

Effect of immobilization on retention of ^{90}Y

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In this study the distribution of the *Bremsstrahlung* radiation resulting from the absorption of β particles was evaluated immediately after the intra-articular injection into the knee of ^{90}Y and subsequently at intervals over the next 3 days. The later results were compared with the original patterns in individual patients. In all the cases in this series the knee was immobilized immediately after the injection and kept enclosed in a plaster of Paris splint for the next 3 days. If there are any real differences between our results and those described in other centres, they may be related to this period of immobilization.

Material and methods

PATIENTS STUDIED

Scans were completed in 22 patients, nineteen of whom had seropositive rheumatoid arthritis; there was one case of ankylosing spondylitis, one of psoriatic arthritis, and one patient in whom Still's disease in childhood had become seropositive adult rheumatoid arthritis.

INJECTION TECHNIQUE

The material injected was ^{90}Y incorporated in particles of Zeo-Karb 225, particle size 20-50 nm. obtained from the Radiochemical Centre, Amersham (product code number YAS 3P), at a concentration of 1.5 to 3.5 mCi./ml. The product is stabilized with glucose and gelatin. 5 mCi. YAS 3P was made up to a volume of 10 ml., using sterile isotonic saline.

24 hours before injection the limb was enclosed in full extension in a long-leg plaster of Paris cylinder which was later split longitudinally into an anterior and posterior half.

A No. 12 needle was inserted carefully into the joint, and 10 ml. joint fluid were withdrawn from the knee. The syringes were interchanged leaving the needle *in situ*, and 10 ml. of the solution of ^{90}Y resin colloid was injected. The knee was immediately immobilized between the halves of the preformed plaster of Paris cast for 3 days.

STUDIES OF RADIOACTIVITY

The distribution of radioactivity was studied within 1 hour and at intervals up to 3 days as follows:

(1) Scintillation scanning in both antero-posterior and

lateral planes, using a Picker Magnascanner fitted with a 5" scintillation crystal.

(2) External counting over inguinal lymph nodes, liver, and spleen.

(3) Successive samples of blood were taken and the activity of these determined.

(4) In one case only a 24-hour collection of urine was examined.

Results

From the scans obtained it was apparent that although there were considerable variations between patients, and a variation up to 8-fold in the intensity of radioactivity in different parts of the same joint, there was very little real change in the distribution of the isotope detected by these methods over the 3 days of the study. More than half the scans show that the isotope is localized to separate discrete areas within the joint space.

Counting was performed over inguinal lymph nodes, liver, and spleen using a scintillation detector and ratemeter. Concentrations down to 1/1,000th of that in the knee would have been detected but on no occasion was any activity detected at these sites.

The level of radioactivity in the blood was less than 1.0 $\mu\text{Ci./litre}$ in the samples tested. Successive measurements showed levels reducing at rates which might be expected to represent those produced by physical decay. No radioactivity was detected in the one urine specimen examined.

Chromosomes from three patients were examined for isochromatid breaks, acentric fragments, chromatid breaks, and dicentrics, before and 48 hrs and 4 wks after the injection. These studies failed to show any significant change in the numbers of abnormal chromosomes in these patients.

Discussion

It will be very difficult to evaluate the effect of exercise alone on the distribution of ^{90}Y resin colloid injected into the knee joint, because many other factors can

determine differences both between patients and at different times in the same patient (Table I).

Table I *Factors which could influence the distribution of ^{90}Y injected into the knee*

In the material used	Particle size Stability
In the method of administration	Accuracy of injection Induced volume/pressure changes Activity, weight-bearing
In the joint	Synovial thickness Degree of inflammation Free particulate, or covering fibrin Cysts and bursae Volume of fluid present Erosion of bone
In the patient	Diagnosis Current treatment Previous treatment (+local) Surgery

Some of the known effects of activity are shown in Table II.

We believe that these or other factors related to activity can influence the distribution of the radioisotope examined here, and that these factors can

Table II *Effects produced by activity*

Large variations in intra-articular pressure; note how pressure-changes may be modified by a small effusion or bulky synovium
Changes in blood flow—possibly synovial blood flow—accompanying a general increase in blood flow through the limb (Lymphatic flow)
Effect of loading of articular surface on passage of large molecules through cartilage
A reduction in the frequency of chromosome damage appears to correlate with restriction of activity following ^{90}Y injection

be modified favourably by careful immobilization of the knee immediately after the injection for 3 days.

Summary

The experience in Belfast of the effect of strict immobilisation on the distribution of yttrium-90 injected into the joint is given.

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