99mTc erythrocytes (in vitro)

1. Indications

In-vitro labelled 99mTc erythrocytes or labelled red blood cells (RBC) are prepared using a registered radiopharmaceutical kit Ultratag® RBC. 99mTc erythrocytes are used for blood pool imaging, including cardiac first pass and multiple gated equilibrium imaging and for detection of sites of gastrointestinal bleeding and hepatic lesions.

2. Preparation

The preparation of 99mTc erythrocytes is described in the the SmPC. The Ultratag® RBC kit consists of three separate components: reaction vial containing Stannous Chloride, syringe I containing a diluted Sodium Hypochlorite solution and syringe II containing a mixture of citric acid and dextrose. The preparation can be summarized in the following steps:

a. Fill a syringe with anticoagulant (ACD-A).
b. Collect blood using a needle with an inner diameter of 19 G. Needles with a smaller inner diameter will damage the cells. Make sure that the blood is well mixed with the anticoagulant.
c. Bring the anticoagulated blood into the reaction vial and mix gently.
d. Allow to react for 5 min.
e. Add the contents of Syringe I to the reaction vial, mix by gently inverting 4 to 5 times.
f. Add the contents of Syringe II to the reaction vial, mix by gently inverting 4 to 5 times.
g. Add the required activity of 99mTc pertechnetate to the reaction vial.
h. Mix by gently inverting 4 to 5 times and allow to react for 20 min with occasional mixing.
i. Draw the needed activity of 99mTc erythrocytes for the patient dose.

Special considerations:

- Working with blood can introduce risks to both the operator and the patient. The department labelling the cells should comply with all regulations. Adequate facilities, equipment, procedures and training for operators should be present. Additional the risks for blood contamination should be recognizes and precautionary measures should be implemented to minimize those risks.
- Excessive amounts of 99mTc, such as in the first eluate of a new generator, in the eluate of a generator with prolonged in-growth time or in an aged eluate can interfere with the labelling of 99mTc to the erythrocytes. It is therefore recommended to use fresh eluate (no older than 8 h) obtained from a generator which is eluted no longer than 24 h ago.

3. Quality control

- Before the blood cell labelling is started and throughout the procedure a check on the absence of blood clots needs to be performed.
- The labelling efficiency of the ^{99m}Tc erythrocytes should be determined after labelling. The labelling efficiency is defined as the total radioactivity measured in the cells as a percentage of the total radioactivity measured in both the cells and the plasma. The method is described in the SmPC. A labelling efficiency above 95% might be expected. The labelling efficiency depends on several aspects such as: hematocrit, volume of whole blood, stannous ion dose, cell damage, concentration of ligand and radionuclide, temperature, operator inter-variability and drugs (see 'interactions').

Although no other quality control tests have been described, measurement of cell efflux of ^{99m}Tc could be performed periodically or for validation purposes.

4. Interactions, contraindications & adverse reactions

Interactions

The following drugs could interfere with either the erythrocyte labelling or alter, by direct pharmacologic effect, cardiac function.

- Aluminium
- ß-blokkers
- Calcium channel blokkers
- Cefalosporines
- Daunorubicin
- Digoxin
- Doxorubicin
- Epirubicin
- Gentamicin
- Heparin
- Hydralazine
- Idarubicin
- Iodinated contrast media
- Methyldopa
- Mitoxantrone
- Nitrates
- Prazosin
- Quinine
- Stannous overload
- Teflon material

- It is advised to do not use intravenous catheters or infusion sets made of Teflon material
- When by accident an overload of stannous is used, a new procedure should be started
- The labelling of erythrocytes with ^{99m}Tc should not be done within 24 h of the use of iodinated contrast media
- The labelling of erythrocytes with ^{99m}Tc should be planned 9 days after a chemotherapy treatment with a "-ubicin" drug
- The labelling of erythrocytes with ^{99m}Tc should be planned just before a chemotherapy treatment with mitoxantron (or 20 days after treatment)

Contraindications

There are no known contraindications.

Adverse reactions

Hypersensitivity and anaphylactic reactions have been reported.

5. Biodistribution & pharmacokinetics

After injection of ^{99m}Tc erythrocytes the labelled red blood cells distribute in the blood pool with an estimated biological half-life of approximately 29 h. Of the total technetium ^{99m}Tc retained in the whole blood pool 24 h after administration, 95% remains bound to the red blood cells. Approximately 25% of the injected dose is excreted in the urine in the first 24 h.

6. Stability

It has been found that ^{99m}Tc erythrocytes are stable with less than 2% loss of label during a 6 h time period. It is essential that cells are viable when returned to the patient. Labelled cells may be damaged from the collection and labelling procedures. Re-suspension of cells in cell free plasma optimizes their viability. The SmPC mentions that the ^{99m}Tc erythrocytes remain viable during at least 6 h, however advises to re-inject after 30 min. In practice, longer periods of time between blood being taken from a patient and the cells being re-injected have provided no evidence of problems. However it is recommended to re-inject as soon as possible, preferably within 1-2 h after labelling.

7. Literature

- Ultratag® RBC [SmPC]. Petten: Mallinckrodt Medical; 2014.
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