External Radiation Exposure Following Sn-117m Colloid Intra-articular Injections

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Abstract

Radiosynoviorthesis (a.k.a. radiosynoviorthesis) is an established treatment for arthritis. We are studying the use of Sn-117m (T1/2 = 14 days) to treat smaller arthritic joints in animal patients. In this study, Sn-117m colloid was administered via intra-articular injection into the articular space of the arthritic elbow. The radiolabeled particles are removed from the synovial fluid by phagocytes and transported into the synovocytes near the surface of 117m tin and also into the inflamed synovial tissue. The release of energy that occurs in the synovial tissue relieves the inflammation through ablation of the tissue.

Canine Treatments

Three veterinary clinics are participating in a clinical trial to treat Grades 1 or 2 osteoarthritis of the canine elbow with a Sn-117m colloid having a nominal particle size of 6 μm. The dosages are being investigated: 44 μCi/kg, 77 μCi/kg and 110 μCi/kg. The 35 dogs of various breeds ranged in weight from 12 to 87 kg, and the dosage ranged from 0.74 to 3.75 mCi (now capped at 3.5 mCi).

V2.0 Software Tool for GATE and MIRDcell

For the owners and the caregivers of human patients that must be isolated, reasonable restrictions on close proximity to the patient were limited to 7 hours a day at 3 feet between the patient and humans was considered at 3.5 mCi and a six hour isolation after administration. The administration site was compressed for two minutes afterward to prevent leakage through the needle track.

Nearby Exposure Rate

The exposure rate at 5 cm from the surface of the chamber of the meter was divided by the administered activity. The result is a mSv/hr/μCi/kg.

Release Factors

In a similar fashion to the release of radioactive human patients under the guidance of NUREG 1029, 0.0034 linear fit to the data was used in the release scenarios that make it unlikely that the model would underestimate the public dose limit if the exposure to the patient were limited to 7 hours a day at 3 feet or 13 minutes a day at one foot plus five hours a day at three feet. Alternately, the owners might limit exposure to two hours a day at three feet for seven weeks and then add exposure for six days a day at one foot.

Example 1: Large dog, treated in both elbows

In the worst case scenario the maximum administered activity to each elbow of 3.5 mCi and a six hour isolation after administration, the owners would be unlikely to allow the public dose limit if the exposure to the patient were limited to 7 hours a day at 3 feet or 13 minutes a day at one foot plus five hours a day at three feet. Alternately, the owners might limit exposure to two hours a day at three feet for seven weeks and then add exposure for six days a day at one foot.

Example 2: Small dog, treated in one elbow

In the case of a single elbow treatment of a smaller dog with 1.75 mCi, the restrictions are less onerous. The limitation during close proximity is only two weeks.

Discussion

It was difficult to obtain good exposure rate readings from some dogs because of their movement. The duration of time for which a dog could receive more than 100 mrem (1 mSv) was limited for reasonable restrictions on close proximity for several hours may be too conservative.

Conclusion

There is no need for protricated irradiation of radiosynoviorthesis patients following treatment. Veterinary patients may require a few weeks of limited contact in order for their owners to receive a radiation absorbed dose of 100 mrem (1 mSv). Human treatment would be unlikely to require any restrictions after release because of the five-fold higher regulatory dose limit of 500 mrem (5 mSv) to the individual who is most exposed to a human patient.

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