

CASE REPORT

A surprising finding during solid-phase gastric emptying scintigraphy

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Abstract

In case of repeated episodes of abdominal discomfort and vagal symptoms, especially occurring after ingestion of a rich meal, the diagnosis of intermittent volvulus could be considered. The sudden arrival of large amounts of partially digested food in the intestine after spontaneous resolution might be associated with a dumping syndrome.

KEYWORDS

dumping syndrome, gastric emptying scintigraphy, gastric volvulus

1 | INTRODUCTION

Gastric volvulus is a rare clinicopathological entity with an unknown incidence, defined as a >180°-rotation of the stomach along its long or short axis, or more rarely, a combination of both.¹

Clinical presentation is most often subacute or chronic, with intermittent nonspecific abdominal symptoms of spontaneous resolution, sometimes precipitated by large meals.² Diagnosis can be delayed for up to years, especially when the rotation of the stomach is not complete.

Gastric emptying scintigraphy is a validated technique to assess the functional state of the stomach noninvasively using either solid- and/or liquid-radiolabeled food. It constitutes the gold standard and most widely used technique to confirm gastroparesis and has also been used in the diagnostic workup of dumping syndrome, though with a lower accuracy.^{3,4} The effective dose equivalent of radiation exposure related to the procedure is about 0.7 to 1.2 mSv (0.019 to 0.024 mSv/MBq) depending on the gender and weight of the patient.⁵ As a comparison, radiation exposure due to radiological examinations of the abdomen amounts to about 0.5 mSv for a plain X-ray and to about 7 mSv for a multidetector CT.

We present the case of a woman with a history of long-standing nonspecific episodic abdominal complaints associated with an inappropriate hyperinsulinemic response to hypoglycemia, raising the possibility of a dumping syndrome, in whom a gastric emptying scintigraphy led to the diagnosis of an intermittent gastric volvulus.

2 | CASE REPORT

A 22-year-old woman repeatedly visited the emergency department for episodes of abdominal pain, faintness, nausea without vomiting, profuse sweat, headache, and palpitations, mostly appearing more or less 1 h after a rich meal. Symptoms lasted for more than 3 years and had started shortly after a severe car accident with multiples fractures, a subdural hematoma, a liver tear, and a traumatic pneumothorax. During her stays in the emergency room, a glycemia at the lower normal range with no improvement after oral intake of fast acting sugar and an inappropriate hyperinsulinemia had been documented several times. Interestingly, the patient was a regular practitioner of intermittent fasting, usually lasting between 18

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and 24 h, and never noticed any hypoglycemic event during fasting.

At the time of the present episode, clinical examination was unremarkable. Palpation revealed a diffuse sensibility of the upper abdomen without defense or rebound. Blood pressure was 123/90 mmHg and heart rate 83 bpm. Glycemia was 3.94 mmol/L (N = 3.9–5.56 mmol/L) and insulinemia 181 pmol/L (N: 17.8–173 pmol/L). The glucose level increased to 5.7 mmol/L after intravenous administration of 20 ml (10 g) of hypertonic glucose.

The patient was hospitalized for further investigations. Abdominal ultrasonography and CT were normal, as well as gastroscopy. Exhaustive biological diagnostic workup, including anti-insulin antibodies and C-peptide dosage as well as a tetracosactide 0.25 mg IM (Synacthen®) stimulation test, did not reveal any abnormality. The 75g-oral glucose tolerance test (OGTT) with measurements up to 240 min demonstrated a late and prolonged mild hypoglycemia (glycemia at T120, T180, and T240 was, respectively, 4.18, 3.74, and 3.41 mmol/L) with an inappropriate hyperinsulinemia.

Because the reported symptoms and the biological measurements observed during the acute episodes could be evocative of a dumping syndrome, a gastric emptying scintigraphy was ordered.

One min. duration sequential anterior and posterior images were obtained more or less every 30 min during 90 min, starting immediately after ingestion of a standardized meal consisting of 2 scrambled eggs labeled with 50 MBq ^{99m}Tc-MAA, 2 slices of white bread, and 200 ml

water. Radiation exposure related to the procedure was about 1.2 mSv. The patient experienced abdominal discomfort and vagal symptoms early after intake of the meal. Clinically, she was pale, nauseous, and sweaty. Heart rate was 100 bpm and blood pressure 100/80 mm Hg. Unfortunately, glycemia was not measured during this episode. At visual analysis (Figure 1), the cardia was located in the right hypochondrium on the anterior view up to T30, with the greater curvature remaining caudal (arrows) and most of the radioactive gastric content located at the level of the fundus and body. Bowels loops were, however, already significantly visualized at T30, indicating that the pyloroduodenal junction was not completely obstructed. Symptoms resumed spontaneously after 45 min. At T60, the stomach had turned back to its anatomical position and visualization of the intestines became prominent compared to the stomach.

Regions of interest were manually drawn over the stomach (Figure 1) at the different time points to quantify the % retention of the radiolabeled meal and the time to half-emptying, taking into account the radioactive decay of ^{99m}Tc. The calculated gastric retention (Figure 2) was 58% at T30 and dropped to 18% at T60 (N after ingestion of a standardized solid meal: ≤90% at 1 h; retention <70% at 30 min and <30% at 1h suggests abnormally rapid emptying,⁶). Clearance (expressed as the half-emptying time) was 33 min after decay correction (N: 50 ± 15 min).

Based on both visual and quantitative analyses, the diagnoses of intermittent mesenteroaxial gastric volvulus and of an abnormally rapid emptying, possibly dumping

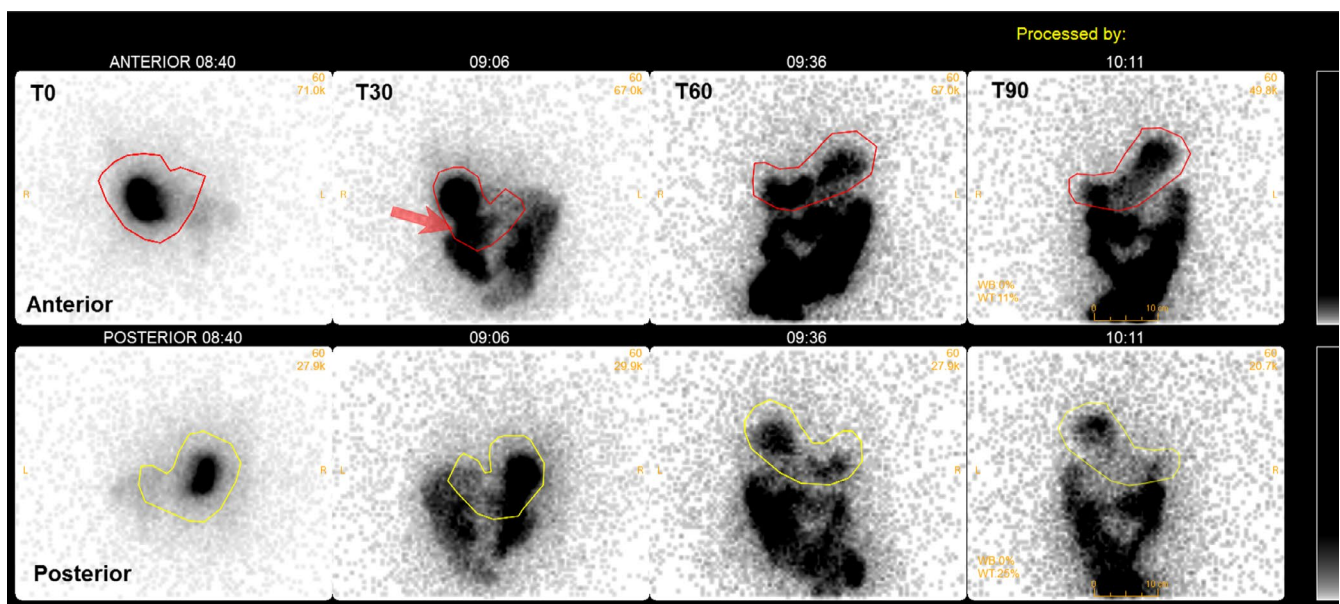


FIGURE 1 Anterior and posterior images of the solid-meal gastric emptying scintigraphy and the corresponding regions of interest manually drawn around the stomach at different time points: immediately after ingestion of the standardized meal, and 26 min, 56 min, and 92 min later (referred to as T0, T30, T60, and T90 in the figure). The gastric fundus and body were located in the right hypochondrium up to T30, with the greater curvature remaining caudal (arrow). The stomach had turned back to its anatomical location at T60

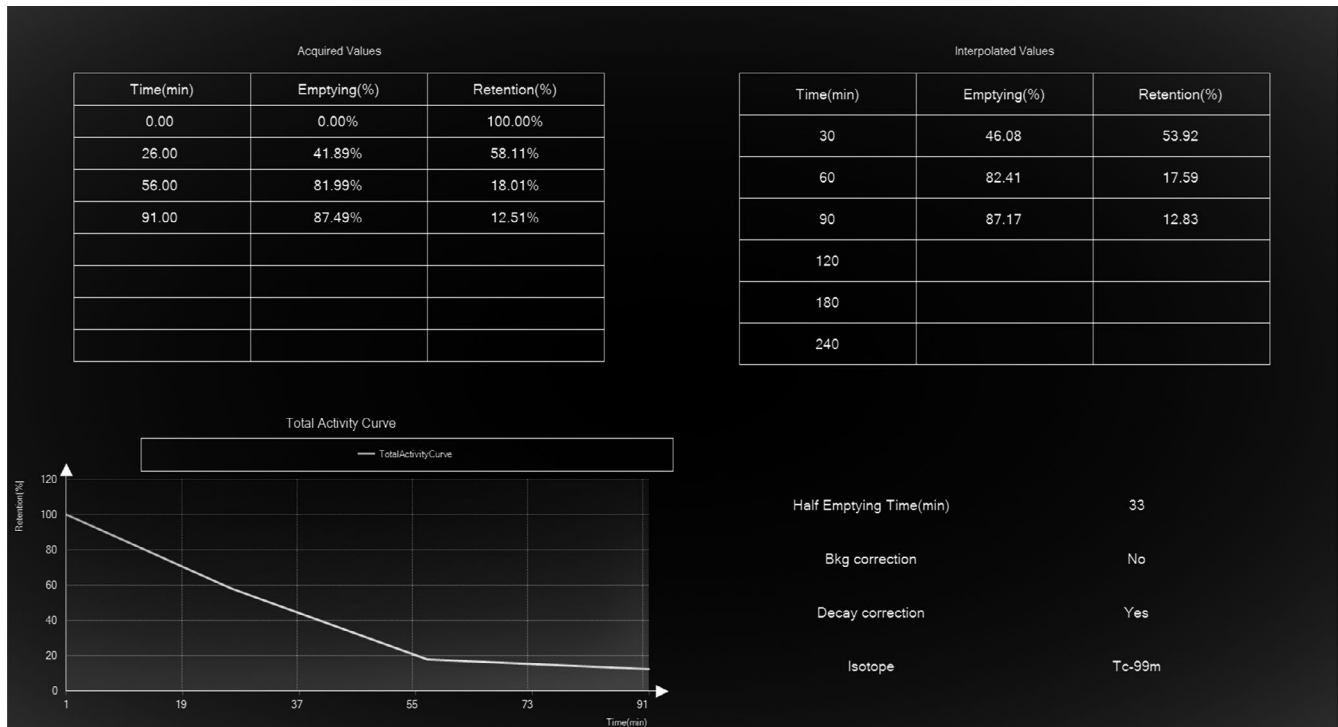


FIGURE 2 Quantitative analysis of the gastric emptying. The radioactivity (in kilocounts/min) is measured in the regions of interest drawn on both anterior and posterior images at the different time points, and a geometric mean is calculated. The mean activity at T0 is considered as the 100% value, and the activity at the other time points is expressed in % of this initial value to calculate emptying and retention rates as well as the time to half-emptying, taking into account the ^{99m}Tc -decay. The left table shows the % emptying and retention at the real time points of acquisition where the images were really acquired, whereas the right table gives the same parameters interpolated at 30, 60, and 90 min. Half-emptying time was 33 min ($N: 50 \pm 15$ min). Using the real acquisition time points, gastric retention was, respectively, 58% and 18% at 26 min and 56 min after ingestion of the standardized radioactive solid meal. The values at the interpolated time points were very similar (54% and 18% at T30 and T60, respectively). Normal retention rate should be $\leq 90\%$ at 1 h. A retention $< 70\%$ at T30 and $< 30\%$ at T60 suggests an abnormally rapid emptying.⁶ The graph at the bottom of the figure depicts the evolution of the gastric radioactive content on the Y-axis (expressed in % of the maximum measured at T0) over time on the X-axis (in min). A steep and continuous decrease can be observed during the first hour after intake of the meal, suggesting that the abnormally rapid gastric emptying was not related to the spontaneous detorsion of the volvulus

syndrome, were proposed. Laparoscopic examination confirmed an abnormal mobility of the stomach, to beyond the gallbladder. No other relevant abnormalities were found. Anterior gastropexy was performed, resulting in an improvement of all symptoms and signs.

3 | DISCUSSION

Gastric volvulus, defined as an abnormal rotation of the stomach by more than 180° along its long or short axis, results in a close-loop obstruction of the upper gastrointestinal tract, either permanent in the acute presentation, or of spontaneous resolution in the intermittent, subacute, or chronic forms. Depending upon the rotation axes, 4 different types are described. Type 1 (organoxial) is due to a rotation about the axis connecting the esophagogastric junction and the pylorus and is the most frequent form (59%), affecting mostly adults of above 50 years (80–90%).

In type 2 (mesenteroaxial), the stomach rotates about the axis between the greater and the lesser curvatures. This form accounts for about 29% of all volvuli and is more common in younger patients.⁷ Type 3 (2%) represents a combination of types 1 and 2, whereas Type 4 (10%) includes all unclassifiable forms.¹

In 30% of the cases, gastric volvulus is idiopathic, attributed to a functional or anatomical failure of the gastric suspensory ligaments, whereas in the remaining 70%, congenital or acquired local abnormalities are found, allowing the stomach to move more or less freely in the left hypochondrium.^{8,9} Among the possible causes of acquired volvuli, a history of abdominal trauma is not rare that can either damage directly the suspensory system or the anatomical structures surrounding the stomach, such as a diaphragmatic rupture or eventration, or induce post-traumatic adhesions around which the stomach can rotate.¹⁰

Clinical presentation varies from the Borchardt's triad associated with the life-threatening acute strangulation of the stomach, to sporadic, recurrent, and extremely nonspecific symptoms of abdominal discomfort or bloating (often improving with ventral decubence), burning epigastric pain, early satiety, nausea and vomiting or hiccups in the subacute or chronic forms. The acute presentation is more frequent in the organoaxial type, whereas mesenteroaxial volvuli are more often characterized by recurrent episodes of intermittent acute symptoms, sometimes associated with intake of large and/or rich meals attributed to a possible rapprochement of the esophagogastric and pyloric ends when the stomach is full.² Spontaneous detorsion after a variable time is frequent.

Diagnosis of the nonacute types can be delayed for many years due to the nonspecific and intermittent clinical picture and absence of definite diagnostic tools.^{11,12} Biological tests are mostly almost or completely normal, as well as gastroscopy out of the acute phase. Rarely, gastroscopy demonstrates a twist at the entrance of the stomach, or difficulties to pass through the pylorus.¹³ Chest and abdominal X-rays, barium swallow, and, more recently, contrast-enhanced multidetector CT imaging are the recommended methods to confirm the diagnosis but can be (near)normal out of an acute episode.^{14,15}

To the best of our knowledge, diagnosis of intermittent volvulus on a gastric emptying scintigraphy has never been reported so far.

In our patient, nonspecific recurrent abdominal complaints occurred often after intake of a rich meal and were associated with an inappropriate hyperinsulinemic response to hypoglycemia, raising the possibility of a dumping-like syndrome.

Dumping syndrome is a quite common complication of upper gastrointestinal surgery, with a prevalence ranging to almost 50% of the patients in some series.^{16,17} It has also been reported in association with diabetes mellitus or viral infections, deteriorating the intrinsic gastric innervation. Even an idiopathic origin has been described, though with a previous history of gastroenteritis in about 50% of the patients.^{18,19} A distinction is often made between the more frequent early dumping (30–60 min after a meal), due to the rapid entrance of undigested hyperosmolar food into the small intestine and the release of various hormones including insulin and glucagon, incretins and vasoactive intestinal substances, and the less common late dumping (>1 h post-ingestion), due to an incretin-driven hyperinsulinemic response to high glucose concentrations in the foregut. Considerable overlap in the clinical presentation and co-occurrence of both are, however, frequent.^{3,20,21}

Symptomatic hypoglycemia can lead to repeated hospitalizations and even seizure or epilepsy.²²

Diagnosis of dumping syndrome relies currently on an OGTT, considered as the best diagnostic test.⁴ Although an abnormally rapid gastric emptying is a key mechanism in dumping syndrome, the accuracy of gastric emptying tests is considered too low to a reliable diagnostic tool, especially after surgery. During the OGTT, clinical (changes in pulse rate during the first 30 min) and biological parameters (hematocrit and glycemia) are monitored. Most studies consider a glycemia <3.33 mmol/L between 120 and 180 minutes as the diagnostic cutoff for late dumping.

In our patient, the lowest glucose value during the OGTT was 3.41 mmol/L at 240 min, slightly too high for a definite confirmation of the diagnosis. The reported symptoms, often precipitated by the ingestion of a rich large meal, were probably due to episodes of intermittent volvulus with spontaneous detorsion. The volvulus was visualized during scintigraphy and associated with a vagal reaction and abdominal symptoms similar to those for which she repeatedly visited the emergency department that disappeared after reversion of the stomach to its anatomical position. At surgery, no gross anatomical lesion could be found but the stomach was abnormally mobile, maybe as a consequence of the previous abdominal post-traumatic injury.

It is unclear whether the rapid gastric emptying found by scintigraphy was independent of the intermittent volvulus, and the concomitant observation of both pathophysiological conditions was purely due to chance, or if a link could exist between the two phenomena. Also, the possible relationships, if any, between the inappropriate hyperinsulinemic response to hypoglycemia, the intermittent volvulus, and the rapid gastric emptying are not obvious. The volvulus and the hypoglycemia with hyperinsulinemia began after the abdominal trauma and improved after gastropexy, suggesting a potential link. Moreover, even when fasting during 18–24h, the patient never experienced hypoglycemic events out of the acute episodes. The rapid emptying on the other hand could be a pre-existing, asymptomatic condition, incidentally diagnosed. Repeating the scintigraphic examination after surgery might have provided some answers, but exposure of a young patient to ionizing radiation without medical justification is nowadays not acceptable.

This case report illustrates the difficulties in diagnosing intermittent gastric volvulus because of its erratic frequency, the atypical clinical presentation as well as the lack of specific clinical, biological, and imaging features. Since the release of large amounts of (partially) undigested food in the foregut after spontaneous resolution of the volvulus could potentially induce a dumping syndrome, this

diagnosis might be evoked in patients with unexplained dumping-like symptoms, especially if there is a history of previous abdominal trauma or surgery, or an association with the ingestion of large meals.

CONFLICT OF INTEREST

All authors state that they have no conflicts of interest.

AUTHOR CONTRIBUTION

ASH wrote the first draft of the manuscript. OK and ASH revised subsequent versions of the manuscript. Both authors read and approved the final version of the paper. ASH accepts responsibility for the integrity of the case description and data analyses.

ETHICS APPROVAL

The patient gave consent for the procedures after detailed explanation of their purpose and the operating mode. For the procedures including exposure to ionizing radiation, dedicated explanation with regard to the risks related to this exposure was given. For the scintigraphic procedure, an informed consent regarding absence of pregnancy and breastfeeding was signed by the patient before ingestion of the radioactive meal.

DATA AVAILABILITY STATEMENT

Data available on request due to privacy/ethical restrictions. The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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