

# Radiosynovectomy of the elbow joint synovitis in rheumatoid arthritis treated with Lutetium - 177 labeled hydroxylapatite (Lu-177 HA) particulates; first case report and image of Lu -177 HA in the elbow joint

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## ABSTRACT

Rheumatoid arthritis is a chronic disease that is mainly characterized by asymmetric erosive synovitis, particularly affecting the peripheral joints. Radiation synovectomy or radiosynovectomy, also known as radiosynoviorthesis was first described in 1950's as an adjuvant treatment for rheumatoid arthritis. Radiosynovectomy is based on the irradiation of the joint synovium by the intra-articular administration of various  $\beta$ -emitting radiopharmaceuticals. Lu-177 has presence of gamma photons of imagable energy with low abundance which provides the additional benefit of carrying out simultaneous scintigraphy. We describe the first case report of use of Lu-177 hydroxylapatite particulates in a 35-year-old female patient who was presented with elbow joint synovitis due to rheumatoid arthritis.

**Keywords:** Elbow joint, lutetium-177 HA, radiosynovectomy, rheumatoid arthritis

## INTRODUCTION

Rheumatoid arthritis (RA) is a chronic, progressive, inflammatory joint disorder, the primary treatment for which consists of medical regimens aimed at controlling the synovial inflammation of the joint.<sup>[1]</sup> Radiation synovectomy (RS), involving a radiopharmaceutical injection into the joint. Its intention is to destroy the inflamed synovium, in the expectation that the regenerated synovium will be disease-free and the symptoms will thereby be alleviated.<sup>[2]</sup> Lutetium-177 (Lu-177) is considered to be a promising radionuclide for use in RS of joints owing to its favorable decay characteristics. Hydroxyapatite particles (HA) are regarded as one of the most suitable carriers for applications in

RS.<sup>[3]</sup> We describe the first case of application of Lu-177 HA in the treatment of the elbow joint synovitis in rheumatoid arthritis.

## CASE REPORT

A 35-year-old female patient was presented with a right elbow joint pain and swelling for a duration of six months. The patient's blood investigation revealed elevated C-reactive protein (60 mg/ml) and diagnosed to have rheumatoid arthritis. The patient was treated with anti-rheumatoid drugs and had no symptom relief. The patient was referred for three phase bone scintigraphy and radiosynovectomy. Perfusion phase images [Figure 1a] demonstrates increased perfusion in the right elbow joint and blood pool images [Figure 1b] shows increased blood pooling consistent with synovitis. Whole body images [Figure 1c] showed increased uptake in the right elbow joint. The patient was then administered intraarticular injection of Lu-177 HA and images of the elbow joint was acquired in a dual head gamma camera (Siemens Symbia True point) in high energy general purpose collimator with multiple windows of 113 Kev and 208 Kev. Lu 177 HA images [Figure 2] showed

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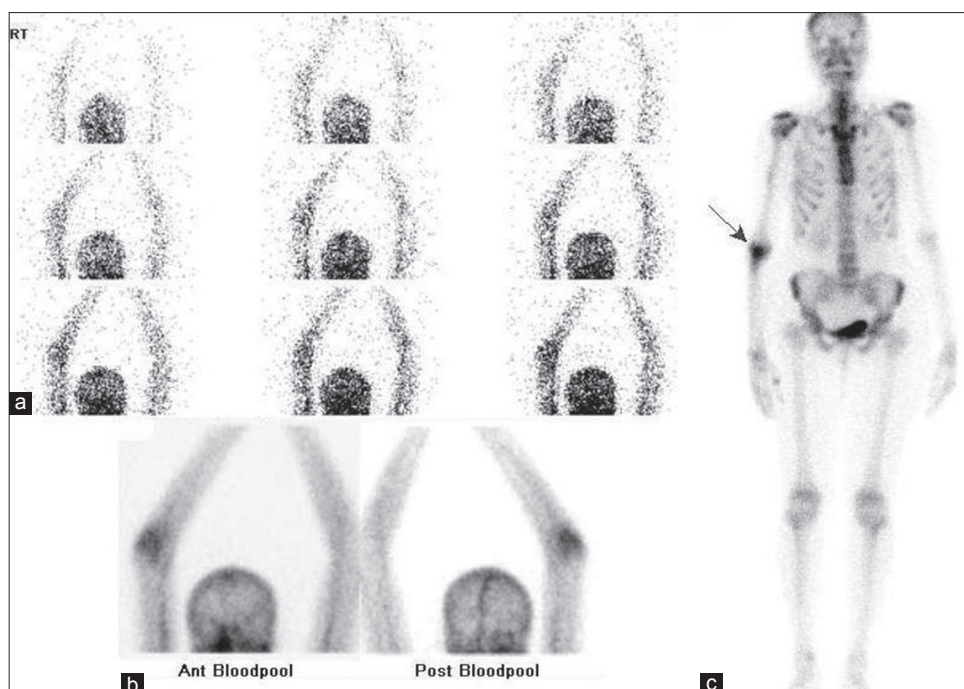


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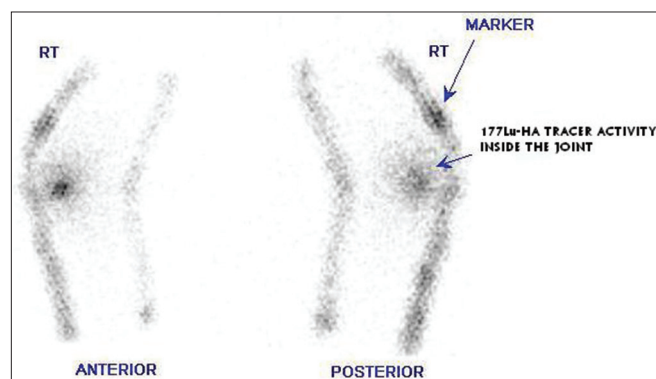
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**Figure 1:** Three phase bone scintigraphy of the elbow joint. Perfusion (a) and anterior and posterior blood pool (b) Images demonstrates increased perfusion and blood pool concentration in the right elbow joint consistent with synovitis. Whole body images (c) Showing increased tracer uptake in the right elbow joint (arrow)



**Figure 2:** Lu-177 HA images of the elbow joint showing good tracer distribution in the right elbow joint

good distribution of tracer in the elbow joint. Her elbow was immobilized for 48 hours. She is on follow-up.

## DISCUSSION

Radiation synovectomy (RS) is a local intraarticular injection of radionuclides in colloidal form. RS may relieve synovitis, joint pain, knee flexibility and joint effusion in about 60%-80% of the cases.<sup>[4]</sup> First used by Fellingner *et al.*,<sup>[5]</sup> in 1952, the technique has been applied for over 50 years in the treatment of resistant synovitis in individual joints after the failure of long-term systemic pharmacotherapy and intra-articular steroid injections. Radioisotopes with emission of  $\beta$  radiation have the capacity to diminish the inflammatory process and ablate the inflamed synovial membrane (pannus) with subsequent fibrosis. Three radionuclides are currently in use: Yttrium-90 (Y-90 silicate/citrate),

Rhenium-186 (Re-186 sulfide), and Erbium-169 (Er-169 citrate), which have been indicated for large, medium, and small joints, respectively.<sup>[6]</sup> Lu-177 has emerged as a pivotal radionuclide in the field of *in vivo* radionuclide therapy could be considered owing to its suitable nuclear decay characteristics [ $t^{1/2} = 6.65$  d,  $E\beta$  (max) = 497 keV,  $E = 113$  keV (6.4%), 208 keV (11%)].<sup>[7]</sup> The presence of gamma photons of imagnable energy with low abundance provides the additional benefit of carrying out simultaneous scintigraphy relatively longer half-life of the radioisotope provides logistic advantage during its transportation to distant nuclear medicine centers. Therefore, RS agents based on Lu-177 will be economically more viable compared to most of the other agents so far in clinical use. An ideal agent for RSV would be one which the radionuclide is irreversibly attached to pre-formed particles of appropriate size. Hydroxyapatite, one of the preferred particulates for use in RS applications, is a naturally occurring mineral form of calcium apatite, mainly found in bone and teeth.<sup>[7]</sup>

Lu-177 HA can be potentially used as an ideal agent for radiosynovectomy of the joints. The choice of this radio-pharmaceutical was made based on the optimal penetration of beta radiation in the synovia. The beta radiation, because of its short penetration distance, reaches only structures in the intermediate vicinity of the joint cavity. As per the limited number of stability and animal studies performed by the scientists<sup>[3,7]</sup> it has been observed that Lu-177 HA is highly stable and leakage from the synovial site is negligible. Leakage has been particularly difficult to quantify where the isotope used was Y-90 or P-32, radioisotopes which are both pure beta emitters with no accompanying gamma emissions that might be used to quantify biodistribution and dosimetry.<sup>[8]</sup>

RS injection was performed according to EANM guidelines.<sup>[9]</sup> RS treatment was performed with precise intra-articular injection of a typical dose of  $333 \pm 46$  MBq under sterile conditions. Before joint puncture, local anesthesia was administered with 2% lidocaine-hydrochloride prior to the injection of Lu-177 HA. Depomedrol (40 mg in 1 mL) was injected into the joint in order to reduce the risk of acute radiation induced synovitis and to avoid skin radiation necrosis.<sup>[9]</sup> Subsequently, 333 MBq (Range: 259-370 Mbq) of Lu-177 HA particles dispersed in 1 mL of sterile, apyrogenic normal saline was administered intra-articularly and then the needle was flushed with 2-4 mL of normal saline. In case of any uncertainty about the exact location of the tip of the needle, arthrography was performed to check the correct location. An orthopedic bandage was applied as a semi rigid splint. Imaging of activity distribution with a dual head gamma camera showed appropriate homogeneously intra-articular distribution of the radionuclide within the joint space. Our case describes the first application of Lu-177 HA in the elbow joint synovitis and image of Lu-177 HA.

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