Detection of Gastrointestinal Protein Loss using ^{51}Cr

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Warning: The use of the radiopharmaceutical ^{51}Cr chloride has not been registered for use as described in this protocol.

1. Introduction

Normal catabolism of serum protein takes place partly in the gastrointestinal tract. A wide range of gastrointestinal disorders, in particular infections, ulcers, tumours and lymphatic circulatory disorders, can cause a pathological increase of this type of protein loss. Following intravenous administration of ^{51}Cr chromium chloride, in-vivo and non-specific binding of the radiopharmaceutical to plasma proteins takes place (albumin and transferrin in particular). Loss of plasma proteins through the intestinal wall results in the excretion of ^{51}Cr chromium chloride into the faeces and can therefore be quantified. ^{51}Cr chromium chloride does not cause denaturation of proteins but is excreted into the bowel lumen in protein-bound form. A disadvantage of this study is that ^{51}Cr chromium chloride is also excreted in the urine, which can cause contamination of the faeces, particularly in females.

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. Hypoproteinaemia caused by protein losing enteropathy which can occur in: Crohn's disease, ulcerative colitis, enteritis, Whipple's disease, sprue, Menetrier's disease (damage to the gastric mucosa), constrictive pericarditis, congestive heart failure, intestinal lymphangiectasis or SLE.
b. Follow-up of these conditions: quantification of protein loss as an indicator of the severity of the disease process.

4. Relation to other diagnostic procedures

There are no other simple techniques with which to demonstrate and quantify plasma proteins in the faeces.

5. Medical information necessary for planning

a. History of presenting complaint especially duration of symptoms.
b. Past medical history including known or suspected abnormalities.
c. Endoscopy results.
d. Blood results: serum protein, ESR and/or CRP, enumeration and differentiation of leucocytes.

6. Radiofarmacon

Tracer: ^{51}Cr chloride
Nuclide: Chromium-51
Activity: 1,2 MBq
Administration: Intravenous

7. Radiation safety

Due to the very small amount of activity administered (1,2 MBq) and very low effective dose to the foetus 0,0516 mGy (0,043 mGy/MBq), there are no precautions during pregnancy or lactation.

8. Patient preparation/essentials for the procedure

Patient preparation

No special preparation is required. It is, however, important to instruct the patient to avoid contaminating the faeces with urine. Duration of examination: 4 days.

Essentials for the procedure

1. Sealable containers (at least 1 per 24 h), each with a label for recording patient details and date.
2. Plastic carrier bag.

Procedure

a. Preparation of test solution. 15 MBq ^{51}Cr chromium chloride in 100 ml sterile saline solution. (Shelf life: five days when stored at 2-8 °C; 12 h at room temperature after opening).
b. Preparation of dose: draw up 8 ml test solution, 1,2 MBq, ^{51}Cr chromium chloride into a syringe.
c. Preparation of standard: add 2 ml test solution to 20 ml ^{3}CrCl solution (0,1 M) in a 100 ml measuring jug. Make up to 100 ml with distilled water. The jug will then contain 25% of the dose to be injected.
d. All faeces is collected for 4x24 h, starting from the time of injection. One or more separate containers are given to the patient for each 24-h period. The containers should be labelled with the patient's name, date of birth and the date of collection. In the interests of hygiene, the containers should be kept in cold storage.
e. Once returned, each container is weighed separately and an average is calculated from these weights. The equivalent weight in water is put into an empty container to which 10 ml of the standard solution is added using a pipette. The standard is then 2,5% of the dose. The activity in each container is measured using a large scintillation counter. The percentage of the dose is calculated for each container using the following formula:

$$V_i = \frac{N_i}{N_{st}} \times 2{,}5\ [\%]$$

in which
Vi = loss in portion i
Ni = counts in portion i

Nst = counts in standard
The percentage loss in four days is equal to the sum of the four percentages.

10. Measuring conditions

The standard and samples are measured in the same geometry and using a scintillation counter set for the ^{51}Cr photon peak (320 keV). 10.000 counts are collected from the standard. The samples and background should be counted for as long as it takes to determine the 1% limit of faecal excretion with a relative accuracy of 5%, making sure that adequate shielding is used.

11. Interpretation

a. Normally, no more than 1% of the administered dose is found in the faeces within 4x24 h. A higher value than this indicates intestinal protein loss. It is, however, essential that the faeces is not contaminated with urine since ^{51}Cr chromium chloride is also excreted by the kidneys.
b. This examination is therefore not reliable when carried out on infants and young children.
c. Hypoproteinaemia due to decreased protein synthesis cannot be demonstrated reliably using radionuclide techniques.

12. Report

The report should contain details of the protein loss over four days expressed in terms of % of administered dose, and the reference value.

13. Literature

- Clapham JF, Hayter DJ. The measurement of gamma emitting isotopes in feces. Phys Med Biol 1962;7:313-7.
- Walker-Smith JA, Skyring AP, Mistilis SP. Use of Cr-51-chromiumchloride in the diagnosis of protein-losing enteropathy. Gut 1976;8:166-8.
- Chau TN, Mok MY, Chan EY, Luk WH, Lai KB, Li FT et al. Evaluation of performance of measurement of faecal α(1)-antitrypsin clearance and technetium-99m human serum albumin scintigraphy in protein-losing enteropathy. Digestion. 2011;84:199-206.