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Edited podcast transcription:

Today I want to talk about the five measures of purity in nuclear medicine. If you are not aware that there are five measures of purity, well, there are, as follows:

1. chemical purity
2. radiochemical purity
3. radionuclide purity
4. physical purity
5. biological purity.

These can be hard to remember, but they also are easy to write questions on, so I do expect that you will be asked some questions about this on the Core Exam.

#### Chemical purity:

Chemical purity refers to whether you have the type of chemical you want in the preparation or whether there is something else in there. The most common scenario that will ask about chemical purity is the amount of aluminum breakthrough in a Molybdenum-Techneium generator.

You need to know the amount of aluminum that is allowable from a Moly-Tech generator is less than 10 micrograms per milliliter. Remember two things here: First is the value 10, and second is *microgram* per milliliter. That is different from the .15 *microcurie* per milliliter limit for Molybdenum breakthrough that we will discuss for radionuclide purity.

For the Core Exam, remember that for chemical purity, the chemical we are talking about is aluminum. The allowable amount is under 10 microgram per milliliter of Tc-99m. One tip to help you remember the unit for aluminum breakthrough is microgram and not microcurie is that aluminum is not radioactive so it would be measured in micrograms and not microcuries.

To test for aluminum breakthrough, you do a paper chromatography measurement, which is a color-based test wherein you drop the liquid from the generator elution on special paper and you see if it changes colors in a certain way (usually turns red) to detect aluminum breakthrough.

Let's talk about what happens if you have too much aluminum in your Tc-99m preparation. Interestingly, what happens depends on the pharmaceutical that is being combined with the Tc-99m. In the case of Tc-99m sulfur colloid, if you have too much aluminum, you will see uptake that is abnormal in the lung. However, if you have Tc-99m MDP (bone scan agent) with too much aluminum, you will see abnormal uptake in the liver.

To make sure you do not have too much aluminum test the chemical purity using paper chromatography.

#### Radiochemical purity:

Radiochemical purity describes the fraction of total radioactivity that is in the desired chemical form. The most tested concept on radiochemical purity for the Core Exam is likely the amount of free technetium that exists in a radiopharmaceutical preparation such as Tc-MDP or Tc-RBC. In such a case,

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you do not want the free technetium that can cause imaging artifact via uptake in undesired areas. So, if you have a pure radiochemical preparation, it will be in the form that is desired.

Remember, poor radiochemical purity means you have a lot of free technetium. It means the Tc-99m didn't bind to the pharmaceutical as robustly as desired and you have a problem.

Remember that to evaluate for free technetium, you look for a few things. One is uptake in the salivary glands in the head and neck region. The other is intense uptake within the stomach. Those are two telltale signs that you may have free technetium present. However, to test for quality control, thin layer chromatography is commonly used.

#### Radionuclide purity:

With radionuclide purity, the one thing they're most likely to ask a lot about this is the ratio of technetium versus molybdenum that you elute from the generator. Radionuclide purity is the fraction of total radioactivity that is in the desired form from the generator. We want technetium. We do not want molybdenum as this increases the radiation dose to the patient and degrades imaging quality. The allowable amount of molybdenum is something you absolutely must know. This is something you might want to write down to study the week or even the day before the exam.

For *radionuclide* purity one tests the amount of Molybdenum-99 breakthrough in the final Technetium-99m elution. The allowable limit is .15 *microcurie* of Molybdenum per millicurie of Technetium-99m. A common trick on this concept on multiple choice questions is to give you the .15 correctly but the unit will be wrong. Maybe the question stem will indicate .15 millicuries of Molybdenum which is incorrect. You need to remember .15 *microcuries*.

To review:

Aluminum breakthrough from molybdenum-technetium generator is a test of chemical purity with the allowable limit being less than 10 micrograms per milliliter.

Molybdenum breakthrough from a molybdenum-technetium generator is a test of radionuclide purity with the allowable limit being .15 microcuries of molybdenum per millicurie of technetium.

#### Physical purity:

Physical purity refers to the total amount of pharmaceutical that is in the desired physical form.

One example is whether you have the correct particle size that you want. If you have something where particle sizes are important, such as lymphoscintigraphy with Tc-sulfur colloid or particle size with Tc-MAA for perfusion imaging.

Physical purity is the fraction of the pharmaceutical preparation that is in the desired physical form. I think it's less likely you will get a question on this. They tend to focus on the other ones because there is no number that you must memorize for this one.

#### Biological purity:

The last is biological purity which denotes the absence of microorganisms or other biologically active things like pyrogens that can cause harm to patients. Biological purity means you are keeping the bad bugs out.