

Lacrimal Scintigraphy

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NOTE: no changes have been made since the version of 2007

1. Introduction

A standardised volume of 10 μl $^{99\text{m}}\text{Tc}$ pertechnetate is instilled into the patient's conjunctival sac using a micro-pipette. In principle, the quantity must be as small as possible, since any increase in the very small tear reservoir can lead to contamination of the eyelids and thus adversely affect the interpretability of the investigation. In contradistinction to the already well-established xray investigation whereby at all times outside influence is exerted on the tear drainage, the aim of this tracer investigation is to study the natural tear drainage. Normally, tears are drained from the conjunctival sac to the lacrimal sac (saccus lacrimalis), then to the naso-lacrimal duct (ductus nasolacrimalis) and finally to the nose and pharynx.

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

Epiphora (watering of the eye) is the initial indication. The ability to adequately manipulate the lacrimal pathways in order to improve drainage is closely linked to the indication. This is often achieved through surgical procedures such as DCR (dacryocystorhinostomy) or DCP (dacryocystorhinoplasty, 'angioplasty' of the lacrimal pathways).

Thereafter, the effect of these interventions can be evaluated by means of lacrimal scintigraphy.

4. Relation to other diagnostic procedures

The Anel test is performed by cannulating the lower lacrimal point and injecting physiological saline. When the system becomes patent, the patient will taste salt. The test is simple and inexpensive but does not distinguish between levels of obstruction. There is also a risk of defects arising as a consequence of the excess pressure applied.

The contrast-dacryocystography (DCG, an x-ray investigation) is performed by cannulation of the lower lacrimal point and the proximal portion of the horizontal canal, after which contrast medium is injected into the lacrimal system under excess pressure. Subsequently, the lacrimal system is imaged from various directions. The entirety gives a picture of the morphology of the lacrimal system.

The major disadvantage is that no information is obtained with regards to the normal physiological drainage. A narrowing found in this way may not necessarily have a functional impact. The place of x-ray investigations is secondary to scintigraphic investigations and serves to detect anatomical abnormalities, which are amenable to therapy. A

dacryocystorhinostomy (DCR) is the most common approach to the problem and essentially bypasses the nature or cause of constriction. However, the location of the constriction is important. Scintigraphy locates the constriction with sufficient certainty in order to allow DCR.

The dacryocystoplasty (DCP) consists of an angioplasty-like procedure in which the lacrimal system is made more patent.

5. Medical information nessecary for planning

- Epiphora, frequency and severity of the symptoms, on which occasions and to which eye.
- Any previous surgery to the lacrimal system.
- Any previous x-rays of the tear ducts.
- Use of eye drops, eye ointments, or similar medications?

6. Radiopharmaceutical

Preparation:	^{99m} Tc Sodium Pertechnetate
Nuclide:	Technetium-99m
Dosage:	4 MBq in 10 µl per eye
Administration:	Drop in the conjunctival sac in the lateral canthus (in seated position) For this purpose a micro-pipette is used with a fixed dose and removable sterile tip

7. Radiation safety

a. Pregnancy

Considering the relatively low dose, < 8 MBq sodium pertechnetate, the benefits of het investigation outweigh the assumed risk for the unborn child. A small amount of sodium pertechnetate will be ingested through the nose, nevertheless the estimated dose to the foetus is less than 0,1 mSv.

No health detriment for unborn children is reported for doses smaller than 100 mGy, therefore a dose less than 0,5 mSv is acceptable.

b. Lactation

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

c. Radiation exposure

The organ dose due to 4 MBq to each eye is 35 mSv per hour at the start of the examination. The half time value in the conjunctival sac is less than 3 min. The estimated dose to the eye will be 2,5 mSv. The organ weighting factor (remainder) is 0,12. The effective dose is estimated at 0,3 mSv. If both eyes are examined the dose will be doubled, 0,6 mSv.

8. Patient preparation/essentials for procedure

Perform preliminary massage of the lacrimal sac.

Use a head rest for fixation, to avoid movements.

Procedure:

a. *Patient:* The patient is examined in a seated (good head fixation) position. The patient may keep his eyes open as normal and make normal blinking movements during the investigation. The radiopharmaceutical is administered in a sterile procedure into the

conjunctival sac of both eyes. Start within 15 sec with the acquisition of the images.

b. Views: Set the persistence-scope or monitor anteriorly with the pinhole or with the LEHR collimator just above the bridge of the nose. If using the LEHR collimator, zoom in with a zoom factor of 2.

If quantification is desired, the following operation can be useful: Before the analysis, four regions of interest, ROIs, are drawn per examined lacrimal system. The total activity (100%) is measured in the first minute by placing an ROI around half of the face. Then ROIs are drawn around the conjunctival sac (excluding the lacrimal sac), the lacrimal sac (excluding the conjunctival sac and tear duct) and the tear duct (excluding the lacrimal sac). Subsequently three time-activity curves (TACs) are generated: of the drainage of the eye, the lacrimal sac and the tear duct. The activity in the conjunctival sac as a percentage of total activity is determined in the first (T1) and the fifteenth minutes (T15). The difference divided by T1 times 100% gives the LCR (linear clearance rate).

9. Acquisition and processing

Energy:	^{99m} Tc-setting, 140 keV
Window:	15%-20%
Collimator:	Pinhole collimator 4 mm or LEHR collimator
Counting time:	Serial exposures of a maximum of 1 min during 15 min
Computer:	15 frames of 1 min (possibly reframing), minimal matrix 128x128

10. Interpretation

The aim of the investigation is to determine whether there is tear drainage and if so, whether and to what extent it is delayed. Normally there is activity evident in the lacrimal sac within 1 min. The activity appears in the tear duct within the 2nd-3rd minute. Emptying of the tear duct is very variable. There may be drainage blockages at different levels: the horizontal channel (between conjunctival sac and lacrimal sac), the lacrimal sac, the tear duct and the transition to the nose. The investigation is more reliable for detecting a drainage disorder at the level of the conjunctival sac than of the lacrimal sac and tear duct. Investigation of both eyes has the advantage that a comparison can be made. If the problem is bilateral the comparison is less useful. When a dacryocystorhinostomy (DCR) has been performed, the drainage is clearly different: the lacrimal sac will appear and this cannot be demarcated from the DCR opening. The tear duct, in this instance, does not come into the picture. Contamination of the eyelid may occur, for example, if too large a drop is administered. LCR is then unreliable, but the T1 parameter can still be used. If there is total obstruction of the lacrimal sac, it is impossible to distinguish a high (horizontal channel) or low (lacrimal sac or more distally in the tear duct) obstruction. However, in practice, a local obstruction of the wide lacrimal sac almost never occurs. To prevent false positive results, the lacrimal sac should be massaged beforehand, thereby emptying it of thickened secretions. There is a poor correlation between the results of lacrimal scintigram and the results of the Anel test (see below) and symptoms. In this context, it does not matter whether or not a previous DCR has taken place.

11. Report

The report indicates how the tear drainage takes place relative to time. Using the above T1 and LCR values results in a sensitivity of 77% or 71% respectively and a specificity of 95%

or 100% respectively, in seated position and with cut-off values of 70% for T1 (T1 normally <70%) and 30% for LCR (LCR normally >50%).

The conclusion should state whether or not there is complete or partial obstruction, and at what level the obstruction is located.

12. Literature

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