Release of dogs following Sn-117m colloid intra-articular injections

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Objective: Radiosynoviorthesis using a tin-117m colloid is proving to be an effective treatment of osteoarthritis of the canine elbow. This study used new clinical measurements of external exposure and Monte Carlo simulations in order to develop guidelines for the release of treated animals from radiation safety isolation based upon the public dose limit of 1 mSv.

Methods: Twelve adult dogs were treated with the Sn-117m colloid for Grade 3 osteoarthritis of the elbow. The nominal dosage of 1.75 mCi to an elbow of a 50 pound dog was adjusted by weight-based body surface area and capped at 3 mCi. Nine dogs were treated in both elbows and three were treated in just one. They weighed 73.8±16.4 [50-101] pounds and received 3.7±1.3 [1.6-5.6] mCi in all. The external exposure rate was measured using a Ludlum 9DP ionization meter laterally at distances of 5 cm and 1 m and cranially at a distance of 1 m as soon as the dogs awoke from sedation and again on the next day. These situations were simulated in a stylized fashion using the Gate Monte Carlo software. For release calculations, walking and playing with a dog were modeled as separation by 3 feet while feeding and petting a dog were modeled as separation by 1 foot.

Results: The simulation of a point source in air gave a dose rate constant of 1.54×10^{-17} Gy-m^2/Bq-s at a depth of 1 cm into water, which is mid-way between the extreme values calculated using the ANSI/ANS-6.1.1-1991 methodology. The simulation of two legs gave an attenuation of the dose from the far joint of 50%. Including this effect, the measured lateral dose rate at 1 m was 52% of the expected dose rate in air and the cranial dose rate was 37% of that expected in air, so for release calculations, an effective dose rate of 8.0×10^{-18} Gy-m^2/Bq-s was used regardless of orientation. The measurements that were made immediately post-treatment and those from the next day did not differ significantly. The restrictions on an individual person's interacting with dogs that were given the maximum dosage of this cohort or the nominal dosage for modeled exposure times while keeping the person's total dose below 1 mSv are tabulated. After ten weeks (or five physical half-lives), more relaxed restrictions would typically allow a further dose of only 0.15 mSv or less.

Conclusion: Dogs that have been treated with Sn-117m radiosynoviorthesis may be released from radiation safety isolation immediately after treatment with tolerable restrictions on human interactions.

Treatment Scenario	Dosage per Treatment (mCi)	Human Dose per Treatment (mSv)	Time at 3 ft (hr/day)	Time at 1 ft (min/day)
120 lb, both elbows, twice in a year	6	0.5	2	8
120 lb, both elbows once,	6	0.66	2	15
then one elbow again	3	0.34	2	16
50 lb, both elbows, twice in a year	3.5	0.50	2	23
50 lb, one elbow, twice in a year	1.75	0.50	2	61