Nuclear Medicine Studies Information for Parents

Introduction:

Welcome to the section of pediatric nuclear medicine studies on the Society of Pediatric for Radiology Quality and Safety Committee website. The purpose of this document is to provide parents/guardians some general information regarding nuclear medicine exams either for diagnostic or therapeutic purpose. It is NOT in any way to substitute for a further detailed discussion between parents/guardians with both the referring physician and with the treating radiologist/nuclear medicine physician. Some of the references provided below for further consultation are from peer-reviewed papers and guidelines. We will follow a question-and-answer format that we as radiologists often engage in with parents/guardians. We aim to provide the readers with a broad overview of Nuclear Medicine and its usefulness.

I. What is a nuclear medicine study?

A nuclear medicine study is either a diagnostic imaging study or a therapeutic treatment that uses radioactive materials called radiopharmaceuticals that are typically injected intravenously, inhaled or swallowed. The radiopharmaceutical agent travels through the area being examined and gives off energy in the form of gamma rays which are detected by a special camera and a computer to create images of the inside of the body. Nuclear medicine imaging provides unique information that often cannot be obtained using other imaging procedures and offers the potential to identify disease, sometime, in its earliest stages. Similarly, a radiopharmaceutical agent can be given in the form of oral pill or IV route delivered to a particular organ in the body to exercise its therapeutic role.

II. What is the size of the radioactive pharmaceutical dose?

The radioactive pharmaceutical dose depends on the patient's weight and the type of study the patient is going to have. In pediatric population the smallest radiopharmaceutical dose is approximately 0.3 mCi for a gastric emptying study and up to 20 mCi for a bone scan. Typically the dose is much less in children than in adult population. Millicuries (mCi) are the unit to measure the amount of radiopharmaceutical agent.

III. How much radiation will my child be exposed to?

The amount of radiation exposure depends on the patient's weight and the type of study. The average effective amount of radiation received by patient who undergoes nuclear medicine exam depends on the study the patient is going to have. Diagnostic nuclear medicine radiation dose typically ranges from 0.14 milliSieverts (mSv) to about 14 mSv (1). Each person receives approximately 3 mSv of radiation exposure for natural background source. mSv is the unit to measure the radiation exposure.

IV. What are some common exams that use nuclear medicine for diagnostic purposes?

Nuclear medicine imaging may be applied to view any system organ in the body. It is common to apply a nuclear medicine study for cardiac imaging and function study; thyroid imaging and function study; lung imaging and function study; kidney imaging and function study; bone scans for bone pain, infection, fracture, lesion and other abnormality including non-accidental trauma; hepatobiliary scans for the liver, bile duct, and gallbladder imaging; tumor localization and characterization as well as staging tumor and

follow-up to document effective treatment. All in all, nuclear medicine is a powerful and safe diagnostic tool to detect and treat many medical conditions.

V. What are the therapeutic roles of nuclear medicine?

Nuclear medicine has both diagnostic and therapeutic roles. For the purpose of this discussion, we will only discuss thyroid diseases such as hyperthyroidism and thyroid cancer, which are not uncommon in the pediatric population. Treatment for bone metastases and certain malignancies will be briefly mentioned here because it involves a much higher dose and is not as commonly utilized as for thyroid treatment.

Radioactive iodine (I-131) therapy may be used to treat hyperthyroidism and thyroid cancer. The thyroid gland collects iodine (mainly from our diet) to form the thyroid hormone. In hyperthyroidism, the thyroid cells are over-stimulated and make larger amounts of thyroid hormone. The excess hormones are secreted into the blood, and produce the symptoms of hyperthyroidism (increased heart rate, weight loss, loss of sleep, hyperactivity) When radioactive iodine is given, the thyroid gland cannot tell if the iodine is radioactive or not, and collects it in the normal way in proportion to the activity of the thyroid. Radioiodine thus accumulates in the cells that make thyroid hormone and remains there long enough to radiate the gland and to slow thyroid production. In the long run, the I-131 treatment gets rid of the abnormal active thyroid cells and renders the patient hypothyroid. The patient then just takes supplement thyroid hormone to balance the thyroid values and eliminate hyperthyroid symptoms.

For thyroid cancer that needs either ablative (get rid of normal residual thyroid tissue in the gland that potentially can turn cancerous) or adjuvant (get rid of residual cancer cells either in the gland or in adjacent lymph node) therapy, the principle is similar but requires a higher dose than for benign hyperthyroidism. After receiving I-131 for thyroid cancer treatment, the patient also needs to take supplement thyroid hormone to keep thyroid function in balance to avoid the symptom of hypothyroidism (weight gain, depression, malaise)

The I-131 treatment dose is typically lower for hyperthyroidism and higher for thyroid cancer. Briefly, in hyperthyroidism, the patient would undergo an uptake thyroid scan that usually involves swallowing a very tiny dose of Iodine (much smaller than the treatment dose and the uptake scan Iodine is different than the treatment Iodine; the uptake scan Iodine is called I-123 and the treatment Iodine is called I-131). Based on the uptake scan result, the treating radiologist or nuclear medicine physician will determine the exact I-131 dose for the patient with hyperthyroidism. For thyroid cancer, the dose the patient is going to receive depends on the type of cancer, the grade of the cancer, and the status of any metastasis. In general, the dose is lower for less aggressive cancer and for non-metastatic disease. For both hyperthyroid and thyroid cancer treatment, the I-131 would be given to the patient orally in liquid or tablet forms.

VI. How do I prepare my child for a diagnostic or therapeutic nuclear medicine exam?

The risks and preparation steps for the study/treatment will be explained to parents/guardians by the radiologists/nuclear physician or their designated staffs in great details. In cases of therapeutic treatment, the radiologist/nuclear physician has to obtain consent from the parents/guardians for the treatment by explaining the risks, benefits, goal of the treatment, potential outcome, and any preparation steps that the patient needs to follow. For example, in addition to any blood tests the patient has, he/she has to be on a low iodine diet for the thyroid study/treatment. In the setting of post

I-131 treatment, the patient needs to be sleeping in a separate bedroom and use a separate bathroom for several days.

VII. Does my child need sedation for the nuclear medicine exam?

Most of the children who undergo nuclear medicine exam do not need sedation, particularly older children, pre-teen and teenagers. Special equipment and entertainments are available such as watching a movie in order to keep the patient in a quiet environment so he/she can lay still for up to an hour for an exam. For younger or non-cooperative patients, the child may be seen by a Child Life specialist to see if the study can be performed without sedation. A Child Life specialist is someone who is trained and has expertise in helping children and parents/guardian to undergo an imaging exam. If the patient still needs sedation after being evaluated by a Child Life specialist, then a staff from anesthesia team would evaluate the patient for sedation after explaining the risk, benefits and type of sedation needed to the parents/guardian.

Visit the Sedation section (http://www.pedrad.org/Specialties/Safety#18062824-sedation) for more information.

VIII. Conclusion:

Nuclear medicine is a very safe and powerful diagnostic tool to detect many medical conditions, sometime in a very early stage, so prompt treatment can be instituted to achieve better outcome. Itself it is also an effective treatment, particularly for hyperthyroidism and thyroid cancer. Parents/guardians are encouraged to ask questions to their providers about any diagnostic exam or treatment in general.

References:

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