J.RADIOANAL.NUCL.CHEM.,LETTERS 146 (6) 415-420 (1990)

TECHNETIUM(99m)-TIN COLLOID: A SIMPLE METHOD FOR THE PREPARATION AND EVALUATION

M. Akhtar, A. Mushtaq, I. Haider,
A. Aziz*, H.M.A. Karim

Radioisotope Production Group,
Nuclear Chemistry Division,
Pakistan Institute of Nuclear Science and Technology,
Post Office Nilore, Islamabad, Pakistan

*Fellow Centre for Nuclear Studies,
P.O. Nilore, Islamabad, Pakistan

Received 30 October 1990
Accepted 5 November 1990

Effect of various amounts of reagents on the quality of ^{99m}Tc-Sn-colloid has been studied, and a simple and reproducible method for its preparation particularly suitable for hospital pharmacy has been developed. PVP has been used as a stabilizing agent. A quick method of its bio-distribution has also been described.

INTRODUCTION

Radioactive colloidal solutions have been found useful for the imaging of organs containing fixed reticuloendothelial cells. The choice of a particular colloid depends upon the organ under investigation[1]. For imaging of liver and spleen ^{99m}Tc-S-colloid and ^{99m}Tc-Sn-colloid are more commonly used as in vitro colloids. The preparation of the former colloid is a multi-step process

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Akadémiai Kiadó, Budapest

and the particle size of the colloid is affected by several parameters[2,3]. Contrary to ^{99m}Tc-S-colloid, preparation of ^{99m}Tc-Sn-colloid is simple, rapid and less sensitive to the amount of Al^{3+}, ^{99m}Tc-Sn-colloid was first prepared using gelatine as colloid protective agent[4]. The high viscosity of gelatine presents problems in handling of its cold solution through syringes and millipore filters. Human serum albumin (HSA) has also been used as a colloid protective agent[5]. The presence of HSA in solution produces foam which may result in undesired flocculation of colloid. In the present procedure, polyvinylpyrrolidone has been used as a colloid protective agent. Animal model has been used to evaluate the colloid for liver scanning. The use of ionization chamber has been made for measuring the radioactivity of various organs.

EXPERIMENTAL

Reagents

Tin chloride solution was prepared by dissolving 95 mg tin(II) chloride dihydrate (E. Merck) in 0.5 ml conc. HCl and diluting to 10 ml with bidistilled water (5 mg Sn/ml) 500 mg of sodium fluoride and 250 mg of PVP (polyvinylpyrrolidone molecular weight 25,000-30,000 BDH) were separately dissolved in 50 ml bidistilled water. All the prepared solutions were then filtered through 0.45 μ membrane filters (Millipore Corporation, USA) prior to their use.

Preparation of ^{99m}Tc-Sn-colloid

Various colloid solutions containing different concentrations of reagents and at different pH values were

prepared. Each preparation was finally diluted to 50 ml and 1 ml from it was dispensed into three penicillin vials. To each vial 3 ml of $^{99m}TcO_4^-$ (30 mCi) from ^{99m}Tc-generator (Amersham plc) was added followed by shaking for half a minute and then set aside for 15 min.

Bio-distribution studies

0.3 ml of ^{99m}Tc-Sn-colloid was injected into the tail vein of sprague-Dawley rats. The animals were sacrificed after 15 min and dissected. Liver, spleen lungs and carcass were transferred into polythene bottles. Ionization chamber (Capintec CRC 5RH) was used to measure the radioactivity of organs. The instrument was calibrated for radioactivity dispensed in different volumes.

Radiochemical purity

Pertechnetate (Tc-99m) contents of ^{99m}Tc-Sn-colloid were measured for product which gave maximum liver uptake by using 3MM Whatman paper and acetone as a solvent. Sn-colloid was stored in a refrigerator and was daily checked for pertechnetate contents after formulation.

RESULTS AND DISCUSSION

The results of bio-distribution of colloid are given in Table 1. These are based on the direct reading of dose calibrator. Dose calibrators have already been used for bio-distribution studies on mice[6]. In case of rat, the calibrator can also be used reliably. It was noted that the response of dose calibrator enhances for

TABLE 1

Organ distribution of ^{99m}Tc-Sn-colloid prepared with different amounts of reagents and pH values

Quantities/Vial				% of dose/organ, 15 min after i.v. injection		
Sn(II), µg	NaF, mg	PVP, µg	pH	Liver and spleen, %	Lungs, %	Carcass, %
100	1	-	5.6		Turbidity	
100	1	250	5.6	82.7	1.4	15.8
100	1	500	5.6	91.4	3.7	4.9
100	1	750	5.6	82.8	5.7	11.4
100	0.5	500	5.6		Turbidity	
100	1.5	250	5.6	64.0	0.3	35.7
200	1	500	5.6		Turbidity	
100	1	500	5.8		Turbidity	
100	1	500	5.4	38.7	2.9	58.4
100	1	500	5.0	34.0	3.1	62.9
100	1	500	4.0	30.0	3.7	66.0

*Mean of three animals.

larger volume of samples[7]. The size of bottle we used was 5.5 x 15 cm.

As the results of Table 1 show, Sn-colloid solution becomes turbid at pH above 5.7. This is in conformation with the optimum value given in KAERI report[8]. In absence of colloid protective agent, i.e., PVP, Sn-colloid solution is not stable and turbidity gradually increases. By increasing PVP to 750 µg per kit, lung uptake of ^{99m}Tc-Sn-colloid increases. This results in liver/lung ratio of 14:1 compared to 25:1 for 500 µg PVP per kit. Without NaF, the solution becomes turbid

TABLE 2

Variation of radiochemical purity of ^{99m}Tc-Sn-colloid with storage time of Sn-colloid kit

Days	Amount of $^{99m}TcO_4^-$ in product, %
1st	0.3
2nd	0.6
3rd	1.5
4th	3.0
5th	4.0

and eventually precipitation occurs. The Sn-colloid can be used upto five days as shown by the amount of free pertechnetate (Table 2).

Final procedure for kit preparation

Mix 1 ml of tin chloride solution (10 mg ml^{-1}), 5 ml NaF solution (10 mg ml^{-1}) and 5 ml PVP aqueous solution (5 mg ml^{-1}) and dilute to 50 ml volume with distilled water. Adjust pH to 5.6 with 1N NaOH solution. Dispense 1 ml in each penicillin vial and store in a refrigerator, if required. Add required amount of $Na^{99m}TcO_4$, mix and wait for 15 min before injecting to the patient. Radiochemical purity of product prepared according to the above procedure was more than 99%.

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