ASK THE EXPERT

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This department provides a forum for *JNMT* readers to ask technical questions and receive answers from an expert in nuclear medicine technology. Send your questions and comments for future *Ask the Expert* columns to: Frank J. Papatheofanis, MD, PhD, UCSD Medical Center Hillcrest, 200 West Arbor Dr., San Diego, CA 92103-8758 or fax 619-543-1975.

Question: **Why does a patient, who had a reaction to a radiology study that used iodine, not have a problem with nuclear medicine studies using iodine?**

The amount of iodine used in common radiology studies is much greater than that used in nuclear medicine studies. Most of the adverse affects of iodine are due to iodide (*1*), not organically-bound iodine as found in contrast agents. Therefore, the amount of iodine is not a factor in reactions to contrast media. Adverse reactions in radiology imaging studies using contrast media are primarily due to the osmolarity of these agents (*1*). These agents are used in studies including intravenous pyleogram (IVP), CT with contrast and others. Conventional ionic contrast media (Conray®-Iothalamate meglumine injection, Mallinckodt Inc., St. Louis, MO (*2*)) used in radiology may cause adverse reactions from a mild rash to death. The incidence of death from the injection of conventional contrast agents ranges from 6.6 per million (0.00066%) to 1 in 10,000 (0.01%) patients. As a result, nonionic contrast media became available and attained widespread use in the late 1980s. The relative amount of iodine in nonionic contrast media did not change appreciably (160 mg/ml to 320 mg/ml for Optiray®-Ioversol injection, Mallinckrodt Inc., St. Louis, MO, as compared to 282 mg/ml for Conray®). However, nonionic contrast media do not bind to serum or plasma proteins and have no significant metabolism, deiodination or biotransformation (*3*). Since the introduction of nonionic contrast media with it's change in osmolarity, the incidence of reactions has been greatly reduced. However, the cost of imaging with nonionic contrast media has increased, due to the cost of the contrast, by as much as tenfold.

In contrast to radiology studies, with levels of iodine in the hundreds of milligrams and concerns of osmolarity, nuclear medicine studies require much smaller quantities of iodine and radiopharmaceuticals have osmolarities similar to serum. Of course, there may be other adverse reactions unrelated to osmolarity of the contrast agents. If these reactions occur, they cannot be compared to radiopharmaceuticals which are completely different agents.

Nevertheless, the amount of iodine in most common nuclear medicine radiopharmauecticals (used for renal imaging, neuroendocrine imaging (*4*), thyroid uptake and imaging, and treatment) is much lower than the recommended dietary allowance (RDA), for iodine of 0.15 mg per day (Table 1) (*5*).

Renal imaging uses iodohippurate sodium ^{131}I injection (Hippuran®, Mallinckrodt Inc., St. Louis, MO; sodium iodohippurate ^{131}I—CIS-US, Inc., Bedford, MA (*6,7*)) has a concentration of iodine of 3.3 mg of hippuran per mCi of ^{131}I at calibration time. A standard dose of ^{131}I iodohipputae sodium of 0.35 mCi would, therefore, have 1.17 mg of hippuran containing 0.46 mg of iodine. Note that nausea, vomiting and fainting have been noted rarely in conjunction with the administration of ^{131}I iodohippurate sodium. No deaths have been recorded.

The most common use of iodine in nuclear medicine is for thyroid imaging. Thyroid uptake and imaging may use ^{123}I and, rarely, ^{131}I. Iodine-131 is used primarily for whole-body surveys and therapy in patients with hyperthyroidism or malignancies. In this form, the concentration of iodine is 0.008 ugm/mCi (*8–10*). Iodine-123 used for thyroid uptake or imaging has a concentration of iodine of 5.2×10^{-7} mg for 100 μCi dose and 1.04×10^{-6} mg for 200 μCi (Mediphysics, Inc., Arlington Heights, IL (*11*)).

As with any other pharmaceutical, the possibility of a reaction always exists (*12*). Patients who undergo nuclear medicine studies are unlikely to have reactions similar to contrast reactions in radiology for several reasons. Patients undergoing radiology contrast studies are primarily having reactions to the osmolarity of the agent. Osmolarity is not a factor in nuclear medicine pharmaceuticals which use iodine. In addition, iodine sensitivities occur with iodide, not with bond iodine. Also, while there can be reactions to iodine, patients in nuclear medicine are exposed to relatively low iodine concentrations. All of these factors contribute to the low incidence of adverse reactions when exposing patients to iodine in nuclear medicine.

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TABLE 1
Iodine Comparison

Agent	mg of Iodine
^{131}I iodohippurate sodium 0.35 mCi	0.46 mg (1.17 mg hippuran)
^{123}I 100 μCi capsule	0.00000052 mg
^{123}I 200 μCi capsule	0.00000104 mg
^{131}I 5 mCi solution	0.00004 mg
^{131}I 29.9 mCi solution	0.00024 mg
^{131}I 50 mCi solution	0.0004 mg
^{131}I 100 mCi solution	0.0008 mg
^{131}I 150 mCi solution	0.0012 mg
^{131}I 200 mCi solution	0.0016 mg
RDA	0.15 mg

REFERENCES

1. Thorn GW, Adams RA, Braunwald E, et al. *Harrisons' principles of internal medicine*, 8th ed. New York, NY: McGraw Hill Book Co.; 1977:502–504.
2. Conray® (iothalamate megumine injection USP 60%) package insert. St. Louis, MO: Mallinckrodt Medical, Inc.; September 1993.
3. Optiray® (ioversol injection) package insert. St. Louis, MO: Mallinckrodt Medical, Inc.; October 1994.
4. Iobenguane sulfate ^{131}I injection USP for diagnostic use package insert (For distribution in the U.S.). Bedford, MA: CIS-US, Inc., April 1995.