ORIGINAL ARTICLE

Radionuclide gastric emptying scintigraphy in patients with suspected gastroparesis in Hospital Kuala Lumpur: A preliminary experience

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ABSTRACT

Introduction: Gastroparesis is a medical condition that can cause significant morbidity. Its prevalence in Malaysia is not known and is often under diagnosed. The gold standard in the assessment of gastroparesis is radionuclide gastric emptying scintigraphy (GES). The aim of this study was to evaluate the added benefit of performing GES in patients with suspected gastroparesis in Hospital Kuala Lumpur (HKL).

Methods: The clinical data and scintigraphic findings of consecutive patients referred to the Department of Nuclear Medicine, HKL for GES from July 2020 to December 2020 were retrospectively reviewed.

Results: Thirteen patients underwent the study (6 males and 7 females) with a mean age of 47.9 years (age range of 25 to 72 years). The majority of patients (n=11) were diagnosed with either type I or type II diabetes mellitus. Ten patients reported abnormal scan findings with only 3 patients had normal GES findings. Scintigraphic findings from our patients, association of symptoms with abnormal GES as well as the challenges in implementing GES in Malaysia is discussed.

Conclusion: GES provides valuable information to the referring physician in the diagnosis and management of patients with gastric motility disorders. However, its use is limited because of limited availability, cost restriction, lack of familiarity among clinicians, and lack of understanding of the test. Further effort is thus needed to enhance the availability and usage of GES in Malaysia.

KEYWORDS:
gastric emptying scintigraphy, gastroparesis, sulfur colloid

INTRODUCTION

Gastroparesis is a chronic disorder that results in delayed gastric emptying without the presence of mechanical obstruction and can greatly impact the quality of life of the patients.[1-6] It is caused by an impaired intrinsic nervous system involving the gastric motor function of the stomach which leads to abnormal peristaltic contractions and stagnation in chyme propagation.[1,3,6] The aetiology can be idiopathic or secondary to other diseases such as diabetes mellitus, infection, cancer, connective tissue disease, renal insufficiency and neurologic dysfunction.[1,3,6-8] Diagnosis is based on symptoms consistent with gastroparesis, normal upper endoscopy findings and evidence of delay in gastric emptying.[9,10]

Accurate diagnosis of this condition is essential to reduce cost and impact on the economy as reflected in patient hospitalization, multiple diagnostic tests, and ineffective therapy causing absence from work and reduction in productivity at the workplace.[1,11,12] Currently, radionuclide gastric emptying scintigraphy (GES) is still the gold standard in the diagnosis of gastroparesis.[1,8] A standard Technetium-99m (^{99m}Tc) labelled meal is ingested by the patient followed by serial scanning with a gamma camera to assess the transit of food through the stomach. Despite its inception in the 1960's,[2,8,13] the usage of this test has not been well documented or published in Malaysia. In addition, the prevalence of gastroparesis in Malaysia is not known and the disorder is often under diagnosed.

In a survey conducted by the Asian Neurogastroenterology and Motility Association on gastroparesis, it was found that the main factors in the lack of interest or under diagnosis of gastroparesis were attributed to lack of knowledge, scarcity of research, limited access to diagnostic tools and lack of effective therapy.[10] However, with the advancement of pharmacological and non-pharmacological therapies,[10] the need for awareness in GES as a reliable diagnostic test for gastroparesis is of paramount importance. Thus, the objective of this study was to evaluate the benefit of performing GES in patients with suspected gastroparesis and to assess the severity of gastroparesis at Hospital Kuala Lumpur (HKL), Malaysia. We also aimed at designing a suitable Malaysian protocol for this diagnostic technique in the future.

MATERIALS AND METHODS

Patient selection

This retrospective study was approved by the Ministry of Health Medical Research Ethics Committee (MREC approval number: NMRR-20-1008-54807) and data collection was in accordance with the Declaration of Helsinki for human

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research. We reviewed the clinical data and scintigraphic findings of consecutive patients referred to the Department of Nuclear Medicine, HKL for GES from July 2020 to December 2020. Inclusion criteria were patients aged 18 years and above with no previous history of gastric surgery who were referred to our department for GES and completed the GES study. Exclusion criteria were: vomiting portion of the meal, incomplete consumption of meal and poor glycaemic control before the study. From our records, there were 14 patients referred and underwent the GES study. One patient did not complete the study due to persistent vomiting at 2 h and was thus excluded.

Radiolabelled meal ingestion protocol

The patients fasted between 6 to 10 h before the study. Medications that were deemed to a) increase gastric motility such as metoclopramide, domperidone, tegaserod and erythromycin; b) decrease gastric motility such as opiates, atropine, antispasmodic agents and phenobarbital; c) increase or decrease gastric motility like calcium channel blocker, progesterone, theophylline, phentolamine, octreotide and benzodiazepine were withheld for at least 48 h before the procedure.[2,13] Patients relevant clinical information pertaining to gastroparesis were retrospectively obtained. The fasting blood glucose levels were recorded on the morning of the procedure with a cut-off value of less than 15.3mmol/L[1,2] being eligible for the study. The standardized radiolabelled meal was then prepared based on the Society of Nuclear Medicine and Molecular Imaging (SNMMI) guidelines, consisting of 255 kcal meal (72% carbohydrate, 24% protein, 2% fiber and 2% fat).[2] The mixture of 1.0mCi of ^{99m}Tc labelled sulfur colloid and 4 oz of egg whites (60 kcal) were cooked into a firm rubbery consistency in a microwave and ingested by the patient with two slices of bread (120 kcal), 30g of jam (75 kcal) and 120ml of plain water within 10 minutes.[2,5] No additional food or drinks were allowed until the completion of the study at 4 h post meal ingestion.

Image acquisition

After ingestion of the radiolabelled meal, patients were placed in a supine position on a dual-head gamma camera. Concurrent static one-minute anterior and posterior images of the region covering the lower chest and lower abdominal region were acquired on either Siemens E-Cam Dual or Siemens Symbia T6 SPECT/CT gamma camera immediately, and at intervals of 0.5, 1, 2, 3 and 4 h post meal. The images were acquired using a low energy all-purpose collimator at 140 keV photopeak of ^{99m}Tc and 20% energy window (140 keV ± 10%).

Image analysis, data interpretation and statistical analysis

Images obtained were then processed and analysed on a dedicated E-soft Syngo workstation (Siemens Medical Systems). The stomach was identified on the immediate image and normalized to 100% as the baseline point (T0). Subsequent gastric residuals were measured at each time point using geometric mean activity and region of interest analysis, corrected for ^{99m}Tc decay. Image interpretation was performed qualitatively, considering the quantitative parameters based on the percentage (%) of gastric retention at each time point that were graphed. The normal limit of % gastric retention is based on the Consensus Recommendation of Gastric Emptying Scintigraphy, where the normal percentage of gastric retention at 1 h is 30 to 90%, ≤ 60% at 2 h and ≤ 10% at 4 h.[2] Rapid gastric emptying is define as gastric retention percentage of < 30% at 1 h while the criteria for delayed gastric emptying includes gastric retention of > 60% at 2 h or > 10% at 4 h.[2,13] This study involves descriptive analysis. The Fischer's exact test is used to assess the association between clinical symptoms and delayed gastric emptying.

RESULTS

Of the 13 patients included, they were 6 males and 7 females with the mean age of 47.9 years (age range of 25 to 72 years). In terms of ethnicity, 53.8% were Malays (n=7) with 3 Chinese and 3 Indians respectively. The majority of patients (n=11, 84.6%) were diagnosed with either type I or type II diabetes mellitus. The recorded mean of fasting blood glucose of our patients was 8.8mmol/L (range of 4.8 to 15.1mmol/L). Ten patients recorded abnormal findings with only 3 patients having normal GES findings (Figure 1). Out of the 10 patients, 1 patient showed rapid gastric emptying (Figure 2), 3 patients demonstrated delayed emptying in the early phase with normal gastric retention at 4 h, and 6 patients reported delayed gastric emptying at 4 h of study. The delayed gastric emptying can be further classified in terms of its severity based on the percentage of gastric retention at 4 h. Of the 6 patients, 4 patients showed mild delay (11% to 20% retention), 1 patient with moderate delay (21% to 35% retention) and 1 patient displayed very severe delay (> 50% retention) in gastric emptying (Figure 3). Table I summarises the characteristics of patients referred for GES, including their clinical symptoms and GES scan findings. As for the main presenting symptoms, most of the patients experienced dyspepsia or epigastric discomfort (n=9, 69.2%) and nausea-vomiting (n=8, 61.5%) before the study. Scintigraphy imaging at 1, 2 and 4 h demonstrated abnormal findings in 7 (53.8%), 9 (69.2%) and 6 (46.2%) patients, respectively. Further analysis revealed that nausea-vomiting symptom was significantly associated with abnormal scan findings at 4 h imaging ($p < 0.05$). Among those with symptoms of nausea-vomiting, 6 patients (75%) had abnormal scan findings at 4 h imaging as compared to none among those who reported no nausea-vomiting. Other parameters were not significantly associated with abnormal scan findings (Table II).

DISCUSSION

Gastroparesis is a debilitating disease that caused significant morbidity and mortality.[4] The actual prevalence of gastroparesis in Malaysia is not known and it is often under diagnosed.[4] Based on an epidemiological study, gastroparesis may present in up to 1.8% of the general population, with only a fraction (approximately 0.2%) being diagnosed.[3] Majority of patients with gastroparesis are diabetic and gastroparesis can involve up to two-third of diabetic patients.[1,2,4,7,10,14] In general, gastroparesis has a significant impact on the quality of life and affects mostly women.[6,15]

The key motor function of the stomach is gastric accommodation which facilitates delivery and storage of

Table I: Characteristics of patients referred for GES, clinical symptoms and scan findings

Case	Age	Gender	Clinical symptoms	Medical comorbidities and past surgical history	Gastric retention %			GES Conclusion
					At 1 h (normal range 30 to 90%)	At 2 h (normal range ≤ 60%)	At 4 h (normal range ≤ 10%)	
1	72	Male	Gastroesophageal reflux, epigastric pain and bloating	Diabetes mellitus, hypertension, bronchial asthma, hypothyroidism and dyslipidemia	74%	53%	3%	Normal gastric emptying study
2	68	Female	Heartburn, bloating and abdominal discomfort	Diabetes mellitus and dyslipidemia. History of total abdominal hysterectomy and bilateral salphingoopherectomy	27%	14%	0%	Rapid gastric emptying
3	25	Female	Nausea, vomiting, diarrhoea, abdominal discomfort and weight loss	Gastritis and hiatal hernia	84%	66%	3%	Delayed gastric emptying in the early phase with normal gastric retention at 4h
4	26	Female	Persistent vomiting	Diabetes mellitus, hypertension and dyslipidemia History of appendicectomy	91%	66%	16%	Mildly delayed gastric emptying
5	39	Male	Abdominal discomfort, nausea, vomiting and diarrhoea	Diabetes mellitus	96%	74%	32%	Moderately delayed gastric emptying
6	52	Male	Postprandial vomiting	Diabetes mellitus, hypertension and dyslipidemia	77%	50%	15%	Mildly delayed gastric emptying
7	63	Female	Epigastric discomfort, frequent burping and regurgitation	Parkinson's disease	80%	61%	10%	Delayed gastric emptying in the early phase with normal gastric retention at 4h
8	32	Female	Persistent nausea and vomiting	Diabetes mellitus, hypertension and dyslipidemia	61%	28%	0%	Normal gastric emptying study
9	34	Female	Persistent dyspepsia and vomiting	Diabetes mellitus	98%	71%	16%	Mildly delayed gastric emptying
10	32	Male	Cyclical vomiting syndrome	Diabetes mellitus	93%	78%	20%	Mildly delayed gastric emptying
11	66	Female	Chronic dyspepsia	Diabetes mellitus, hypothyroidism and bronchial asthma. History of appendicectomy and cholecystectomy	97%	68%	9%	Delayed gastric emptying in the early phase with normal gastric retention at 4h
12	66	Male	Dyspepsia and weight loss	Diabetes mellitus and hypertension	66%	24%	0%	Normal gastric emptying study
13	47	Male	Abdominal discomfort, vomiting, chronic diarrhoea and weight loss	Diabetes mellitus, chronic pancreatitis and hyporeninemic hypoaldosteronism	97%	94%	60%	Very severe delayed gastric emptying

h = hour, GES = gastric emptying scintigraphy

Table II: Association of gender, age, diabetes mellitus and symptoms with gastric emptying scintigraphy findings at 1, 2 and 4 hours

	One Hour		p-value	Two Hour		p-value	Four Hour		p-value
	Normal	Abnormal		Normal	Abnormal		Normal	Abnormal	
Gender									
Female	3	4	1.000	1	6	0.266	5	2	0.286
Male	3	3		3	3		2	4	
Age group									
≤40 years	2	4	0.592	1	5	0.559	2	4	0.286
>40 years	4	3		3	4		5	2	
Diabetes mellitus									
No	2	0	0.192	0	2	1.000	2	0	0.462
Yes	4	7		4	7		5	6	
Dyspepsia									
No	2	2	1.000	2	2	0.53	1	3	0.266
Yes	4	5		2	7		6	3	
Nausea-vomiting									
No	3	2	0.583	2	3	1.000	5	0	0.021*
Yes	3	5		2	6		2	6	

Fisher's Exact Test (p value <0.05 indicated a significant difference)

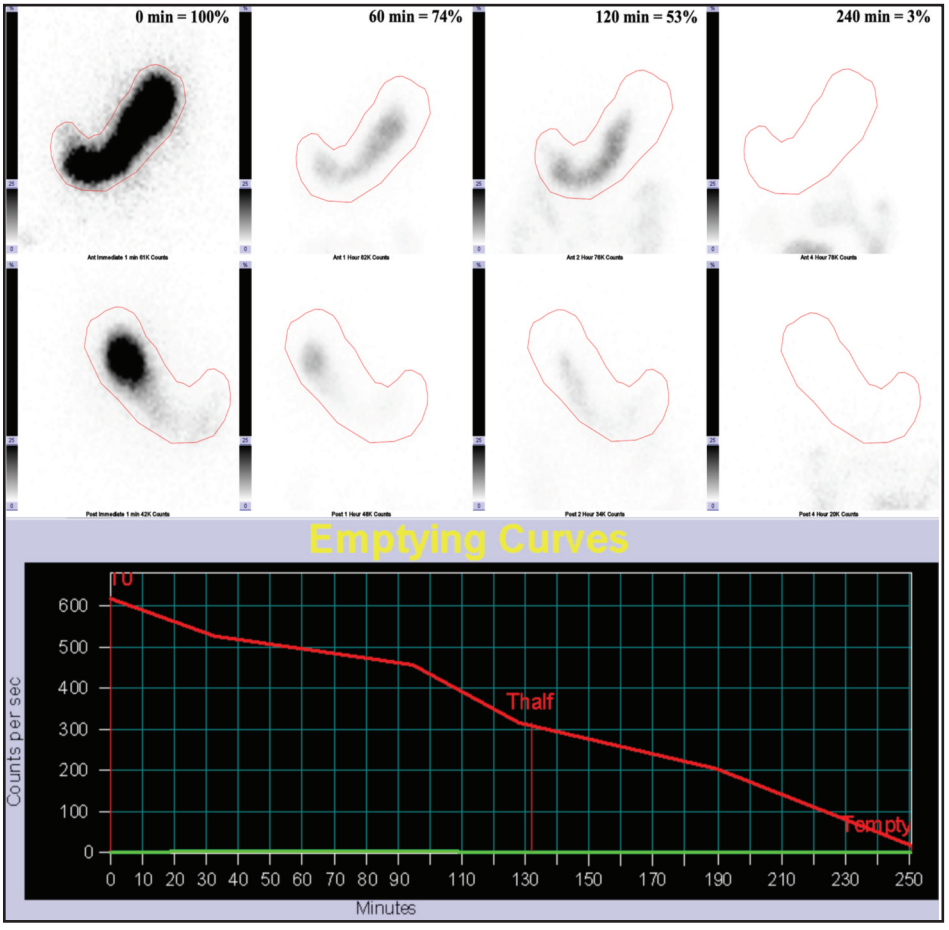

Fig. 1: A 72-year-old male diagnosed with diabetes mellitus, hypertension, hypothyroidism and bronchial asthma, complained of a 1-year history of epigastric pain and abdominal bloating. GES showed the radiopharmaceutical meal in the stomach in the immediate image with progressive emptying of radiotracer from the stomach into the small bowel as the study progress. Quantitative assessment and emptying curve showed the gastric retention at 1, 2 and 4 hours were within the normal range denoting a normal GES study.

food, followed by subsequent grinding of food into smaller fragments, also known as trituration.[1,3,4,13] The fragmented food is then liquefied by the actions of both antral contractions and digestion of gastric acid, producing a high liquid shearing force that propels the food particles, 1 to 2 mm in size against the pylorus before it empties into the duodenum.[1,3,4,13] In gastroparesis, there is impairment in extrinsic neural control, intrinsic nerves dysfunction and

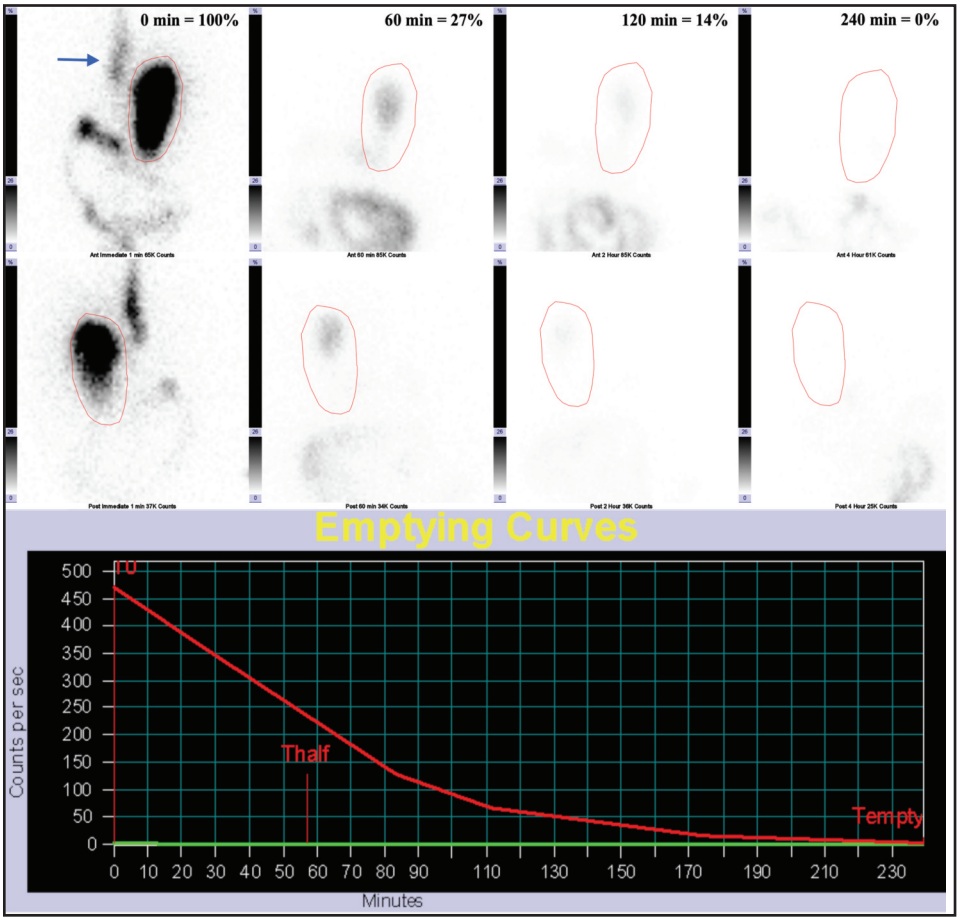

Fig. 2: A 68-year-old female with diabetes mellitus and dyslipidemia who presented with a 2-year history of heartburn, bloating and abdominal discomfort. GES showed rapid movement of tracer from the stomach into the small bowel with early visualization of the large bowel in the immediate (0 min) image. Quantitative assessment and emptying curve revealed 27% gastric retention at 1 hour (normal tracer retention range at 1 hour is 30% to 90%) indicating a rapid gastric emptying. There is also an ancillary finding of gastroesophageal reflux as evidenced by abnormal accumulation of radiotracer in the distal esophagus seen in the immediate (0 min) image (blue arrow).

interstitial cells associated with local control of gastrointestinal muscle as well as loss of function of the smooth muscles.[1,3,4,6]

The symptoms of gastroparesis include early satiety, nausea, vomiting, postprandial fullness, belching, bloating, abdominal pain and abdominal discomfort.[2–4,6,8,13] Nonetheless, patients with rapid gastric emptying and functional dyspepsia may present with almost identical symptomatology.[2,4,6] This presents a diagnostic dilemma amongst the treating physician as the treatment strategies for each of the disorder differ. Furthermore, both gastroparesis and rapid gastric emptying can present in diabetic patients.[4] In our case (Figure 2), a 68-year-old patient with diabetes mellitus who was initially thought to have gastroparesis was found to have rapid gastric emptying from GES which result in a change of the patient's treatment plan. Moreover, in our study, it was found that the clinical symptoms of nausea and vomiting were significantly associated with delayed gastric emptying (abnormal gastric retention at 4 h) (Table II). This is similar to the findings from a systematic review and meta-analysis by Vijayvargiya et al.[16], which noted a significant association between symptoms of nausea and vomiting with delayed gastric emptying. In addition, other symptoms such as abdominal pain and early satiety were also recognized to be significantly associated with gastroparesis.[16] Nonetheless, further assessment with larger sample size is needed to validate our findings.

There is a myriad of tests that can be used to diagnosed gastroparesis such as GES, gastric emptying breath test (GEBT) and wireless motor capsules (WMC).[1,3,17] GEBT does not involve radiation exposure and is easy to use. A ^{13}C-labelled substrate is added to a standard liquid or meal. When the labelled food enters the duodenum, $^{13}CO_2$ is released as the labelled food is absorbed and broken down. The release of $^{13}CO_2$ from the breath is sampled at regular intervals to generate an emptying curve.[18] However, the test is not widely available, is easily influenced by physical activity and unreliable in patients with malabsorption, chronic obstructive pulmonary disease and pancreatic insufficiency.[1,3,18] Like the GEBT, WMC can assess gastric emptying without the involvement of radiation exposure with the added advantage of evaluating intestinal and bowel motility.[1,3] The gastric emptying is measured when a change of pH is detected as the capsule enters the alkaline duodenum

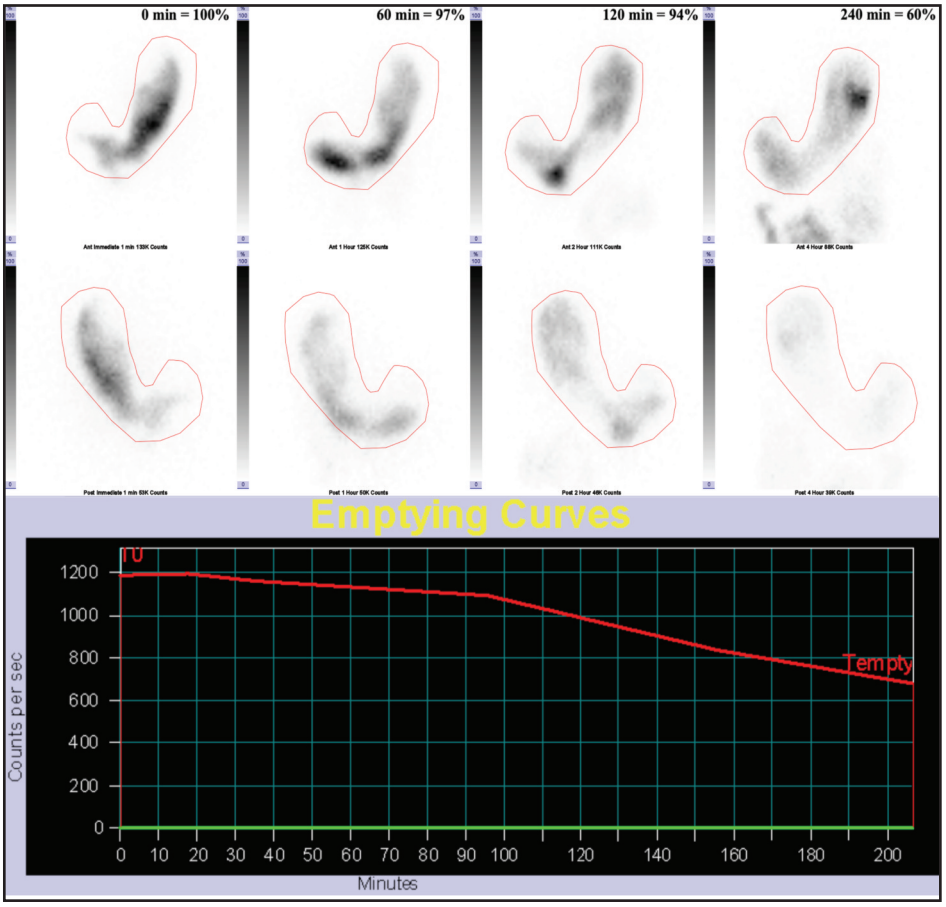

Fig. 3: A 47-year-old male with diabetes mellitus, chronic pancreatitis and hyporeninemic hypoaldosteronism. Presented with a history of chronic diarrhea, epigastric pain, vomiting and loss of weight. GES showed tracer accumulation in the stomach in the immediate image with slow transit of tracer into the small bowel as the study progress. There is significant retention of tracer by 4 hours of study with 60% gastric retention (upper limit of tracer retention is 10% at 4 hours) signifying very severe delay in gastric emptying.

from the acidic stomach.[18] However, this method is expensive, limited in availability and does not empty at a similar rate as a digestible meal.[18] Comparatively, GES has the advantage of being non-invasive, quantitative as well as physiologic in the evaluation of gastric emptying.[2] GES involves ingestion of radioisotope labelled solid meal with a short half-life and the measurement of radioactivity in the stomach at various time intervals to determine the rate of gastric emptying.[3,8] The limitations of GES include minimal radiation exposure, the prepared meal may not be palatable to the Malaysian population and long duration of study which may require patients to be in the nuclear medicine department throughout the day.

GES aims to identify patients with gastroparesis who may benefit from pharmacological or other treatments.[8,13] Common indications for performing GES are a) unexplained nausea, vomiting and dyspeptic symptoms; b) assessment of gastric motility before fundoplication for gastroesophageal reflux disease; c) evaluation of gastric motility before small bowel transplantation or colectomy for colonic inertia; and d) screening for gastroparesis in diabetic patients.[19] Since the introduction of GES in 1966, there were variations in terms of meal composition, imaging protocols and normal values of gastric emptying which hinders its clinical application. A consensus between the American Neurogastroenterology and Motility Society and the Society of Nuclear Medicine was reached in 2008 [2] to resolve the issues. The universally recognized test meal is the low fat, egg white meal which was described by Tougas et al. with image acquisition to be performed the least, at 0, 1, 2, and 4 h post radiolabelled meal ingestion.[5] The consensus is currently the accepted standard for GES and has been adapted in many centres around the world, including in HKL. Apart from diagnosing gastroparesis and rapid gastric emptying, other ancillary findings can also be found on the GES study such as gastroesophageal reflux disease (Figure 2), reduced fundus compliance, reduction in fundus accommodation, and antral dysmotility which further enhance its diagnostic utility.[2,7,17]

Although the ^{99m}Tc generator is readily available in the nuclear medicine department, the sulfur colloid kit which is tagged with ^{99m}Tc is deemed expensive and not cost-effective, limiting the study's availability. Usage of ^{99m}Tc sulfur colloid is primarily due to its properties of not being absorbed by the mucous membranes of the gastrointestinal tract and its good binding to the egg white protein.[13] Other cheaper alternatives with good labelling efficiency have been sought such as tin colloid, nanocolloid and macroaggregated albumin [14] to replace sulfur colloid. However, none of the studies were

conducted in vivo. In a study conducted by Mat Nawi et al. [20] involving 31 healthy individuals who underwent GES on two separate days using ^{99m}Tc sulfur colloid and ^{99m}Tc phytate, it was found that there was no statistically significant difference in gastric retention percentage at each time point between both radiopharmaceuticals. The in vivo study further concluded the use of ^{99m}Tc phytate as a valid alternative to the gold standard ^{99m}Tc sulfur colloid. In addition, the cost of a kit for phytate is five-fold cheaper compared to sulfur colloid with the added advantage of a more convenient radiopharmaceutical preparation.[20] The normative range of gastric retention percentage was almost identical to the one used by Abell et al., [2] hence, can be a reference point for its use in Malaysia. Usage of ^{99m}Tc phytate for GES has also been reported in other countries such as Thailand and Brazil.[21,22]

The commonly used radiolabelled meal in GES is the Western-styled meal, which consists of scrambled eggs, jam and two slices of bread. Nonetheless, the Western-styled meal may not be well accepted by other cultures including in Malaysia. Other centres from different regions of the world have modified or used different types of meal labelled with ^{99m}Tc sulfur colloid that is acceptable to the local population. This includes vegetarian solid meal comprising of Indian bread or chapatti,[17] hamburger,[23] steamed rice,[21] chocolate mug-cake[24] and scrambled tofu[24]. However, its use is not recommended until sufficient validation is available.[8] Hence, there is a need to formulate a locally acceptable and validated test meal for the GES study.

In patients who are unable to tolerate egg-white based meals or who have egg allergies, other alternatives have been proposed. In a study by Sachdeva et al. [9] comparing liquid nutrient meal (EnsurePlus) of similar caloric content to the standard egg-white meal involving 20 healthy volunteers, it was concluded that the overall gastric emptying is similar between the two meals. In another study by Solnes et al. [25] involving 21 healthy subjects using liquid nutrient meal for GES, the normal gastric emptying values were determined and compared with another group of normal volunteers which used the standard egg-white based meal. No significant differences in gastric retention percentage were found between liquid nutrient meal and the egg-white based meal group at specific time points. Both studies further advocate the use of liquid nutrient meal as an acceptable and reliable alternative to egg-white based meal in GES study. However, the main drawback of a liquid nutrient meal lies in its inability to assess the physiological aspect of trituration of the GES study.

Therapeutic strategies in gastroparesis encompassed treating the underlying cause, diet and lifestyle modifications such as multiple small meals, weight loss and avoidance of smoking and alcohol, antiemetic drugs, prokinetic agents and psychotropic medications.[1,3] For diabetic patients, the emphasis is on the normalization of blood glucose levels.[1,3] In patients who have failed pharmacological treatment, other therapy such as endoscopy, surgery and gastric electrical stimulation are utilized.[1,3] The grading in terms of severity of gastroparesis derived from GES can be used to assess treatment response and point the clinicians towards the appropriate treatment,[1,2] paving the way for personalize medicine. Mild to moderate gastroparesis can be treated with prokinetic agents in addition to dietary and nutritional modifications, while endoscopic treatment, gastric electrical stimulation and surgery can be considered in patients with severe or very severe gastroparesis as illustrated in our case (Figure 3). Prokinetic drugs may not be efficacious in those who have a normal GES study and this group of patients may likely benefit from other treatments.[5] In contrast to gastroparesis, the treatment strategies for patients with rapid gastric emptying include dietary modifications such as high protein and high fibre meals, pharmacological agents such as somatostatin analogues and acarbose, invasive procedures such as gastric pouch restriction as well as jejunostomy in malnourished patients.[4]

In our study, three patients had delayed gastric emptying in the early phase with normal gastric retention at 4 h. The early phase (0 to 2 h) reflects gastric fundus function whereas the delayed phase (2 to 4 h) signifies antral trituration as well as the movement of the meal into the duodenum.[7] Future therapies may be tailored to individually i.e. target fundus or antrum based on the early or late abnormalities characterized by a 4 h GES study.[7] At the present, patients with delayed gastric emptying in the early phase and mildly delayed gastric emptying at HKL are generally treated with pharmacological therapy along with dietary and lifestyle modification whereas two patients in the moderate to very severe delayed gastric emptying group are being considered for endoscopic treatment.

Because of limited nuclear medicine centres and resources in Malaysia, it is imperative to make use of available scan slots and gamma camera time for GES study. We therefore suggest a designated day for GES and to maximize the number of patients to be tested for that day. Close coordination and planning is thus needed amongst the referring clinician, nuclear medicine physician and nuclear medicine technologist in patient scheduling to ensure efficiency and optimal use of available gamma camera. Moreover, cheaper radiopharmaceutical alternatives can be considered if the need arises. This will inadvertently enhance the cost-effectiveness of the GES study without compromising the accuracy of the test.

LIMITATIONS OF THE STUDY

Limitations from this study is the small sample size and patients from a single institution. Thus, we were unable to generalize the findings observed in this study. In addition, this is a retrospective and cross sectional study with no long term follow up. Hence, we were unable to determine the causal relationship as well as changes in future management and patient outcome. Future prospective study with a larger sample size involving other institutions and long term follow up is thus advocated to ascertain the change or outcome of treatment in patients who underwent GES.

CONCLUSION

Gastroparesis is a relatively under diagnosed medical disorder and GES remains the gold standard in the assessment of this condition. GES provides valuable information to the referring physicians in the diagnosis of

gastric motility disorders and facilitate subsequent treatment plan. The limited availability of GES however hampers its clinical usefulness. Further effort is thus needed to enhance the availability and usage of GES in Malaysia.

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