

Samarium-153-Labelled Hydroxyapatite Particles in Radiation Synovectomy

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ABSTRACT

The suitability of samarium-153 particulate hydroxyapatite (PHYP) as a radiation synovectomy agent was evaluated in 24 patients (21 knee joints, 9 ankle joints, 2 wrist joints and 1 elbow joint) with chronic synovitis. Sm-153 PHYP was intra-articular injected and flushed through with a mixture of xylocaine and triamcinolone acetonide. Whole-body images were acquired immediately and 72 hours after injection in order to demonstrate the extra-articular leakage of the radiopharmaceutical. Anterior and lateral static images of the injected joint were performed following the whole-body imaging. Mean extra-articular activity accumulation was calculated. In eleven patients (34.4%) activity was noted in the lung immediately after injection (mean 1.3% of injected activity). In ten patients (31.3%) and nine patients (28.1%), 0.36% and 0.25% of the injected activity accumulated immediately in the liver and the regional lymph nodes, respectively. Good distribution of radioactivity in the joint space was seen. No acute symptomatic complications from this radioactivity leakage were observed. We believe that Sm-153 PHYP is useful for radiation synovectomy as an out-patient procedure because the procedure is very easy and is associated with low extra-articular leakage.

INTRODUCTION

Radiation synovectomy using various radiopharmaceuticals has been used to alleviate the pain and swelling of rheumatoid arthritis for more than 40 years⁽¹⁾. After an injection of a beta-emitting radiopharmaceutical into the joint space, some of the injected radioactivity is absorbed by phagocytic lining cells along the synovial surface. As radionuclide decays, regenerating synovium will be irradiated.

Sm-153 PHYP that is recently used in this field, can be locally prepared by the Isotope Production Division, Office of Atomic Energy for Peace, Thailand⁽²⁾. Sm-153 decays by emission of gamma radiation (29.8%) with beta radiations of 810 keV (20%), 710 keV (50%) and 640 keV (30%). The penetration in soft tissue is 2.5 mm. It has a physical half-life of 1.95 days. With 103 keV gamma photon from the decay of Sm-153, extra-articular and in-

tra-articular distribution of activity accumulation in patients can be assessed by gamma camera. We evaluated the biodistribution of Sm-153 PHYP from whole-body imagings in patients treated for chronic arthritis.

MATERIALS AND METHODS

Patients Selection

Twenty-four patients with active and persistent arthritis who were refractory to intra-articular steroid injection were enrolled. There were 22 females and 2 males. Their age ranged from 33-81 years (mean 57 years). Pregnant or breast feeding females, patient younger than 18 years old and patients with extensive cartilage and bone destruction (Stage 3, 4 of Steinbrocker's classification) were excluded.

Methods

Intra-articular injection of 15 mCi of Sm-153 PHYP was given by the rheumatologist as an outpatient therapy. To be sure that the needle was in the correct intra-articular position, synovial tapping from the large joint through a 21-gauge needle was tried first. Most of the effusion was removed as much as possible before the radiopharmaceutical was injected into the joint and flushed through with a mixture of 2% xylocaine and 10 mg of triamcinolone acetonide. The total minimum volume of injection was 5 ml for knee joint and 2 ml for ankle joint. To make the volume of radiopharmaceutical solution appropriate for the particular joint, xylocaine and triamcinolone acetonide were also helpful to minimize the transient local reaction and effusion after injection. The activity in the injection apparatus was measured both before and after injection. Immediately after injection, the joint was passively flexed to

augment intra-articular distribution. The patients remained nonweight-bearing for 4 hours after injection. Then they were allowed to leave the department 4 hours postinjection and advised to rest but allowed to resume their normal activities the following day.

For extra-articular activity analysis, anterior and posterior whole-body imagings were acquired immediately and at 72 hours following injection using a single-headed gamma camera (Toshiba GCA-901A) with a low-energy, high resolution collimator with a 20% window centered at 103 keV for Sm-153. For intra-articular distribution analysis, anterior and lateral static images of the injected joint were performed following the whole-body imaging. SPECT images were acquired in five cases.

RESULTS

Thirty-three intra-articular injections were performed (21 knee joints, 4 ankle joints, 2 wrist joints and 1 elbow joint) Nine patients received two injections. Mean injected activity was 15.39 mCi (range 6.45-20.24 mCi). Immediately after injection, no extra-articular activity was evident in 12 patients (37.5%) whereas 72-hour images showed no extra-articular accumulation in 7 patients (21.9%) (Fig. 1). Mean extra-articular activity accumulation was calculated from whole-body imaging data. Lung activity was noted in 11 patients (34.4%) both immediately (mean 1.3% of injected activity) and at 72 hours after injection (mean 1.6% of injected activity) as shown in Table 1. Accumulation of activity in regional lymph nodes occurred in 9 patients (28%) immediately after injection (mean 0.25% of injected activity) and appeared in 14 patients (43.8%) at 72 hours after injection (mean 0.44% of injected activ-

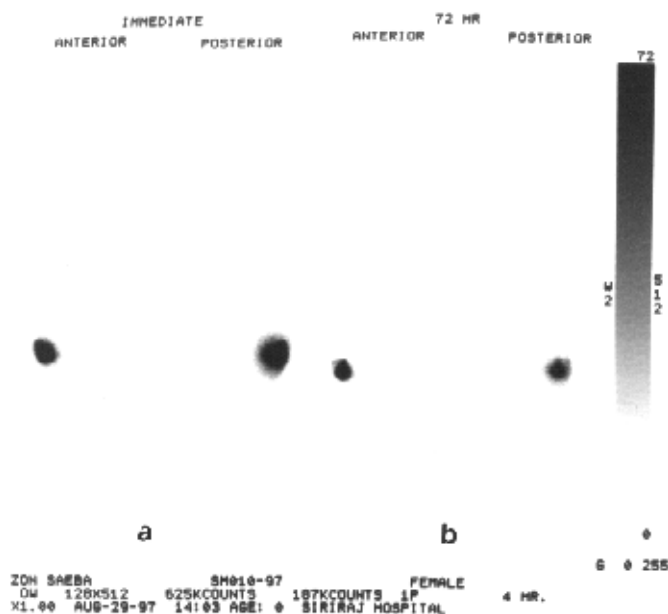


Fig. 1 Anterior and posterior whole-body imagings (a) immediately and (b) at 72 hours after Sm-153 PHYP synovectomy of the right knee showed no extra-articular activity.

Table 1 Activity localization in different organs post radiation synovectomy

Time following injection	Mean activity in different organs (% intra-articular injection)		
	Lung	Liver	Lymph nodes
Immediate	1.3 (n = 11)	0.36 (n = 10)	0.25 (n = 9)
72 hours	1.6 (n = 11)	0.94 (n = 16)	0.44 (n = 14)

ity). Whole body images immediate and 72 hours after injection showed mean activity of 0.36% and 0.94% of injected activity in the liver in 10 patients (31.3%) and 16 patients (50%), respectively (Fig. 2).

More than 90% of the injected activity in the joint was seen even at 72 hours after intra-articular injection. Distribution of the activity in most patients was noted in the joint space with maximal activity in the suprapatellar bursa.

DISCUSSION

A major problem associated with an intra-articular injection of radiocolloids is extensive leakage of radionuclides. It was suggested that leakage would be reduced by either a period of bed-rest or rigid splinting⁽³⁾. Radiation synovectomy with radioactive particles is believed to partly overcome this problem. In this study we found extra-articular activity in many patients but

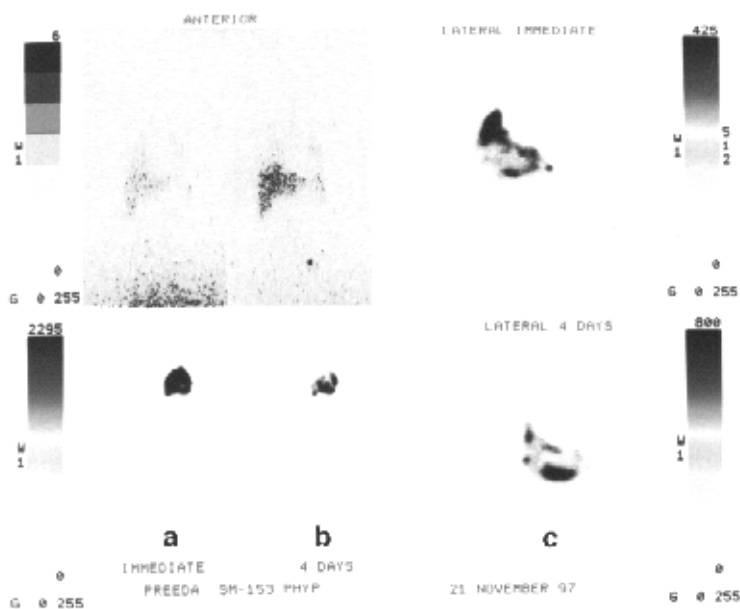


Fig. 2 Anterior whole body imaging acquired immediately after synovectomy of the left knee (a) showed accumulation of activity in the lung and liver. The 72-hour image of the same patient showed additional activity in the left inguinal nodes. Anterior and left lateral static images of the left knee showed distribution of activity in the injected joint.

the amount of the leakage was very low. Thus it will be possible to perform synovectomy with Sm-153 PHYP as an out-patient therapy and it will be convenient for patients as well as physician.

From the distribution of leakage activity, we believed that Sm-153 PHYP passed into the blood because of the injury of synovial vessels during injection and the leakage activity may be due to the particle of PHYP. If the activity had been resulted from free Sm-153, it should have been demonstrated in the kidneys or bone⁽⁴⁾. There was no acute symptomatic complication from these small amounts of extra-articular leakage in our studied group.

Local preparation of Sm-153 PHYP that has been supported by the International Atomic Energy Agency leads to an appropriate utilization of national resources and low expense. We believe that Sm-153 PHYP may be useful for radiation synovectomy as an out-patient procedure because the procedure is very easy and associated with low extra-articular leakage.

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