Essay on nuclear medicine

Environment, Disaster

Nuclear medicine is the use of radioactive isotopes to diagnose and treat patients. It is considered a functional measurement method, as the imaging is based on cellular function and physiology, rather than structure, like an X-ray (Prvulovich & Bomanji, 1998). The kind of radiation that is measured in nuclear medicine is gamma rays. Patients are prepared for a nuclear medicine procedure by having an amount of tracer isotope administered that is just enough to obtain the sought for information before its decay. The World Nuclear Association reports that in the United States each year there are about 18 million nuclear medicine procedures performed on approximately 311 million people (2013).

A primary advantage of nuclear medicine is that it is a non-invasive means of measuring the function of organs such as the thyroid, bones, heart, and liver. The greatest limitation on nuclear medicine is resolution of the image, which impacts the usefulness of the test results (Frey, Humm, & Ljungberg, 2012). Because of radiation’s lethal effect on dividing cells, nuclear medicine is used to treat various forms of cancer (World Nuclear Association, 2013). Many illnesses can be diagnosed using nuclear medicine including neurological diseases, coronary artery disease, cancer, endocrine diseases, gastrointestinal diseases, genitourinary diseases, pulmonary diseases, bone diseases, and infections (Society of Nuclear Medicine and Molecular Imaging, 2009).

One type of test in this area that is used to diagnose infections is a Gallium scan. The isotope used to do nuclear medicine is Gallium-67. It has long been used to locate infections, based on it ability to bind with molecules such as neutrophil membranes, a type of white blood cell (WBC) found near

infections, as well as transferrin and lactoferrin, iron products found in high concentration in the blood near infections (Palestro, Love, & Miller, 2007). But this test has a relatively low accuracy of 65-80%, and many test results are reported as equivocal (subject to two or more interpretations). This has resulted in doctors limiting the use of Gallium scans to selected situations, such as when a patient presents with a fever from an unknown cause (Palestro, Love, & Miller, 2007).

Another type of nuclear medicine diagnostic test that is used for infections is

Indium WBC scans. In this test, Indium-111 is used to label WBCs and then the cells are reintroduced back into the patient by injection. The image is taken about 24 hours after reintroduction (Palestro, Love, & Bhargava, 2009). Like Gallium, the Indium binds to neutrophils, so there is significant overlap in the use of these two imaging techniques. However, Indium tends to bind better to live neutrophils, while Gallium tends to bind better to dead neutrophils, so Indium is better for new infections while Gallium can be better for imaging older ones (Palestro, Love, Bhargava, 2009).

A newer technique for diagnosing infections using nuclear medicine is a hybrid imaging technique that combines positron emission tomography (PET) with computed tomography (PT). PET/CT has the advantage of being able to provide very precise locations for the sites of infection and inflammation as compared to Gallium and Indium scans. Measuring of the amount of infection is even possible so it can be used to evaluate treatment effectiveness (Palestro, Love, & Bhargava, 2009). In the field of diagnosing infections,

these three nuclear medicine techniques are very useful, particularly when the cause and location of an infection are unknown.

References

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