NUCLEAR MEDICINE- Gastric Emptying

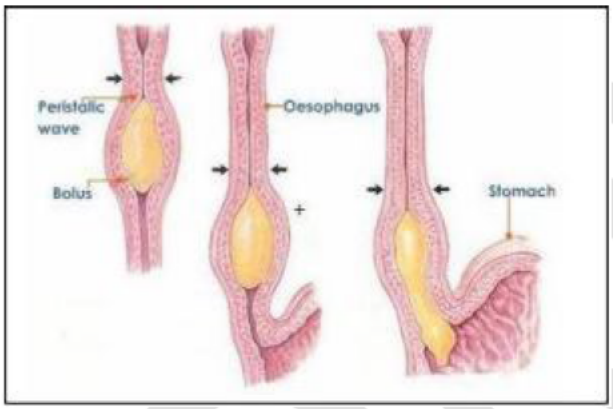
SETTING Nuclear Medicine, Department of Clinical Radiology, Bristol Royal Infirmary

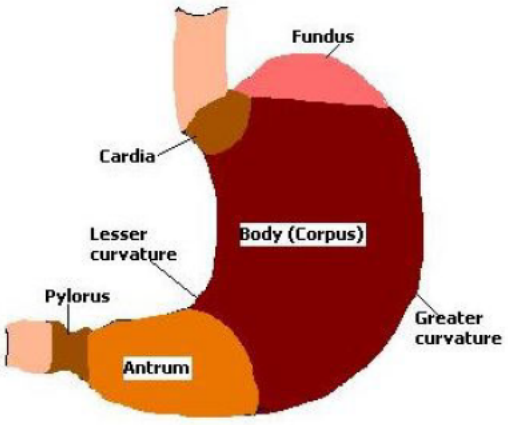
FOR STAFF Nuclear medicine staff holding the correct competencies

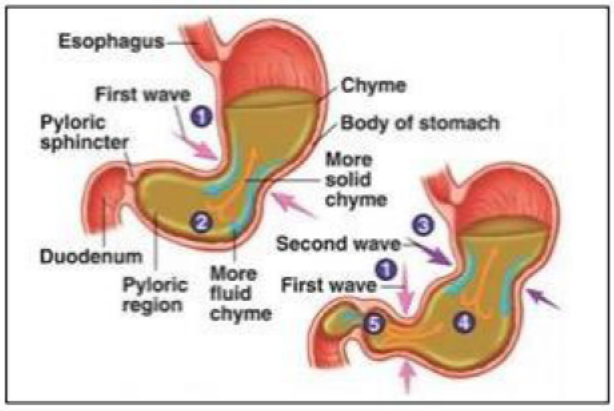
PATIENTS All adult & paediatric patients

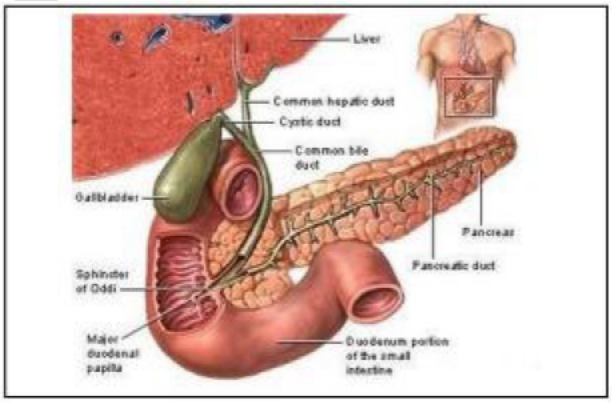
Background

Radionuclide studies of gastric emptying and motility are the most comprehensive and physiologic studies of gastric motor function available (Donohoe et al, 2009). 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 stomach consists of four regions, each having a separate role;









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. 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 and can also present with a range of symptoms. The time required for grinding food into small particles before solid emptying begins is the lag phase during which there is no emptying. Food content and composition will affect the rate of emptying,
e.g. a high fat content decreases gastric motility.

Delayed emptying defined by >10% retained at 4 hours (30% at 3h) (Abell et al, 2008).

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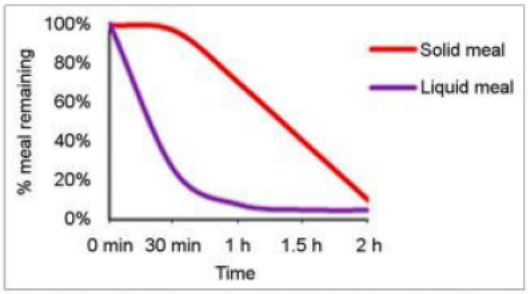

FIGURE 5. Normal gastric emptying curves. For solid meal (red), there is an initial 20-30 m lag period as the antrum reduces meal particle size and mixes with gastric acid. After the lag period, the solid material empties from the stomach in a linear fashion. The liquid meal (purple) immediately begins to leave the stomach and empties in an exponential pattern.

Patients suffering from gastroparesis or dumping syndrome may feel full very quickly, experience frequent nausea and vomiting and exhibit bloating, abdominal pain or heartburn.
This can be caused by damage to nerves and muscles that control how the stomach empties or be related to certain conditions (e.g diabetes, eating disorders, Parkinson's or Lewy body Dementia).
Dumping, may occur following stomach surgery and can be associated with dysfunction of the pyloric sphincter.
Treatment can involve dietary modification, medication or in severe cases may require invasive intervention.

Indications

- Gastroparesis can occur in diabetes as well as other conditions
- dumping is a common complication following bypass surgery or partial removal of the stomach.
- Functional dyspepsia

Contraindications

Pregnancy
Oral contrast 1 week prior to scan (EZ-Paque, Barium, Baritop)
Oral contrast 24 hrs prior to scan (Omnipaque/Visipaque)
Intravenous contrast administered on the same day (Omnipaque)

Failure to stop medication which interferes with gastric emptying
Stop for 48hrs with agreement of referrer-
Otherwise results should be considered with caution BNMS 2023
Drugs that increase gastric emptying (prokinetics)-

Domperidone	**Clebopride**
Eurythromycin	**Trimebutine**
Metoclopramide hydrochloride	**Cisapride**
Prochlorperazine	**Tagaserod (Zelnorm)**
Bethanechol	**Lubiprostone(Amitiza,Lubilax, Lubowel)**
Prucalopride(Resolor)	**Erythromycin**

(mostly Dopamine antagonists/serotonin-4 antagonists)

Drugs that decrease gastric motility

- **Opioids (Morphine. Fentanyl, meperidine, methadone)**
- **Opioid Analogues (Diphenoxylate, Loeramide hydrochloride(Imodium)**
- **5-HT receptor agonists(Alosetron, Ondansetron, Sumatriptan, Sildenafil**

Narcotic analgesics – e.g. tramadol, buprenorphine, fentanyl, morphine?

Patient preparation

Nothing to eat or drink for ~~6~~ 4 hours prior to study, ideally overnight- BNMS 2023
Check appropriate medications
No smoking and/or nicotine patches on morning of test

Blood glucose must be less than 16 mmol per litre for test to proceed BNMS 2023

Patient symptom assessment questionaire may be useful

Radiopharmaceutical

Tc99m Pulmocis oral SOLID
For dual isotope study- In111 DTPA LIQUID

UHBW Diagnostic Reference Level

Tc99m Pulmocis 12MBq in reconstituted powdered egg white
In111 DTPA 12 MBq in 100-200mls water BNMS 2023

ARSAC Maximum and Estimated dose

Tc99m 10MBq 0.3mSv (maximum 40MBq)

Breastfeeding Cessation

Contact ARSAC for advice if examination essential

Method of administration

Oral: Dual Phase, Single phase solid, Single phase Liquid

A solid meal should be administered initially. If the patient is not capable or not of an age where solids can be given, then a liquid meal can be administered.

Bnms suggests solid: Erect Statics every 10-15 mins for first 2 hours after meal completed then static at 3 or 4 hrs
Liquid only: Erect , imaging should start before patient drinks liquid- dumping should be Rapid. Dynamic for first 30 mins then as per solid up to 3 hours

Oral-
Meal options; Scrambled egg on toast or Cheese on toast
Radioactive solid meal of scrambled egg white made in a saucepan to be eaten with as much milk as required
The Egg is served on 2 slices of lightly buttered toast but if quantity is an issue only the egg needs to be consumed

A percutaneous endoscopic gastrostomy (PEG) or a "MIC-KEY" can be used for liquid/Semi-solid Radiolabelled meal. The connector should be flushed with a small volume of sterile water but be guided by carer.

UHBW Nuclear Medicine staff are unable to administer via NG tubes.

Liquid meal-
Semi-skimmed Cow's milk (warmed or cold)
Under 1 year of age:50mls
Over 1 year of age: 100mls
Over 5 years of age: 400mls (Gosh 2021)

Milk substitutes can be brought in by parents/carers for use.
Radiolabelled water should not be used due to poor binding. (GOSH Protocol 2021)
Bnms guidelines suggest water
Meal should be consumed within 5 minutes Paeds, 10mins adults and scanning started immediately afterwards.

Pre administration checks

Complete Trust/Departmental Patient Identification Checks

Complete Pregnancy Checks (12-55 years)

Paediatric calculation checks

Complete pre examination specific checks

Imaging

Both detectors
Supine whilst immobilised

Dynamic 20sec frames for 180 frames (60mins)
Simultaneously acquires 13 x 1 minute static every 5 minute

2, 3, 4 hour imaging
20sec/fm for 18 frames (6 mins)
Simultaneously acquires 2 x 3 minute statics

Patients are not permitted to eat or drink during the interim period until the test is complete

Camera setup

Symbia T16 (Room 15) and Intevo Bold (Room 16)

Collimator

LEHR

Patient position

Supine- region (Top of shoulder to bottom of stomach)

Imaging Acquisition

Processing

Notes

For all children capable a solid phase study should be completed first. After a lag phase emptying should then be linear.(The Requisites Edition3)

If both solid and liquid are requested at least 48hrs must have passed between solid and liquid Phase.

Dual isotope study has little clinical benefit over a single phase solid emptying.- The requisites 3rd Editio

Naso-jujunal (NJ tubes must not be used for either a solid or liquid dose)
Naso-gastric tube must not be used for solid phase

Children following a wheat/gluten free diet can bring in "free from" bread if necessary

UHBW have tested vegan cheese as an alternative

If the family decline eggs or cheese, then the study will not be booked and the referral returned to referrer

All ½ times and percentages quoted are specific to the meal used at the BRI (historic). The norma ranges were set by the study of normal subjects and will not apply to other techniques.

To make the scrambled eggs (52 Calories)

Empty 3 egg white powder sachets- Dr. Oetker
(other manufacturers will have a different calorific content which will alter transit times)
Add several tsp of warm water gradually and beat into a smooth paste.
Then add more warm water until required consistency obtained.
Cook as conventional egg
Add the 10Mbq of Tc 99m colloid whilst still liquid to ensure homogeneity and mix well

- If a patient is allergic to eggs –cheese(30g) is a valid alternative with a suitable proportion being utilised in young children.

- For those with a vegan diet we have successfully tested vegan cheese as an alternative.

RELATED DOCUMENTS

https://eanm.org/publications/guidelines/2013_published_EANM-SNMMI_Practice_GL_Small_Bowel_Colon_Transit-1.pdf
http://snmmi.files.cms-plus.com/docs/Guideline%20for%20Adult%20Gastric%20Emptying.pdf
https://www.ajronline.org/doi/abs/10.2214/AJR.18.19787 **2018**

ARSAC Guidance notes Feb 2020
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/865493/ARSAC_NfG_2020.pdf

Lit review G:\Nuclear Medicine\Bristol Royal Infirmary\Clinical\Gastric Emptying
References G:\Nuclear Medicine\Bristol Royal Infirmary\Clinical\Gastric Emptying

QUERIES Contact [redacted], [redacted]

Change control information (include additional version numbers, description of change, major/minor change and staff groups tables as more changes are made)			
Document keywords	**Paediatric Gastric Emptying protocol**		
Version Number:		Description of Change:	
Major/Minor Change:		Staff Group(s) if applicable:	Nuclear Medicine staff