RED BLOOD CELLS LABELING TECHNIQUES

Clinical Uses

- Gated Blood Pool Study
- Gastrointestinal Bleeding Study
- Hemangioma Study

General Information

- Three methods are currently utilized for labeling red blood cells:
  1. In-vivo method
  2. In-vitro method
  3. Modified in-vitro method

In-Vivo Method

- Reconstitute stannous PYP vial with non-bacteriostatic normal saline.
- Inject appropriate volume of reconstituted stannous/PYP kit (optimal red blood cell labeling occurs with 10-20 µgm of tin/kg body weight).
- See "Tc-99m-Pyrophosphate" in the Radiopharmacy Section for sources of Pyrophosphate Kits.
- After injection of stannous/PYP wait 30 minutes then inject 25 mCi of sodium pertechnetate.

In-Vitro Method

- Ultra-Tag by Mallinckrodt kit contains a vial with two syringed (labeled A & B):
  1. Collect 1-3 mL of blood using heparin or ACD as an anticoagulant.
  2. Transfer the anticoagulated blood to the reaction vial and gently mix to dissolve the contents of the vial.
  3. Allow to react for 5 minutes.
  4. Add the contents of syringe A (sodium hypochlorite solution) and mix by gentle swirl 4-5 times.
  5. Add contents of syringe B (citric acid, sodium citrate, and dextrose solution) to the reaction vial and mix by gentle swirling 4-5 times.
  6. Add 30 mCi of sodium pertechnetate to the reaction vial in a maximum of 3

mL volume (before adding activity shield the vial).
7. Mix by gently swirling the vial 4-5 times.
8. Allow to react for 20 minutes and agitate occasionally by gently swirling.
9. Mix gently prior to withdrawing the patient's dose. The labeled RBCs are ready to administer IV.

- To determine the radiochemical purity:
  1. Transfer 0.2 mL of the red blood cell solution into a vial.
  2. Add 2 mL of 0.9% sodium chloride solution.
  3. Gently agitate vial.
  4. Centrifuge for 5 minutes.
  5. Separate the supernatant from the cells and determine the percent of the activity, which remains with the red blood cells.
  6. The radiochemical purity should be greater than 90%.

Modified in-vitro method

- Reconstitute stannous/PYP vial with non-bacteriostatic normal saline.

- Inject 10 mgm/kg of stannous ion intravenously

- After injection of stannous/PYP place a 19 gauge butterfly needle set into a vein. Attach a 3 way stopcock to the butterfly and attach a syringe containing 5 U/mL of heparin. Flush the tubing set with the heparinized saline solution.

- Wait 20 minutes after injection of the stannous/PYP, attach a syringe containing 25 mCi of sodium pertechnetate to an open port on the stopcock and withdraw 3 mL of blood into the syringe.

- Remove syringe-containing blood.

- Flush tubing set with a 5 U/mL heparinized saline solution.

- Gently agitate the Tc-99m-RBC syringe for 10 minutes then re-inject the Tc-99m labeled RBC.

Factors Affecting Red Blood Cell Labeling and Imaging

- Increased free pertechnetate has been reported due to:
  1. Carrier Tc-99
  2. Inadequate stannous ions
  3. Inadequate incubation time

- Low red blood cell concentration may decrease the rate and extent of tagging.

- Spleen visualization with increased plasma activity has been reported with excess stannous ions.

- Excess heparin may result in a lower labeling efficiency, more extravascular activity and more urinary activity.

- Saline used to reconstitute the Sn-PYP kit, which may have high amounts of dissolved oxygen, may decrease the in-vivo RBC labeling efficiency.

- Oxidation of 99mTc with exposure to air may decrease the labeling efficiency.

- Prior patient administration of intravenous solutions containing preservatives or antioxidants

- Prior intravenous administration of iodinated x-ray contrast may impair RBC labeling efficiency and increase the renal excretion of the tracer (15). However, utilizing the X-ray contrast agent, Hypaque, did not show a reduced binding to the in-vivo and in-vitro binding of red blood cells.

- The use of different types and amounts of anticoagulants may affect the RBC labeling efficiency of the Ultra-Tag RBC labeling kit.

- RBC hemolysis with biliary excretion of Tc-99m labeled heme, the precursor of bilirubin, has been reported.

- Various drugs have been found to significantly lower the red blood cell labeling efficiency:
    1. Hydralazine
    2. Prazosin
    3. Methyldopa
    4. Propranolol
    5. Digoxin
    6. Quinidine
    7. Doxorubicin
    8. Cyclosporin (Sufficient concentration of stannous ions in the blood may minimize the poor labeling problem.
    9. Cytotoxic, immunosuppressive and antibiotic medications
    10. Nifedipine

- Decreased labeling has been associated with the use of a Teflon catheter butterfly needle.