Use of yttrium 90 in persistent synovitis of the knee

II. Direct comparison of yttrium colloid resin and yttrium citrate

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The choice of radiocolloid for intra-articular therapy depends largely on factors of efficacy and safety. The β -emission from yttrium 90 (^{90}Y) has a satisfactory range for use in the knee and a short half-life as well as freedom from gamma-radiation and from contamination. Since the demonstration by Stevenson, Bedford, Hill, and Hill (1971) and Stevenson and 12 others (1973) that chromosomal changes occur in circulating lymphocytes after intra-articular injection of ^{198}Au and ^{90}Y , and that the degree of these changes relates most closely to the uptake of isotope by lymph nodes, there are now definite theoretical reasons for using isotope preparations that show least spread to regional lymph nodes.

At the time of this study, three preparations of ^{90}Y were commercially available, although one, the resin, has subsequently been withdrawn because of problems of manufacture. Prichard, Bridgman, and Bleehen (1970) had compared the resin and the silicate in the knee and had found better retention of resin with considerably less lymph node uptake. Subsequent workers have confirmed the good retention of the resin (Oka, Rekonen, Ruotsi, and Seppälä, 1971; Gumpel, Williams, and Glass, 1973) especially when the knees are at rest after injection. Ingrand (1972) has shown that there is little lymphatic spread using the citrate. This study is a comparison of the resin and the citrate preparations.

Characteristics of materials

Yttrium 90 citrate (code Y-MM-1) was obtained from the Commissariat à l'Energie Atomique (France); Resin colloid (code no. YAS 3P) from the Radiochemical Centre at Amersham. Their principal features and those of the silicate are shown in Table I.

Bontoux, Marignan, and Bali (1968a) showed that the majority of particles of yttrium citrate are less than 10 μ , and that there is a range of particles from less than 1 μ to aggregates of 1 μ . However, the theoretical particle size in the case of the citrate may be largely irrelevant, as the same

Table I Summary of characteristics of radiocolloids of ^{90}Y

Colloid	Manufacturer	Particle dimensions (μ .)	Stability in vivo
Citrate	C.E.A.	10-30 with agglomerates to 1 μ .	Dissociates
Resin	Radiochemical Centre	20-50	Stable
Silicate	Radiochemical Centre	100	Dissociates

authors (1968b) have shown that the citrate precipitates by reaction with phosphate ions after injection.

Yttrium 90 resin is a stable preparation of isotope adsorbed onto colloidal particles of a cation exchange resin—Zeo-carb 225—of which more than 90 per cent. of the particles range between 20 and 50 μ in size.

Methods

The techniques used for measuring have been previously described (Gumpel and others, 1973). The subjects were eight patients with chronic rheumatoid synovitis of both knees, in whom the knees were the major area of disease. Each knee was injected with 5 mCi. of ^{90}Y , citrate being injected in one knee, resin in the other. One of these patients, with some response to the first injection, was given a repeat injection of 2.5 mCi. in both knees; in this case the sides receiving citrate and resin were reversed. The scans and calculations were reviewed by an independent observer (EDW).

Patients were scanned immediately after injection and after 5 days. Where possible, an additional scan including regional lymph nodes and major organs was performed after 24 hours. Patients were treated in 'groups', and were at rest in bed unsplinted for the 3 days subsequent to injection.

Results

5 days after injection, 82.1 ± 9.5 per cent. of resin was retained, compared with 75.1 ± 9.5 per cent. of

citrate (Figure and Table II). These differences are not statistically significant (*t* tests and Wilcoxon's simple nonparametric tests).

FIGURE Retention of colloid resin and citrate

Table II Comparison of retention of isotope in knees after 5 days (Corrected for decay)

Patient	Dose (mCi.)	Retention at 5 days	
		Resin per cent.	Citrate per cent.
A	5.0	75	61
B	5.0	88	66
C	5.0	81	61
D	5.0	97	100
E	2.5	83	51
F	5.0	76	79
G ₁	5.0	95	82
G ₂	2.5	67	82
H	4.0	77	94

Considerable practical difficulties prevented us from calculating the uptake in regional lymph nodes in more than three patients (Table III). There was greater uptake observed in regional nodes on the citrate side and this occurred much earlier than on

Table III Regional lymph node uptake

Patient		Resin per cent.	Citrate per cent.
F	24 hrs 5 days	— 0	— 2
G	24 hrs 5 days	0 0	3 1.7
H	24 hrs 5 days	0.3 0.5	1.8 0.8

the resin side, so that the radiation dose to the lymph nodes on that side would be considerably greater. This pattern of early uptake was seen on other scans, although insufficient data was available for calculation. There was a minimal difference in patient tolerance, the citrate knees being less swollen after injection than the resin knees. One patient experienced pain in the resin colloid groin one day after injection, while scanning revealed lymph node uptake in the opposite (citrate) groin only.

Discussion

This direct comparison has shown that there could be a small therapeutic advantage in using the resin, and that the theoretical risk of malignant change in draining lymph nodes is probably lessened. Of more practical interest is the realization that retention in the joint would appear to be a function of the stability of the colloid rather than of particle size. In terms of particle size, the resin is midway between the citrate and silicate forms, and while the bond between the yttrium and resin is very strong, the yttrium easily dissociates from citrate and silicate *in vivo*. Further studies on the handling of radio-colloids in the synovial cavity are needed.

Summary

A direct comparison of two radiocolloids of yttrium 90, the citrate and the resin, showed slightly better retention of the resin in the knee after injection, but not significantly so. Uptake of the resin by regional lymph nodes occurred later and to a lesser degree than for the citrate.

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