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Review

Importance of Medical Imaging Methods in Medicine

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Abstract: Medicine, it is a multidisciplinary science. It is based on the principle of obtaining clearer information about diseases through the cooperation of many branches. In the medical field, radiology science has an important place especially in diagnosis and treatment of diseases. With the development of radiology science, in other words, medical imaging methods, the diagnosis of diseases has become easier. Imaging techniques are mainly based on the process of making the invisible parts of the human body visible by various methods. Radiology; It can basically be classified under two titles: diagnostic radiology and interventional radiology. For diagnosis, there are seven basic methods in radiology and nuclear medicine clinics: x-ray, mammography, computed tomography (CT), magnetic resonance (MR), ultrasonography (US), single photon emission computed tomography (SPECT) and positron emission tomography (PET). While ionizing radiation sources such as X-ray and gamma-ray are used in some of these methods, radiation is not used in some, instead there are methods that use radio waves and supersonic waves. In terms of interventional radiology, biopsies, and ablation treatments samples can be shown. Apart from these methods, there are various devices for special use with the developing technology. In this study, basic imaging methods will be mentioned. It is very important for both patients and healthcare professionals to know the devices containing radiation and to have information.

Keywords: *Radiology; medical imaging methods; diagnostic radiology; interventional radiology; radiation*

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1. Introduction

In order to get clearer results in the medical field, various branches of science have to work in partnership with this field. One of these fields of science is radiology. The word radiology consists of the combination of the words radius (ray) and logos (word) in ancient Greek and it is described as ray science (Kaya et al., 1997). The radiology science was born on December 22, 1895, after Wilhelm Conrad Rontgen discovered his X-rays and the projection on photography, on December 22, 1895, at the Wurzburg physics institute, on December 22, 1895 (Riesz, 1995). In the first quarter of the twentieth century, the science of radiology entered the clinic as a branch of medicine. Thanks to radiology methods, it is quite easy to diagnose the diseases.

2. Materials and Methods

Radiology is used in the field of science, which uses radiation for the purpose of imaging and diagnosing diseases, or for guiding the way to enter the body through interventional methods. Radiology, it can be classified under two headings as diagnostic radiology (diagnostic-radiodiagnostic) and interventional radiology. Diagnostic radiology has five basic methods: x-ray, computed tomography (CT), magnetic resonance (MR), ultrasonography (US) and nuclear medicine (NM). Some of these methods like X ray, CT and NM use ionizing radiation sources like X ray and gamma ray while MR, US don't use radiation sources. In addition, mammography (Egan, 1966), angiography (Ovit et al., 1980), bone mineral densitometry (Stain et al., 1987), and dental imaging methods (Olaf et al., 2002) can be added to X-ray imaging methods. In terms of interventional radiology, angiography and ablation treatments are examples. Apart from these methods, there are various devices special for use with the developing technology (Bushong, 1997).

2.1 *Diagnostic Radiology*

2.1.1 *X-ray (Roentgen)*

X-ray is an imaging method that involves conventional operations and uses the X-ray source for imaging the relevant region (Tunacı ve Tiryaki, 2007). The planar, 2-dimensional image of the patient is taken. It is basically divided into two as radiography and radioscopy. In both methods, images are created by lowering the energies of X-rays from the patient onto image-receiving systems. While films are used as the image acquisition system in radiography, fluorescent screens are used in radioscopy and live images are obtained

Various cross-sectional imaging methods have come to the fore in order to obtain more detailed and clear images with the developing technology. However, the prevalence of X-ray shots in diagnosis continues (Kocaer et al., 2018).For example, the method that provides data in a forearm fracture or a chest radiography in such a cheap and simple way is again X-ray.

2.1.2 *Computed Tomography*

Computed tomography also uses X-ray sources, as in X-rays. Unlike X-ray, image acquisition systems are detectors (Bushong, 1997). The signals coming through the detectors are converted into numerical data in computer environment and images are created. Computed tomography is a cross-sectional imaging method. By rotating the X-ray tube and detectors around the patient together, 3D cross-sectional images are obtained and detailed view of the relevant region is provided. Computed tomography is mostly used in intracranial traumas, thorax and abdomen imaging (Kocaer et al., 2018).

2.1.3 *Mammography*

With the mammography device used in the diagnosis of lesions in the breast, the image of the region related to X-rays applied at low doses is obtained. With these devices, which have a very important place for the diagnosis of breast cancer, the breast of the patient is compressed thanks to the device units, so that the overlapping breast tissues are opened and thinned, and in this way, the patient is given a low dose of radiation (Kaya et al., 1997). These are devices that have evolved and diversified over time.

2.1.4 *Magnetic Resonance Imaging*

Magnetic resonance imaging method is a cross-sectional imaging method used mostly in imaging soft tissues. Radio waves are used as an energy source in the MR system. Proton atoms in the body are used as data source (Tekin et al., 2018). Thanks to radiofrequency energy, these protons are stimulated, causing a change in their current directions. Then, when this arousal is interrupted, protons leave a signal to the environment as they return to their former positions. These digitalized signals are converted into images in computer environment. An important advantage of the MR method is that the patient can take images in any plane without changing their position. It is used mostly in the central nervous system, musculoskeletal system, sometimes in the lungs, mediastinum imaging, separation of the uterus layers, etc.(Tekin et al., 2018).

2.1.5 *Ultrasonography*

On ultrasonography, unlike other radiology methods, supersonic waves are used. Sound energy, which is a type of mechanical energy, consists of the propagation of molecular vibration in the medium in a wave. Thanks to the probe heads used in the device, these sound waves are sent to the relevant area of the patient and the image is instantly displayed on the screen with the echoes made by these sound waves in the body (Rumack, 1991).

2.1.6 *Nuclear Medicine*

Nuclear medicine is a branch of medicine that provides diagnosis by monitoring the image obtained as a result of the detection and processing of gamma rays emitted using radioactive materials by the scanners using planar or tomographic methods. Generally, with this method, organs such as the brain, bones, heart, kidneys, digestive tube, liver and spleen can be examined in detail (Demir, 2000).

2.1.6.1 *PET (Positron Emission Tomography)*

In this technique, photons occurring at the same place and spreading in opposite directions are detected at the same time. The patient is injected with radioisotopes emitting positron. Positrons are positively charged electrons, and when they collide with (-) charged electrons on their path, the event of mass conversion into energy occurs. As the colliding masses disappear, the 511 KeV-powered anilation photon is released in opposite directions at an angle of 180° to each other. These anilation photons turn into scintillation by hitting the detectors. Scintilations turn into electrical signals in photo-multiplier tubes. Electric signals are processed in other electronic circuits and converted into images (Ayaz, 2017).

2.1.6.2 *SPECT (Single Photon Emission Computed Tomography)*

SPECT is the only computerized photon tomography system. The gamma photons emitted in one direction from the radiopharmaceuticals delivered to the body in the SPECT technique are based on the principle of creating a cross-sectional image by detecting them by the SPECT detectors and processing them in the computer unit. Power to separate images in SPECT, it is of poor quality than planar system, but the fact that organ depths are displayed at a higher contrast in SPECT compared to the planar system, and the fact that the numerical measurement of volume, size and activity is realized with high accuracy has made use of SPECT devices (Ayaz, 2017).

2.2 *Interventional Radiology*

Interventional radiological procedures are based on the process of imaging the relevant region under the guidance of other imaging methods by entering the body in various ways and it can be classified under various headings like biopsies, fluid drainages, percutaneous nephrostomies, biliary drainage, ablation procedures (Şirikçi, 2015).

3. Results

Medical imaging methods, in other words, the use of radiological methods in medicine, is quite common. With the use of these methods, diagnosis and treatment of diseases has become easier. The sensitivity of imaging methods is different for each tissue and organ. Therfore, these methods are developing day by day. In this study, all these methods are mentioned in detail.

4. Discussion

All medical imaging methods used for diagnosis have advantages and disadvantages. While CT, X-ray methods are preferred for anatomical anomaly due to hard tissues such as bones and joints; MR, nuclear medicine scintigraphy methods are preferred for physiological anomaly due to soft tissues such as brain and liver. In addition, among all these methods involving radiation, reducing the doses that patients and healthcare personnel will be exposed and should be a priority. For this reason, alternative methods such as ultrasound should be preferred in imaging of tissues and organs, especially near the surface, such as thyroid gland, kidney.

The device technologies used in cancer diagnosis and staging, which are very popular in radiology, are also in continuous development. While PET devices used in clinical routine have been used in combination with PET-CT until recently, today it is planned to be reduced in patient dose and produced as PET-MR combination. In addition, tomography techniques played a very important role in the diagnosis and follow-up of the treatment in the Covid-19 pandemic, which started in late 2019 in China's Wuhan region and spread all over the world. Republic of Turkey Ministry of Health, in conjunction with other health authorities, but negative PCR test to diagnose the disease in people with symptoms and clinical follow-up treatment has the effect of emphasizing the importance of shooting and suggested tomography (URL-1). We think that tomography shots will play an important role in the subsequent processes of the pandemic and in determining the damage to the tissues and organs of people who overcome the disease.

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Conflict of Interest

The authors declare no conflict of interest.

References

Ayaz, S. (2017). Current nuclear medicine. Çukurova Nobel Tıp Kitabevi. 1st Ed. Istanbul, TR.

Bushong, S. C. (1997). Radiologic science for technologists (physics, biology and protection). 6th Ed. Mosby, St. Louis.

Demir, M. (2000). Nuclear medicine physics. İstanbul University Yayınları. 1st Ed. Istanbul, TR.

Egan, R. (1966). Mammography. The American Journal of Nursing, Vol. 66, No. 1, 108-111. Doi: 10.2307/3419514

Kaya, T., Adapınar, B., Özkan, R. (1997). Basic radiology technique. 1st Ed. Güneş & Nobel, Bursa, TR.

Kocaer, A. F., Cavlı, B., Yılmaz, B., Öztürk, C., Beşevli, F., Bozkaya, H., Tekin, H.O., Kamışoğlu, M., Dündar, M., Oyar, O., İkizceli, T. (2018). X-ray imaging techniques. Kongre Kitap Evi, 1st Ed. Istanbul, TR.

Olaf, E., Langland, Robert, P., Langlais, J., Preece, W. (2002). Principles of dental imaging. 2nd Ed. Philadelphia, 19106 USA.

Ovitt, T. W., Christenson, P. C., Fisher, H. D., Frost, M. M., Nudelman, S., Roehrig, H., Seeley, G. (1980). Intravenous angiography using digital video subtraction: x-ray imaging system, American Journal of Roentgenology, 135, 1141-1144. Doi: 10.2214/ajr.135.6.1141.

Rumack, C. (1991). Diagnostic ultrasound. Mosby Elsevier Health Science3rd Ed. Toledo, OH, USA.

Riesz, P. B. (1995). The life of Wilhelm Conrad Roentgen. American Journal of Roentgenology, 165, 1533-1537. Doi: 10.2214/ajr.165.6.7484601.

Stein, J. A., Lazewatsky, J. L., Hochberg, A. M. (1987). Dual-energy x-ray bone densitometer incorporating an internal reference system. Radiological Society of North America 73rd scientific assembly and annual meeting (Abstracts).

Şirikçi, A., Kervancıoğlu, S. (2015). Basic embolization: method and material selection. Türk Radyoloji Seminerleri. https://doi:10.5152/trs.2015.207

Tekin, H. O., Dündar, M., Salar, A., Cavlı, B., Gök, M. C. (2018). Magnetic resonance imaging techniques and basic principles. Kongre Kitap Evi. 2nd Ed. İstanbul, TR.

Tunacı, C., Tiryaki, B. (2007). Basic radiology. Nobel Tıp Kitabevi. 1st Ed. Istanbul, TR.

Turkish Republic Ministry of Health, Covid-19 Tomography units, https://covid19bilgi.saglik.gov.tr/tr/covid-19-tomografi-uniteleri.html (accessed 23 June 2020)