

Non-Invasive Radiation Diagnostic Methods

Kattaxodjayeva Dinara Utkurxodjayevna

Senior Lecturer, Tashkent State Medical University

Qosimboyeva Shodiyabony Baxodir qizi

Student, Tashkent State Medical University

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Annotation: This study examines noninvasive radiation diagnostic methods. It shows that film radiography, in which a person receives a radiation dose of 0.5-0.8 mSv, and the more advanced digital method (0.1-0.2 mSv), are less effective. Fluorography, however, focuses on a specific area of the chest and produces images much smaller (approximately 10 x 10 cm). The radiation load on the body ranges from 2 to 10 mSv, equivalent to 2-10 annual doses.

Keywords: non-invasive, radiation, method, diagnostics, X-ray, fluorography, chest.

November 8th marks World Radiology Day, which celebrates radiological diagnostic methods used in medicine.

X-ray diagnostics – This method of radiological examination was the first to be discovered, back in the late 19th century. It was then that Wilhelm Conrad Röntgen noticed that when X-rays passed through a person's hand, an imprint of their bones remained on photographic film. This was the first way to determine the internal structure of the body without disturbing the integrity of tissue (incisions in the living or autopsies in the dead).

This method's importance can be compared to the discovery of penicillin in the treatment of infectious diseases, as it divided the history of medicine into "before" and "after." This idea was quickly adopted by Russian scientists, and just a year after its discovery, X-ray diagnostics arrived in our country.

However, radiology specialists didn't stop there and began to refine certain types of X-ray diagnostics. The primary goal was to make them as informative as possible for individual patients while minimizing the risk to their health.

As a result, today there are two main types of X-ray examination methods: non-invasive and invasive, which involves the introduction of a radiocontrast agent into the body, which improves the quality of visualization of the organ or tissue of interest.

Non-invasive diagnostic methods - Non-invasive X-ray diagnostic methods do not involve tissue damage . The procedure is performed without causing any discomfort. The procedure involves X-rays passing through the body and being absorbed differently by different tissues, which have different densities. Bone tissue is the densest, so it reduces the intensity of the X-rays the most, resulting in them appearing as light areas on the film.

Internal organs attenuate X-ray radiation to a lesser extent, so they are either not visible at all or are only faintly visible on images. However, radiologists are excellent at determining the presence or absence of diseases even from these sometimes very blurry images.

The data from this study are the main criterion for diagnosing any fractures (without it, it is impossible to confirm or refute this diagnosis) and pneumonia, which also requires mandatory confirmation using a chest X-ray.

X-ray is the first method of radiological examination, in which images of internal organs are recorded on special film or paper. To enable the doctor to assess the organ's structure most clearly, it is advisable to take images from different angles (projections).



Fig. 1. The radiography process

For example, some areas of the lungs are not visible when imaging only from the front, so lateral and oblique views are required. To maximize the effectiveness of the examination, the patient must remain still (this makes radiography significantly more difficult in children).

Today, film-based radiography is possible, in which case a person receives a radiation dose of 0.5-0.8 mSv , and a more advanced digital option (0.1-0.2 mSv , respectively).

Fluorography is a similar technique to conventional X-ray imaging. However, it examines a specific area of the chest and produces images that are much smaller (approximately 10 x 10 cm).



Fig. 2. The process of fluorography and

Its primary role is the early detection of tuberculosis and focal lesions in the lungs. Therefore, it is performed on healthy individuals, not on sick individuals, for preventative purposes. Considering that fluorography is recommended at least once every two years, the radiation dose is lower than with X-rays, amounting to 0.5 mSv for film and 0.1 mSv for digital imaging.

A safe radiation dose for humans is 1 mSv per year.

Thus, by undergoing just one film fluorography, a person already receives half the annual radiation load.

Fluorography is a preliminary examination. Doctors can usually visually assess the condition of the chest organs and, if they have any suspicions, they'll refer the patient for a standard X-ray. Making a precise diagnosis from this small image is extremely difficult, especially since it's only performed in a frontal projection.

Fluoroscopy is another method of radiation diagnostics, in which the doctor evaluates the condition and functioning of the patient's internal organs in real time.



Fig. 3. The process of X-ray imaging

This happens in the following way: a person is standing or lying down, X-rays are passed through the area being examined, and the doctor sees the image on a special screen; it changes depending on the patient's movement, or the movement of individual organs, tissues, or foreign bodies.

This method is only useful when the pathological condition is associated with a dynamic process. Therefore, it is not suitable for diagnosing pneumonia, dental root canals, or cranial bones.

Fluoroscopy is used in the following cases:

- Study of the movement of barium mixture through the esophagus, stomach and intestinal loops,
- Movement of iodine-containing contrast through the uterus, fallopian tubes (salpingography) and ureters (retrograde urethrogram).
- Sometimes it is inserted into the fistula area and its course is determined.
- To visualize the alignment of bone fragments in fractures. This is called reduction, because, especially with closed fractures, the doctor cannot always assess how correctly they have aligned the edges before connecting them with a plate or pin.

The radiation dose for this examination is significantly higher than that of a standard X-ray, let alone a fluorography. It depends on the duration of the procedure. However, this method is performed only for vital indications or in cases of serious illnesses where the patient's health would be seriously jeopardized without it.

Computed tomography



Fig. 4. Computed tomography device

Unlike conventional X-rays, computed tomography (CT) produces a series of layered images of the human body (usually of a specific area or organ). The advantage is that this examination is much clearer and more reliable, as the doctor can evaluate a three-dimensional image rather than a flat one.

On a special monitor, the doctor sees several layered images, with the gray color having 1024 shades.

As this diagnostic method developed, first spiral and then multi-slice CT scanners began to appear, which allow changing the speed of the device and the thickness of the slices.

The radiation dose to the patient undergoing this type of X-ray diagnostics is high. It ranges from 2 to 10 mSv, equivalent to 2-10 annual doses. This is perhaps its only real drawback.

However, the load can be reduced.

Firstly, this examination should be carried out only according to indications, that is, it is desirable that it be carried out not on the chest and abdominal cavity, but on a specific organ.

Secondly, modern devices (multilayer) are safer for the patient.

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