⁹⁰Y ferric hydroxide colloid

R. J. BAYLY, J. A. PEACEGOOD, AND S. C. PEAKE
Radiochemical Centre, Amersham

At the Radiochemical Centre we have recently developed a new ⁹⁰Y colloid which has greater stability than the currently available ⁹⁰Y silicate colloid and appears from the results of animal tests to be suitable for the treatment of rheumatoid knee joint effusions. In this report the need for a new ⁹⁰Y colloid is assessed and the preparation and properties of the new colloid are described.

Currently two radioactive colloids are routinely available from the Radiochemical Centre for therapeutic applications: ⁹⁰Y silicate and ¹⁹⁸Au colloid. Both have been shown to display considerable leakage from the synovial cavity of patients undergoing treatment for rheumatoid knee effusions. ¹⁹⁸Au has the additional disadvantages of being a γ -emitter and of giving relatively low energy β particles with a maximum range in tissue of only 4 mm., compared to a range of 11 mm. for the more energetic β particles from ⁹⁰Y. An alternative colloid in which ⁹⁰Y was adsorbed on particles of ion exchange resin was produced until last year, and was considered to be a more useful agent for knee joint treatment. Unfortunately we were forced to discontinue its supply because of technical difficulties encountered in maintaining preparation of the colloid to a uniform standard. More recently the supply of chromic phosphate (³²P) colloid was discontinued because ⁹⁰Y was felt to be a more suitable radionuclide for therapeutic work. It was decided to develop an improved ⁹⁰Y colloid of relatively large particle size, which could replace the existing ⁹⁰Y silicate product in its applications and, at the same time, be suitable for intra-articular injection.

To achieve a product of high stability and with the desired physiological properties, we decided to investigate the use of very high specific activity ⁹⁰Y, derived from β decay of strontium 90 (⁹⁰Sr), rather than the usual low specific activity ⁹⁰Y produced by reactor irradiation of ⁸⁹Y. In the new process the high specific activity ⁹⁰Y is separated by an ion exchange technique. The ⁹⁰Y is then converted to its chloride,

mixed with a small amount of ferric chloride and a colloid stabilizer, and the pH is adjusted with a buffer solution. This gives a ferric hydroxide colloid in which the ⁹⁰Y is incorporated in the colloidal particles. Our choice of a ferric hydroxide support was influenced by the considerable experience of this colloid built up through its use in the Radiochemical Centre's kit for preparing indium-113m labelled colloid as a liver scanning agent.

The colloid has good stability, and tests carried out after adding saline diluent and autoclaving at 120° C. have shown that less than 0.2 per cent. of the ⁹⁰Y is present as free ionic yttrium. With a product of this type, effective quality control is clearly of prime importance. For the detection of ⁹⁰Sr impurity in the ⁹⁰Y we have developed a method of routinely measuring ⁹⁰Sr levels in the region of 10⁻⁷ parts in 1 part of ⁹⁰Y activity. Our specification allows less than 10⁻⁶ parts ⁹⁰Sr in 1 part ⁹⁰Y, which is lower by a factor of ten than the acceptable limit.

The requirements imposed by the various clinical uses of β -emitting colloids are to some extent conflicting, since for some applications it is desirable that the activity should 'plate out' on body cavity walls, whereas in others such an effect is undesirable. For treatment of knee joint effusions it is believed that the activity should plate onto the synovial membrane to have maximum effect. In animal experiments, the new ⁹⁰Y ferric hydroxide colloid has shown the properties required for each of its clinical applications. We have been extremely fortunate in receiving active co-operation from groups of medical workers, and some encouraging preliminary results on the potential of the new colloid in the treatment of knee joint effusions will be presented later during this meeting.

We are currently examining problems associated with increasing the ⁹⁰Y separation process to a production scale. Meanwhile we must stress that the new product is not yet routinely available to would-be users.