

Salivary Gland Scintigraphy

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1. Introduction

The selective uptake, accumulation and secretion of ^{99m}Tc pertechnetate by the salivary glands allow the function of the parotid and submandibular glands to be assessed. The function of the sublingual glands and the minor salivary glands, however, cannot be assessed using this method. The activity that becomes visible in the oral cavity during the examination is due to radioactive saliva secreted by the salivary glands.

In order to assess the maximum functional secretion capacity of the salivary glands whilst at the same time reducing the examination time, citric acid is orally administered 10 minutes after intravenous administration of ^{99m}Tc pertechnetate. In normal salivary glands, this results in rapid secretion of ^{99m}Tc pertechnetate whereby the duration of the examination can be limited to 20-30 min. As an alternative to citric acid, carbachol may be administered subcutaneously. The advantage of this parasympathomimetic drug is that it results in more standardised secretion of the labelled saliva than citric acid. Carbachol may, however, cause cholinergic side effects.

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. Indications

- a. Obstruction of the salivary glands without an obvious cause.
- b. Traumatic abnormalities and fistulas.
- c. Following surgery (e.g. stenosis operations, symptoms following subtotal parotidectomy, transposition of the duct orifice or surgical denervation to prevent drooling).
- d. Following irradiation or high dose ^{131}I therapy.
- e. Salivary gland aplasia.
- f. Sjogren's syndrome.
- g. Warthin's tumour.
- h. As an alternative to sialography e.g. in patients with a sensitivity to radiographic contrast agent or in failure to cannulate the duct.
- i. Contraindications for the use of carbachol: bronchial asthma and ventricular/duodenal ulcer. Inform the patient of the possible side effects following administration of carbachol: peripheral vasodilation and (facial) sweating.

4. Relation to other diagnostic procedures

- a. Unlike ultrasound and x-ray examinations, which mainly provide morphological and anatomical information, scintigraphy is primarily a physiological examination.

- b. Salivary gland scintigraphy is indicated when the orifice of the salivary duct is not accessible or cannot be found (then contrast sialography is not possible). In such cases, the functional status of a gland can be assessed using scintigraphy. This problem occurs in the following clinical situations: technical failure of duct catheterization/cannulation, developmental abnormalities (aplasia), obstructive abnormalities, traumatic lesions and fistulas, and the need for post-surgical information following glandular extirpation or following ligation or transposition of a main duct opening. Given the diversity of these conditions, it is essential that scintigraphic results are assessed in conjunction with the clinical information provided.
- c. CT or MRI can provide useful information about abnormal anatomy, particularly if sialography is not possible. The later stages of Sjogren's disease can be demonstrated using MRI.

5. Medical information necessary for planning

- a. Results of clinical examination.
- b. Results of previous relevant investigations (e.g. x-ray or ultrasound).

6. Radiopharmaceutical

Tracer:	^{99m}Tc -sodium pertechnetate
Nuclide:	Technetium-99m
Activity:	100 MBq
Administration:	After the patient has been positioned, the radiopharmaceutical is administered intravenously. 10 min later oral administration of citric acid or subcutaneous injection of carbachol should occur.

7. Radiation safety

- a. *Pregnancy*
The external radiation dose received by the foetus after intravenous administration of the radiopharmaceutical to the mother is approximately 0,81 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 for this investigation. Nevertheless, the investigation should be postponed till after parturition whenever possible.
- b. *Lactation*
Breast feeding 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 normal biological functioning.

8. Patient preparation/essentials for the procedure

Patient preparation

- a. Patients must fast for at least 2 h prior to the investigation. They may NOT be given perchlorate.
- b. Inform patients of the nature and duration of the investigation (20-30 min).
- c. Anticholinergic medication should be stopped during 24 h prior to the examination.

Essentials for the procedure

- a. Citric acid solution (1 ml; 10%), small syringe or pipette

- b. As an alternative to citric acid, carbachol (0,25 mg/ml; 1 ml), small syringe and needle for subcutaneous injection
- c. Head support for fixation

9. Acquisition and processing

- a. The patient lies in supine position with their head slightly extended and the gamma camera positioned anteriorly. The head should be fixed and preferably not turned laterally since this will result in asymmetry. The patient's nose should be level with a point just above the centre of the field of view. Alternatively, the patient can be seated (e.g. claustrophobic patients) with their head in slight antelexion and the camera positioned posteriorly. This allows for better imaging of the parotid glands (but poorer imaging of the submandibular glands).
- b. Total acquisition time is 20-30 min.
- c. Time-activity curves are generated using ROIs for the salivary glands, background and oral cavity. These provide an impression of the total function of the salivary glands before and after administration of carbachol or citric acid. This type of quantification can play an important role in the evaluation of Sjogren's disease.
- d. To assess asymmetry, additional acquisitions can be obtained from the left and the right (2 min each).
- e. Camera settings and processing:

Energy:	^{99m} Tc setting, 140 keV
Window:	15-20%
Collimator:	LEAP/LEHR
Time:	1 min perfusion phase (30 frames of 2 sec) followed by 19-29 min (e.g. 19-29 frames of 60 sec each)
Computer:	64×64 matrix. Use a zoom factor that provides a 25 cm wide field of view

10. Interpretation

- a. One advantage of this investigation is that the function of all the large salivary glands (except the sublingual glands) can be assessed at the same time, which allows comparison with the contralateral, healthy gland in the event of a unilateral abnormality.
- b. Normally the curves show an initial fast increase which starts immediately after the intravenous administration of the radiopharmaceutical and lasts about 6 minutes. Thereafter the increase is slower and a plateau is usually reached after about 10 min. Citric acid (or carbachol) administration results in a fast and symmetrical decrease of salivary gland activity. The wash out of activity from the parotid glands usually exceeds the washout from the submandibular glands.
- c. Reduced uptake and abnormal secretion of ^{99m}Tc pertechnetate (compared to the contralateral gland) is seen in chronic infections/inflammations (sarcoidosis) and obstructions (salivary calculus, stenosis e.g. post irradiation, aplasia).
- d. Increased uptake and abnormal secretion of ^{99m}Tc pertechnetate is sometimes seen in conditions associated with sialadenosis (e.g. diabetes mellitus, liver cirrhosis and anorexia nervosa). Increased uptake is the result of reduced salivary secretion.
- e. In acute sialoadenitis intense activity is seen in the glands during the flow (perfusion) phase. The eventual accumulation and excretion are decreased due to swelling of the glands.

- f. This investigation provides an objective illustration of reduced function in all the large salivary glands (sometimes resulting in xerostomia) in Sjogren's disease. The loss of function correlates with the stages seen on contrast sialography (0-4) and starts with reduced uptake in the submandibular gland and reduced secretion by the parotid gland. The abnormalities will not necessarily be symmetrical.
- g. Scintigraphy is not useful in demonstrating salivary gland tumours, with the exception of adenolymphomas or Warthin's tumours. These two tumours demonstrate increased pertechnetate uptake as well as retention (after stimulation) as compared to surrounding salivary gland tissue.
- h. Activity in the oral cavity is localized to the tongue area and is caused by radioactive saliva from the large salivary glands. The presence of extensive dental restoration work (gold alloys in particular) may result in cold spots.
- i. Be aware of motion artefacts. A sudden decrease in all curves can be the result of movement of the salivary glands out of the ROI's.

11. Report

The report should describe the scintigrams and time-activity curves concerning uptake and stimulated secretion of ^{99m}Tc pertechnetate.

12. Literature

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