Technetium (^{99m}Tc) tin pyrophosphate complex injection (Stanni pyrophosphatis et technetii (^{99m}Tc) multiplex injectio)

Other name. (^{99m}Tc)-PYP complex injection.

Description. Technetium (^{99m}Tc) tin pyrophosphate complex injection is a clear, colourless aqueous solution.

Technetium-99m has a half-life of 6.02 hours.

Category. Diagnostic.

Storage. Technetium (^{99m}Tc) tin pyrophosphate complex injection should be kept at a temperature between 2°C to 8°C.

Additional information. Wherever V is used within the tests of this monograph, V is the maximum recommended dose in millilitres.

Requirements

Complies with the monograph for "Parenteral Preparations" and with that for "Radiopharmaceuticals".

Definition. Technetium (^{99m}Tc) tin pyrophosphate complex injection is a sterile solution of sodium pyrophosphate that is complexed with technetium-99m, in presence of a stannous salt or other suitable reducing agent. The injection is suitable for intravenous administration and contains sufficient sodium chloride to make the solution isotonic with blood. The content of technetium-99m is not less than 90% and not more than 110% of the content of technetium-99m stated on the label at the reference date and time stated on the label. Not less than 95% of the total technetium-99m radioactivity is present as technetium (^{99m}Tc) pyrophosphate complex. The injection contains a variable quantity of tin (Sn) not greater than 3 mg/mL.

Manufacture

Radionuclide production. Technetium-99m is a radioactive nuclide formed by the radioactive decay of molybdenum-99. Molybdenum-99 is a radioactive isotope of molybdenum and may be produced by neutron irradiation of natural molybdenum or of molybdenum enriched in molybdenum-98 or it may be produced by uranium fission.

Production of radiopharmaceutical preparation. Technetium (^{99m}Tc) pyrophosphate complex injection is prepared aseptically from sterile starting materials such as a sterile kit containing sodium pyrophosphate and a stannous salt with sodium pertechnetate (^{99m}Tc) injection (fission or non-fission). It may have the pH adjusted and may contain reducing, chelating, stabilizing, filling and antioxidizing agents as well as antimicrobial preservatives and buffers. The injection may also be prepared under aseptic processing combined with sterilization by Filtration (see 5.8 Methods of sterilization).

Identity tests

• Either tests A and C or tests B and C may be applied.

A. Record the gamma-ray spectrum using a suitable instrument with a sample of technetium-99m, suitably diluted if needed. The spectrum is concordant with the *reference spectrum* of a specimen of technetium-99m in that it exhibits major peaks of 140 keV.

Standardized technetium-99m solutions are available from laboratories recognized by the relevant national or regional authority.

B. The half-life determined using a suitable detector system is between 5.72 and 6.32 hours.

C. Examine the radiochromatogram obtained in the test for radiochemical purity. The distribution of the radioactivity contributes to the identification of the preparation.

pH value. Carry out the test as described in the monograph for "Radiopharmaceuticals". pH of the injection, 3.5 to 7.5.

Sterility. The injection complies with 3.2 Test for sterility, modified as described in the monograph for "Radiopharmaceuticals". Test for sterility will be initiated on the day of manufacture. The injection may be released for use before completion of the test.

Bacterial endotoxins. Carry out the test as described under 3.4 Test for bacterial endotoxins, modified as described in the monograph for "Radiopharmaceuticals". The injection contains not more than 175/V I.U of endotoxins per millilitre. The injection may be released for use before completion of the test.

Radionuclidic purity. Record the gamma-ray spectrum using a suitable instrument and measure the half-life using a suitable method. Determine the relative amounts of technetium-99m and radionuclidic impurities that may be present.

Radiochemical purity. Carry out two separate tests as described under *1.14.1 Chromatography*, Thin-layer chromatography using silica gel R as the coating substance and methyl ethyl ketone R (system A) or sodium acetate (1 mol/l) VS (system B) as the mobile phases. Apply to the plates about 5 µl of the injection to be examined, suitably diluted to give an optimum count rate and develop for a distance of about 15 cm. Allow the plates to dry and determine the radioactivity distribution by a suitable

method. In system (A), the technetium (^{99m}Tc) pyrophosphate complex and reduced hydrolysed technetium-99m have an Rf value of 0 and the pertechnetate ion has an Rf value of 1. In system (B), the technetium (^{99m}Tc) pyrophosphate complex and the pertechnetate ion have an Rf value of 1 and reduced hydrolysed technetium-99m has an Rf value of 0.

The sum of the percentages of radioactivity corresponding to the pertechnetate ion in system (A) and reduced hydrolysed technetium-99m in system (B) is less than 5%. Not less than 95% of the total technetium-99m radioactivity is present as technetium (^{99m}Tc) pyrophosphate complex.

Chemical purity

Tin. Carry out the test as described under R2.1.4 Tin estimation by UV absorption, using 1.0 mL of a test solution prepared by diluting 1.0 mL of the injection to be examined to 50.0 mL with hydrochloric acid (1 mol/l) VS and mixing thoroughly. Prepare the reference solution by dissolving 0.115 g of stannous chloride R in hydrochloric acid (1 mol/l) VS, diluting to 1000 mL with the same solvent and mixing thoroughly. The absorbance of the test solution is not greater than that of the reference solution; not more than 3 mg of Sn per mL.

Radioactivity. Measure the radioactivity as described under R.1.1 Detection and measurement of radioactivity in a suitable calibrated counting equipment by comparison with a standardized technetium-99m solution or by measurement in an instrument calibrated with the aid of such a solution (a good approximation may be obtained using an ionization chamber and employing a standardized solution of cobalt-57 provided that correction for the differences in the radiations emitted are made).

Standardized technetium-99m and cobalt-57 solutions are available from laboratories recognized by the relevant national or regional authority.

Biodistribution. Carry out the test as described under R3.1 Biological distribution using a set of three rats as described. Inject a volume less than 0.2 mL containing not more than 0.05 mg of pyrophosphate. Determine the radioactivity per gram weight in the femora (A1), the leg muscle (A2) and blood (A3). In not fewer than two of the three rats, the following percentages of the injected radioactivity should be found: not less than 2.5% in the femora, not more than 1% in the liver; the ratio A1/A2 is not less than 100 and the ratio A1/A3 is not less than 40.