A ^{133}Xe TRANSMISSION SOURCE

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The gaseous element ^{133}Xe has been used in a container of appropriate design as an extended source for transmission imaging.

Transmission scintiphotography has been used as an aid in the interpretation of anatomical features as reported by Anger, et al (*1*); Volpe, et al (*2*); and by Swann, et al (*3*). These workers have used a solution of ^{99m}Tc-pertechnetate in a uniformly distributed sheet source for transmission scintiphotography. Difficulties in the use of ^{99m}Tc arise from the necessity of preparing a new source daily due to the 6-hr half-life of ^{99m}Tc. In addition, in order to achieve meaningful transmission scintiphotos, a uniform mixture of the pertechnetate solution must be obtained.

These difficulties suggest the use of ^{133}Xe as a transmission source. The 5.27 day half-life of ^{133}Xe requires refilling the source at an interval of 1–2 weeks. The 80-keV principle gamma emission is in the ideal range for the required delineation of anatomic structures in transmission scintiphotography. Kinetic theory of gases further suggests that in order to have a sheet source of uniform activity, one need only release the required amount of xenon gas in a vessel of uniform thickness with the required cross-section.

METHOD

A vessel was constructed using ¼-in.-thick Plexiglas for the top, bottom, and sides. The vessel has a thickness of 1 in., inside dimension, and a cross-section of 16 in. square. A double set of lateral walls was used as shown in Fig. 1 to insure against gas leaks. The two sets of lateral walls were separated by ½ in. The top and bottom of the vessel had ⅛-in.-deep grooves cut to coincide with each wall segment seen in Fig. 1. Epoxy glue was carefully applied to all mating surfaces to achieve a gas-tight and structurally strong vessel.

The filling device consists of a ½-in. bolt placed in a ½-in. hole previously drilled through the center of a pair of two lateral walls. During the assembly, epoxy glue was applied to the threads of the bolt and thin nuts were drawn up tightly to each side of the two walls through which the bolt passes. The bolt had been previously drilled and tapped for a ¼-in. screw. To seal the filling hole, a ¼-in. screw was wrapped with Dupont Teflon pipe joint tape and screwed into the bolt.

To fill the vessel, 20–30 mCi 133-Xe, in a volume not exceeding a few milliliters, was placed in a syringe fitted with a long spinal needle. The needle

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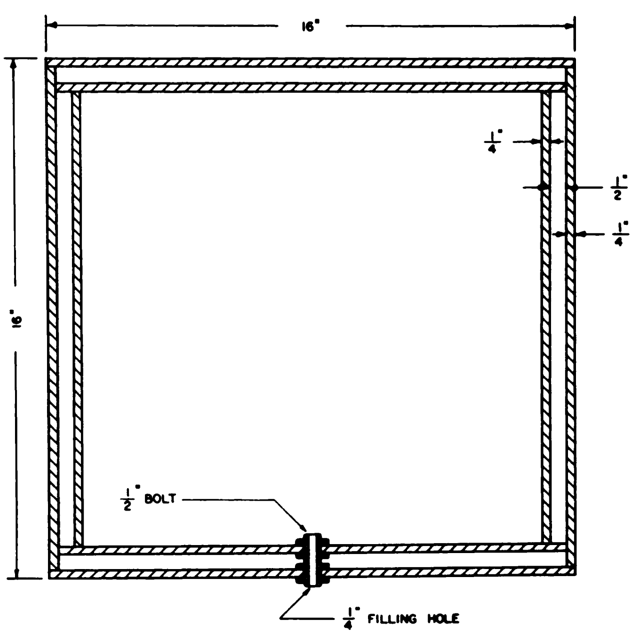

FIG. 1. Cross section of ^{133}Xe transmission source.

was inserted through the filling hole and the gas injected into the vessel space. The Teflon-wrapped screw was quickly inserted and tightened.

RESULTS

Due to lower diffusion rate of heavy gases, approximately 1 hr is required for the ^{133}Xe to become uniformly distributed. Uniformity is maintained thereafter as revealed by scintiphotography of the source with a gamma camera using a high-resolution collimator. The presence of leaks may be determined by serial counts with the gamma camera using constant conditions of geometry and detector parameters. If the counts decrease with an apparent half-life of 5.27 days, the source may be considered leak-free. Or, if the counts decrease with an apparent half-life less than 5.27 days, the apparent half-life may be used to assess the magnitude of the leak. When counted in the manner described above, the apparent half-life of the source was 5.20 days.

Our ^{133}Xe sheet source gives transmission scintiphotos with quality comparable to those made with a ^{99m}Tc sheet source but without the inconvenience of daily refilling.

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