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CT Working Group

What Patients Should Know: Radiation Dose in Computed Tomography

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ESR EUROPEAN SOCIETY OF RADIOLOGY

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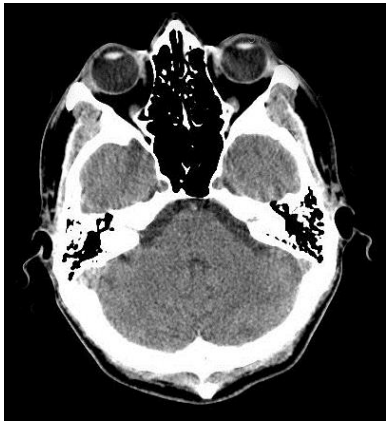
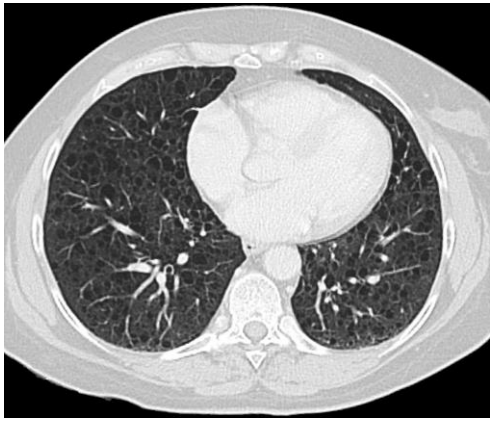
Introduction

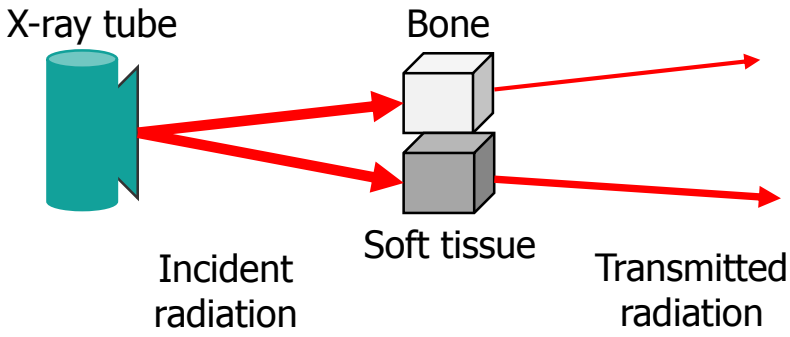
- Computed Tomography allows physicians to view the inside of patients, in a non-invasive manner. Computed Tomography is therefore an invaluable tool when diagnosing patients for different ailments.


An example of images that can be generated with Computed Tomography.

Introduction

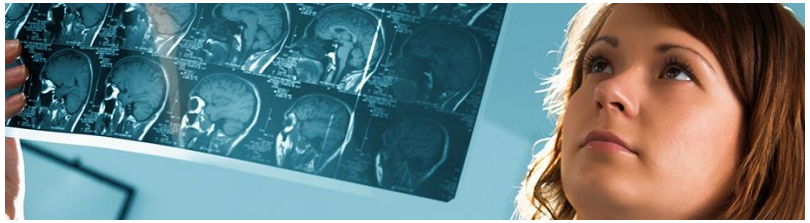
- Computed Tomography uses ionizing radiation emitted from an X-ray tube. The ionizing radiation emitted from the X-ray tube can be regarded as electro-magnetic waves, similar to visible light. The difference between visible light and the ionizing radiation emitted from an X-ray tube is that the ionizing radiation has an energy high enough to transmit (or penetrate) through the patient.



Different tissues will "block" the ionizing radiation differently as it is transmitted through the patient. For example, bone will "block" more of the ionizing radiation than soft tissue.

Introduction

- As the radiation is "blocked" by different parts of the body, the radiation deposits energy within the patient.
- The energy that is deposited by the ionizing radiation "interacts" with the cells of the patient and is associated with a risk of developing cancers and other non-cancer health effects (although the risk is very low).
- Our current scientific understanding is that the health risk, due to the ionizing radiation from a typical Computed Tomography examination, is a random process (does not effect all patients equally) and the risk is proportional to the amount of radiation used during an examination [1].

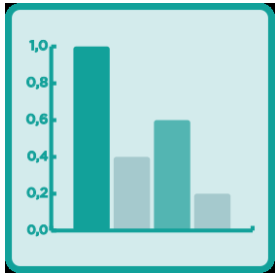


Radiation Protection

- Since radiation can be harmful when used improperly, Computed Tomography examinations are highly regulated on a European, national and local level.
- There are a set of guiding radiation protection principles that are used ubiquitously throughout Europe by medical professionals to protect patients from the health risks associated with exposure to ionizing radiation.

Principles of Radiation Protection in Diagnostic Imaging:

- Justification: All exposure to radiation should provide more benefit than harm to the patient. Make sure that the requested CT is fully justified and that also a non ionizing radiation (MRI) was considered by your physician as alternative.
- Optimisation: All exposure to radiation should be as low as reasonably achievable.



Radiation Dose Comparisons

When comparing the Effective Dose from common Computed Tomography examinations, it is useful to have a reference. A common reference is naturally occurring background radiation.

Background Radiation

- Radiation occurs naturally in the form of cosmic radiation, radioactive trace elements in building materials, soil, food and the body.
- The global average Effective Dose from natural radiation sources is estimated to be 2.4 mSv per year [2]. Take note, local variations to this value may exist.

Radiation Dose Comparisons

Examination	Effective Dose (mSv) [3]	Equivalent Exposure time to Background Radiation (mSv)
Chest X-ray	0.1	0.5 Months
Mammography	0.3	1.5 Months
CT Head	1.9	9.5 Months
CT Neck	2.5	1.0 Years
CT Spine	7.7	3.2 Years
CT Chest	6.6	2.8 Years
CT Abdomen	11.3	4.7 Years
CT Pelvis	7.3	3.0 Years

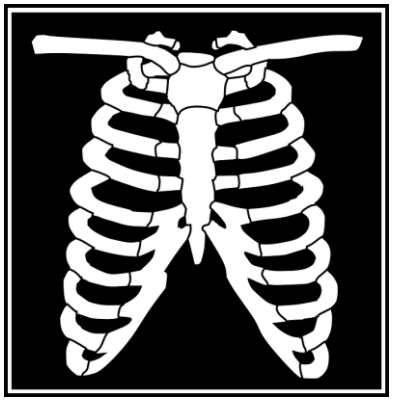
This table shows the average Effective Dose for common X-ray examinations over 36 European countries. The equivalent exposure time to background radiation has been calculated. Computed Tomography has been abbreviated with CT in this table.

On the Reliability of Different Sources of Information about Radiation Dose

- It is important that patients review reliable and credible information about radiation dose in Computed Tomography. However, online sources of information can vary in quality and sometimes be misleading.
- One study found that nearly 40% of the results from Google searches of keywords related to radiation dose in Computed Tomography were considered to be somewhat inaccurate or inaccurate [4].
- In that same study, they found that if a webpage has an identifiable author, references to peer-reviewed literature and a HON code (Health on the Net Foundation Code of Conduct) it was more likely to be accurate [4].
- Medical professionals that work in radiology can provide reliable sources of information about radiation dose in Computed Tomography.

Conclusion

- Computed Tomography is an invaluable diagnostic tool for physicians.
- When used properly, Computed Tomography provides more benefit to patients than the health risks associated with exposure to ionizing radiation. Justification and optimisation of radiation exposure provides a solid foundation for radiation protection.
- When in doubt about the health risks associated with your Computed Tomography examination, do not hesitate to consult with the health professionals you come into contact with, e.g. referring physician, attending radiologist, radiographer, or medical physicist.



References

[1] International Commission on Radiological Protection (ICRP). "Report 103: The 2007 Recommendations of the International Commission on Radiological Protection". ICRP, 2007.

[2] United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). "Sources and effects of ionizing radiation volume 1". United Nations Publications, 2000.

[3] European Commission. "Radiation Protection No 180 Part 1: Medical Radiation Exposure of the European Population". European Union, 2015.

[4] O'Neill S, Glynn D, Murphy KP, James K, Twomey M, Kavanagh R, O'Connor OJ, Maher MM. An Assessment of the Quality of CT Radiation Dose Information on the Internet. Journal of the American College of Radiology. 2017 Oct 24.