



Guideline for Gastric Emptying – British Nuclear Medicine Society.

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This guideline must be read in conjunction with the BNMS Generic Guidelines

1. Purpose

This guideline must be read in conjunction with the BNMS Generic guidelines.

The purpose of this guideline is to assist specialists in Nuclear Medicine and Radionuclide Radiology in recommending, performing, interpreting and reporting the results of gastric emptying studies. This guideline will assist individual departments to formulate their own local protocols. This does not aim to be prescriptive regarding technical aspects of individual camera acquisitions which need to be developed in conjunction with the local medical physics expert. These guidelines pertain only to adult patients.

2. Background.

Gastric emptying scintigraphy is a safe, non- invasive method for assessing the ability of the stomach to empty which has been used clinically for many years (1,2). It is regarded as a “gold standard” to assess gastric emptying of both solids and liquids allowing assessment of early, mid and late emptying, each of which may be altered by pathology.

The normal stomach serves as a temporary storage area for food. It physically and chemically breaks down food into smaller particles via muscular activity, hydrochloric acid and enzymes. It mixes the food with gastric secretions to form chyme which it releases in a controlled manner through the pyloric sphincter into the small intestine.

The rate of emptying varies with a variety of factors with liquids emptying more rapidly than solids (3). Liquids tend to empty exponentially and solids in a linear manner. There can be a large variation for normal gastric emptying even in the same subject. Food content and composition will affect the rate of emptying, e.g. a high fat content decreases gastric motility. Other patient factors such as sex, smoking, time of day and time of the menstrual cycle in women may also affect the gastric motility. However, some of the evidence in these areas is contradictory.

Several drugs alter the rate of emptying (3) so a history of relevant medication should be taken prior to the test. Erythromycin, Domperidone and Metoclopramide (prokinetic agents) increase the rate of emptying. Opiates and antispasmodics decrease the gastric emptying rate. Where possible, drugs that affect the emptying rate should be stopped 4 drug half-lives prior to the test; however, this may not be possible or advisable and should be tailored to the individual clinical context.

The wide range of procedures used and the variability of gastric emptying makes it essential that standard, validated methods are applied (4). For departments wishing to set up this study, the US standard meal is one option as there is much experience with this method and it is relatively straightforward although the meal may not be suitable for all patients (5). Where a

department is already using another method, then they should be encouraged to keep to that protocol where this is suitable for the local population but only if it has undergone a process of validation.

These guidelines are not a substitute for local clinical support and gastric emptying studies require adequate, medical, physics and technical support to achieve good results.

3. Conditions which are investigated using gastric emptying scintigraphy include:

Diabetic patients with upper GI symptoms

Possible gastroparesis or dumping syndrome

Possible gastric reflux

Endoscopy negative dyspepsia

Persistent symptoms after gastric surgery

Follow up scans to assess response to therapy.

4. Contraindications.

Absolute: Allergy to the food stuff (e.g. eggs, nuts, lactose, gluten)

Relative: Pregnancy and breastfeeding (If ^{99m}Tc -Colloid is used there is no need to interrupt breast feeding. However, as studies of gastric emptying are not life-threatening, consideration should be given to delaying the investigation until after breast feeding has ceased.)

Diabetic patients require caution when fasting.

5. Radiopharmaceuticals and dose

For solid or semisolid gastric emptying studies, ^{99m}Tc can be combined with any non-absorbable compound which does not dissociate; colloids are often used. If a dual liquid/solid study is required, a simultaneous liquid study can be performed labeled with ^{111}In -DTPA.

The ARSAC diagnostic reference level for ^{99m}Tc non-absorbable compounds is 12MBq. The ARSAC diagnostic reference level for ^{111}In is 12MBq for non-absorbable compounds and 10MBq when combined with DTPA for liquid gastric emptying.

The choice of the meal to which radiopharmaceuticals are labelled will depend on the protocol (4).

Some examples of meals used are:

Liquid gastric emptying- radiolabelled water or orange juice

Semi-solid gastric emptying-radiolabelled mashed potato (6) or porridge (7)

Solid gastric emptying-radiolabelled scrambled egg with toast and jam is the standard meal (3). However, other non-standard meals may be used if they have undergone validation (8).

6. Radiation exposure The effective dose from ^{99m}Tc non absorbable compounds is 0.3mSv. The effective dose for liquid ^{111}In -DTPA is 3mSv and for ^{111}In -non-absorbable compounds is 4mSv (9).

7. Patient preparation

Generally the patient should fast for 4 hours prior to the procedure. Smoking should also be avoided. It may therefore be prudent to book diabetic patients first thing in the morning and advise them to bring food with them as well as their medication.

Where possible, drugs that affect the emptying rate should be stopped 4 drug half-lives prior to the study, however, this may not be possible or advisable clinically. A study may be performed on medication to assess its efficacy when it is used to treat a condition, however, a note should be made and care taken in interpretation, especially with repeat studies.

Patients should be informed about what meal they will be expected to eat before the appointment so that they can inform the department of any allergies or religious/cultural restrictions.

The standard meal should be given and eaten within 5-10 minutes. A record of the time to start eating and the time to start scanning should be made. Nothing other than the test meal should be eaten for the duration of the study.

Since many patients complain of sensations such as nausea, bloating and pain on eating, it is valuable to record patients' symptoms during the study. This may be used to aid interpretation of the investigation results.

8. Imaging Procedure

Camera	Preferably dual headed gamma camera to allow simultaneous anterior and posterior acquisitions
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Collimator	LEAP (other collimators may be used if sensitivity tests have been performed)
Scanning mode	This will depend on the protocol, for example with solid meals some centres use an hour's dynamic sequence with static images up to a maximum of 4 hours (6), other centres use a series of static images (5). Enough images should be acquired for the system to generate a reliable emptying T1/2. With liquid and semisolid studies it is preferable to perform a 1 hour dynamic sequence-60 x 1 minute frames.
Matrix size	128x128
Window	140keV with 20% window if ^{99m} Tc agents are used. 172 and 246 keV with 20% window if Indium agents used.
Patient position	Most studies are performed erect, however, semi-supine or supine may also be used although this may affect the emptying rate. The same method should be used throughout, especially if repeat studies are performed. The same position should be used throughout the study with the camera heads at the same distance from the patient. The stomach, distal oesophagus and proximal small bowel should be included in the field of view.
Time of start	As soon as the meal is finished, ideally within 5 minutes post ingestion.

9. Interventions

If vomiting occurs during the course of the study, this should be stored in a protected bowl and be counted to allow an estimation of counts lost.

10. Review and Processing

For dynamic sequences: A review for motion should be made with possible corrections made if appropriate. Reviewing the cine of the images is a good way of defining the gastric region and assessing any reflux.

ROIs should be drawn around the stomach and a remote background area on both anterior and posterior acquisitions, allowing generation of background corrected geometric mean values, producing a series of counts which can be plotted against time elapsed since consumption of the meal to produce a time activity curve.

How this data is used will depend on the protocol. A series of static views will allow the time activity curve to be plotted and compared to a normal range. Alternatively the half emptying time (from 0-60 minutes) for a dynamic study or static series can be calculated and compared to the normal range for the chosen meal.

Correction for radioactive decay should be performed, especially with the longer investigation times. Where a software programme is used, the user should be familiar with the programme operation, input variables and any calculation routines applied.

11. Reporting

The study should be reported by the ARSAC holder or suitably trained delegate with an understanding of both the clinical and technical issues involved. Structured reports are recommended to include:

1. Indication.

2. Technical note. This should comment on any factor which may cause a source of error such as incomplete consumption of the meal, vomiting, drugs, movement, non-fasting, stomach overlied by bowel, meal takes too long to eat or oesophageal problems.

3. Description. This should include both positive and negative findings as well as correlation with previous studies or alternative modalities if appropriate. Any symptomatic data should be added to provide additional information back to the referrer.

4. Interpretation The clinical question should be answered in the report

Reflux: Any oesophageal reflux should be mentioned together with any abnormal retention in the oesophagus.

Dynamics: There should be steady emptying of tracer from the antrum to the pylorus and on into the small bowel. Significant variations in this should be commented on, including intragastric reflux.

Gastric clearance: The clearance rate should be compared to the normal range for the protocol. The half-emptying time and/or the final % retention at 4 hrs should be quoted with the normal reference values for the protocol used.

12. Auditable aspects

Adherence of departmental scan acquisition, processing and reporting may be made against these guidelines. Gastric emptying can be controversial and further work and audit is needed in this area.

The protocol for the method used should be reviewed every 3 years to ensure that it is still valid and that there has been no drift from established practice.

13. References

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