik RA. Diabetic gastroparesis: Therapeutic options. *Diabetes Ther* 2010;1(1):32–43.
4. Olausson EA, Brock C, Drewes AM, Grundin H, Isaksson M, Stotzer P, *et al*. Measurement of gastric emptying by radiopaque markers in patients with diabetes: correlation with scintigraphy and upper gastrointestinal symptoms. *Neurogastroenterol Motil* 2013;25:e224–32.
5. Camilleri M, Bharucha AE, Farrugia G. Epidemiology, mechanisms, and management of diabetic gastroparesis. *Clin Gastroenterol Hepatol* 2011;9:5–12.
6. Hyett B1, Martinez FJ, Gill BM, Mehra S, Lembo A, Kelly CP, *et al*. Delayed radionuclide gastric emptying studies predict morbidity in diabetics with symptoms of gastroparesis. *Gastroenterol* 2009;137:445–52.
7. Wang YR, Fisher RS, Parkman HP. Gastroparesis-related hospitalizations in the United States: trends, characteristics, and outcomes, 1995–2004. *Am J Gastroenterol* 2008;103(2):313–22.
8. Parkman HP, Yates K, Hasler WL, Nguyen L, Pasricha PJ, Snape WJ, *et al*. Similarities and differences between diabetic and idiopathic gastroparesis. *Clin Gastroenterol Hepatol* 2011;9:1056–64.
9. Parkman HP, Yates KP, Hasler WL, Nguyen L, Pasricha PJ, Snape WJ, *et al*. Dietary intake and nutritional deficiencies in patients with diabetic or idiopathic gastroparesis. *Gastroenterol* 2011;141(2):486–98.
10. Kojecy V, Bernatek J, Horowitz M, Zemek S, Bakala J, Hep A. Prevalence and determinants of delayed gastric emptying in hospitalised Type 2 diabetic patients. *World J Gastroenterol* 2008;14(10):1564–9.
11. Bharucha AE, Camilleri M, Forstrom L, Zinsmeister AR. Relationship between clinical features and gastric emptying disturbances in diabetes mellitus. *Clin Endocrinol* 2008;70:415–20.
12. Camilleri M, Iturrino J, Bharucha AE, Burton D, Shin A, Jeong I-D, *et al*. Performance characteristics of scintigraphic measurement of gastric emptying of solids in healthy participants. *Neurogastroenterol Motil* 2012;24:1076–e562.
13. Choung RS, Locke GR 3rd, Schleck CD, Zinsmeister AR, Melton LJ 3rd, Talley NJ. Risk of gastroparesis in subjects with type 1 and 2 diabetes in the general population. *Am J Gastroenterol* 2012;107:82–8.

Address for Correspondence:

Dr Saima Seher, Nuclear Medical Centre, Armed Forces Institute of Pathology, Rawalpindi, Pakistan.

Received: 28 Oct 2016

Reviewed: 15 Dec 2016

Accepted: 16 Dec 2016