# Scintigraphy of Ectopic Gastric Mucosa

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## 1. Introduction

Normal and ectopic gastric mucosa can be demonstrated by the active uptake and secretion of $^{99m}$Tc pertechnetate. Ectopic gastric mucosa is found in 60-85% of Meckel's diverticula. A Meckel's diverticulum (MD) is a congenital pouch in the small intestine caused by incomplete closure of the omphalomesenteric duct. The abnormality occurs in the distal part of the small intestine 40-150 cm proximal to the ileoceacal valve. MD affects 1-3% of the population and is asymptomatic in 70-80% of cases. Symptoms related to bleeding or ulceration of the diverticulum usually occur before the age of two. Symptoms usually comprise painless gastrointestinal blood loss in children, whilst adults may present with diverticulitis, invagination, volvulus or perforation. Bleeding from a MD is unusual after the age of forty. Scintigraphy can also demonstrate ectopic gastric mucosa at uncommon locations in children such as in a double loop of the small intestine, in normal small intestine or in the oesophagus.

## 2. Methodology

This guideline is based on available scientific literature on the subject, the previous guideline (Aanbevelingen Nucleaire Geneeskunde 2007), international guidelines from EANM and/or SNMMI if available and applicable to the Dutch situation.

## 3. Indication

a. Occult or acute anal blood loss
b. Unexplained abdominal symptoms

## 4. Relation to other diagnostic procedures

Small bowel follow-through studies using barium sulphate do not rule out MD. Scintigraphy is therefore the examination of choice in the evaluation of a MD. Depending on the scintigraphic findings, supplementary examinations may be performed (ultrasound, abdominal CT, barium examinations of the bowel, and contrast angiography) to demonstrate not only the presence of MD but also other pathology.

## 5. Medical information necessary for planning

a. The duration and nature of symptoms including any faecal blood loss.
b. Information on any prior diagnostic investigations such as radiological investigations using contrast media, colonoscopy or recent abdominal surgery.

## 6. Radiopharmaceutical

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| Tracer: | $^{99m}$Tc sodium pertechnetate |
| Nuclide: | Technetium-99m |
| Activity: | 200 MBq |
| Administration: | Intravenous |

**7. Radiation safety**

*a. Pregnancy*

The external radiation dose received by the foetus is approximately 1,62 mGy (0,0081 mGy/MBq). Extra hydration and frequent bladder emptying can further decrease the radiation exposure of the foetus. Foetal risk is therefore low. Nevertheless, the investigation should be postponed till after parturition whenever possible.

*b. Lactation*

Breastfeeding should be interrupted for 12 h according to ICRP 106.

*c. Effective dose (mSv/MBq)*

0,079; 0,042; 0,026; 0,017; 0,013 for respectively a 1-yr-, 5-yr-, 10-yr-, 15-yr old and an adult patient with a normal biological functioning.

**8. Patient preparation/essentials for the procedure**

*a Patient preparation*

1. The patient should be nil by mouth. Gastroscopy, colonoscopy and x-ray examinations of the small or large bowel using contrast media may not be carried out within three days prior to scintigraphy. If an examination has nevertheless been carried out using barium sulphate contrast, a plain abdominal x-ray should be taken before carrying out scintigraphy to determine the presence of any remaining barium.
2. Medication which affects bowel motility should be discontinued for three days beforehand.
   The sensitivity of this test can be increased by administering cimetidine (Tagamet®) or ranitidine (Zantac®). These $H_2$-receptor antagonists inhibit the secretion of $^{99m}$Tc pertechnetate into the gastric lumen thus suppressing abnormal transport distally to the small intestine. Ranitidine is preferable to cimetidine both from a pharmacological and a practical point of view.
   Ranitidine (Zantac®) may be administered intravenously, immediately before the examination, or orally one day prior to the examination. Intravenous administration: 50 mg/2 ml diluted to 20 ml using saline solution, or 1 mg/kg for patients weighing < 50 kg (see 9.e). Oral dosage: for adults, 150 mg, 2 x daily; for children, 2-4 mg/kg/day administered in 2 doses.
   Cimetidine (Tagamet®): 200 mg, three times daily for adults and 20 mg/kg for children in three oral doses given between meals for two days before the examination.
3. In the past, a combination of pentagastrin and glucagon was used to increase the accuracy of the test. Pentagastrin stimulates the uptake of $^{99m}$Tc pertechnetate in the gastric mucosa and glucagon slows down gastrointestinal peristalsis preventing a false positive result at the level of the MD. Pentagastrin, however, can give false negative results due to an increased wash-out effect. Besides, it can induce peptic ulcer formation. Therefore, and since pentagastrin is no longer available in the Netherlands, pentagastrin is not frequently used and the use of ranitidine and/or glucagon is preferable.
4. The influence of the proton pump inhibitor omeprazol (Losec®), on the test results, has not been investigated.
5. The thyroid must not be blocked using perchlorate as this may cause false negative results.

*b Essentials for the procedure*

1. $H_2$-receptor antagonists (preferably ranitidine (Zantac®)), see 8.a.2 en 9.e
2. Glucagon (and pentagastrin) as required (see 8.a.3, 9.d and 9.f).

**9. Acquisition and processing**

a. Ask patient to empty his/her bladder and remove all metal objects prior to the investigation.
b. The patient is positioned supine under the gamma camera so the area between the xiphoid process and the pubic symphysis is in the field of view.
c. A butterfly needle or intravenous cannula is then inserted into a vein and attached to a three-way tap and a syringe containing 10 ml of saline solution.
d. If pentagastrin is used to stimulate the gastric mucosa, this should be administered in a dose of 6 µg/kg subcutaneously 15 minbefore the radiopharmaceutical is given. As noted, pentagastrin can induce ulcer formation and is no longer available in the Netherlands (see 8.a 3).
e. If using ranitidine, this should be administered intravenously over 2 min immediately before injecting the radiopharmaceutical. Alternatively, it can be given orally one day prior to the investigation (see 8.a.2)
f. Once the radiopharmaceutical has been administered, 0,33 mg glucagon may be administered intravenously to minimize the transport of activity within the bowel lumen; this may be repeated after 15 and 30 min, after which the needle may be removed. Alternatively, when glucagon is unfavourable (e.g. diabetic patients) the spread of radioactivity from the stomach into the bowel can be prevented by removing gastric secretions through nasal catheter suction.
g. In order to better evaluate the distribution of activity around the bladder, the patient may be asked to empty his/her bladder at the end of the examination, after which one additional static abdominal image should be obtained.
h. Camera settings and processing

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| Energy: | $^{99m}$Tc setting, 140 keV |
| Window: | 15-20% |
| Collimator: | LEAP |
| Counting time: | 60 sec (60 frames of 1 sec) for the flow phase, followed by 45 min of dynamic imaging (1-5 min per frame). Static post-micturation image: 5 min per image (anterior, posterior, and lateral as required) |
| Computer: | 128×128 matrix |

**10. Interpretation**

a. The flow images demonstrate initial blood flow to the liver, spleen and the large abdominal and pelvic vessels. Later images demonstrate the concentration of radioactivity in the gastric mucosa, bladder, kidneys, and transport of the radiopharmaceutical to the proximal small intestine.
b. Functioning ectopic gastric mucosa in Meckel's diverticula is seen as a sharply defined hotspot that appears at the same time and with the same intensity as normal gastric mucosa. The abnormality is often seen in the lower right quadrant of the abdomen adjacent to the navel. Although, the location can change spontaneously as the patient changes position. Other common locations of ectopic or gastric mucosa are the

oesophagus, a double loop in the small intestine or in normal small intestine.

c. False positive results may be caused by blood pooling in the uterine mucosa, often referred to as uterine blush. During the first half of the investigation, there is local uptake of activity above the bladder which fades or disappears during the investigation. This is caused by mucosal hyperaemia in the second half of the menstrual cycle.
d. False positive results include the presence of free $^{99m}$Tc pertechnetate in the bowel lumen excreted from the stomach, activity in the renal pelvis, the ureter or in a bladder diverticulum. The transport of activity to the small intestine will be inhibited if glucagon has been administered.
e. Several other abdominal abnormalities may cause false positive results. These include bowel inflammation, haemangioma, abscesses, vessel defects and small bowel tumours (e.g. leiomyosarcoma and carcinoids). In some cases, an additional SPECT/CT may be necessary to distinguish these.
f. False negative results can be caused by small MD (< 1 cm$^2$), MD without gastric mucosa, MD with a faster secretion the radiopharmaceutical than normal gastric mucosa, perchlorate use prior to the test or when pentagastrin use results in increased wash out. A SPECT/CT may increase sensitivity for detection of smaller lesions. In addition, previous barium studies may hinder the detection of an MD and the MD may not be detected due to over projection of activity in the urinary bladder.
g. The sensitivity of this examination is high in young children (approximately 85%) but only 60% in adults. A negative study does not necessarily rule out MD but simply indicates that no functional ectopic gastric mucosa is present.

**11. Report**

The report should include a description of the medication used during the investigation ($H_2$-receptor antagonists, glucagon or pentagastrin), the presence and location of ectopic gastric mucosa and an explanation of any false positive results.

**12. Literature**


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