

A Safe, Simple Method for Preparing Heat-Damaged Red Cells for Diagnosing Splenic Infarct or Trauma

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Objective: The purpose of this study was to demonstrate a fast, safe and simple method for preparing heat-damaged red blood cells.

Methods: Patient blood was radiolabeled using the UltraTag® RBC kit and then heated to 49.5°C for 20 min. The reaction vial was cooled in ice water for 1 min and the required activity was administered to the patient. The patient was imaged 60 min postinjection.

Results: High-quality planar and SPECT images of the spleen were obtained with low background activity noted. Radiolabeling efficiency was greater than 95%.

Conclusion: The method was safe and simple to perform. High-quality images of the spleen were obtained.

Key Words: technetium-99m-RBC; UltraTag®; heat-damaged red cells; spleen imaging

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Investigations of splenic infarction or trauma-related dysfunction of the spleen (1,2) were commonly diagnosed in nuclear medicine departments by preparing and injecting radiolabeled heat-damaged red blood cells (RBCs). Computerized tomography (CT) has taken much of this role from nuclear medicine departments in recent years. Confirmation of CT findings by nuclear medicine techniques has been required at times for diverse reasons.

Several in vitro procedures are available for radiolabeling RBCs (3). For many years our department used the method described by Bardy et al. (4). This pre-existing procedure for preparing heat-damaged red cells for identifying splenic trauma or infarction required pretinning the patient blood, separating the red cell mass from the plasma by centrifugation, several saline washes of the extracted cells, radiolabeling the cells with ^{99m}Tc, more saline washes, heating, cooling and eventual administration to the patient. A biohazard cabinet is required due to the ever-present threat of infectious diseases and the need for sterility.

UltraTag® (Mallinckrodt, St. Louis, MO) (5,6) is known to radiolabel red blood cells in vitro with a radiolabeling efficiency greater than 95% without the need to wash or separate the red blood cells. We investigated the possibility of combining the two methods to produce a simpler, safer method for preparing heat-damaged red cells.

MATERIALS AND METHODS

In Vitro Red Blood Cell Radiolabeling

Ten milliliters of whole blood were collected through a 21-gauge needle in a sterile, evacuated blood collection tube containing 143 USP units of lithium heparin. Three milliliters of this blood were transferred to the UltraTag® reaction vial. The blood was radiolabeled with 800 MBq (~22 mCi) ^{99m}Tc in 1 ml saline according to the UltraTag manufacturer's directions. The reaction vial was placed in a constant-temperature water bath at 49.5°C for 20 min with periodic mild agitation. The vial was cooled in ice water for 1 min. The patient was injected with 200 MBq (~5.4 mCi) radiolabeled cells and imaged 60 min postinjection.

Identical procedures were performed on control blood to determine radiochemical purity. Control blood was not injected into subjects.

Radiolabeling Efficiency

Two milliliters of the remaining patient whole blood was washed with 2 ml normal saline and centrifuged for 5 min to separate the red cells from the plasma. The plasma was pipetted off and the radioactivity in the two fractions counted in a dose calibrator. The ^{99m}Tc-RBC labeling efficiency was calculated according to the following equation:

$$\% \text{ RBC labeling} = \frac{\text{Radioactivity of RBC}}{\text{Radioactivity RBC} + \text{Radioactivity plasma}} \times 100.$$

RESULTS

Radiolabeling Efficiency

All samples tested achieved a radiolabeling efficiency > 95% (Table 1).

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TABLE 1
Technetium-99m-RBC Radiolabeling Efficiency

Experiment	Radiolabeling efficiency (%)
Controls (n = 3)	97.4 ± 0.6
Patient	97.2

Spleen Imaging

A 50-yr-old woman presented with rheumatoid arthritis, neutropenia and left upper-quadrant pain. The CT showed splenomegaly but raised the possibility of splenic infarct.

A spleen scan was performed 60 min postinjection of the ^{99m}Tc heat-damaged red blood cells. Static and tomographic images were obtained of the spleen with low background. The scan showed a markedly enlarged spleen with uniform distribution of activity throughout with no evidence of infarction (Fig. 1).

DISCUSSION AND CONCLUSION

The method presented here was far simpler for the operator than the established method that required several washing steps before and after radiolabeling of the RBCs. The safety aspects were evident since the procedure did not require multiple blood handling steps. The only deviation from the manufacturer's recommended preparation was the heating and cooling of the blood in the final steps.

The high radiolabeling efficiency obtained was evident in the quality of the images produced. This procedure is now our established protocol for spleen imaging.

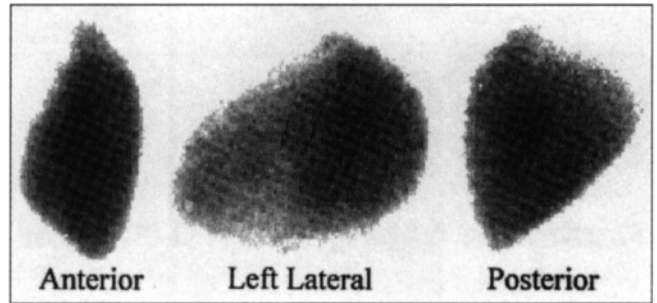


FIGURE 1. Spleen images obtained 60 min following the intravenous administration of ^{99m}Tc heat-damaged RBCs.

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