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Resources. Day 4

1 Establishing and Improving Interventional Radiology

International Atomic Energy Agency (2021), Human Health Series; (no.42); 98 p. Vienna, Austria

Abstract

This publication provides a general overview of interventional radiology (IR). It presents an evidence-based rationale for establishing, improving and maintaining an IR service consistent with current clinical knowledge benchmarks. A summary is provided of necessary elements for the establishment of an IR clinical service and to ensure its sustainability. The publication includes information on specific challenges faced especially but not uniquely in emerging nations, as well as a defined list of expert recommendations. Safety and quality standards are emphasized in addition to necessary funding, human resources, education, training and certification/recertification, as well as involvement of the main professional societies.

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2 Imaginological Parameters in Patients with Bone Mass Alteration

Barra, Sâmila Gonçalves (2021), Universidade Federal de Minas Gerais, Belo Horizonte, MG (Brazil). Faculdade de Odontologia. Pós-Graduação em Odontologia; (Portuguese)

Abstract

Aromatase inhibitors (AIs) are the most commonly used drugs to treat breast cancer patients. AIs work by inhibiting the aromatase enzyme, which is responsible for converting steroid hormones. Several studies show the importance of estrogen for bone formation. It is believed that estrogen deprivation can have a deleterious effect on bone, causing increased bone resorption, decreased bone mineral density (BMD) and thus an increased risk of osteoporosis and fractures. Osteoporosis is a multifactorial systemic disease characterized by reduced bone mass and structural disorganisation of bone tissue. The diagnosis of osteoporosis is based on densitometric criteria of the World Health Organization (WHO) with reference to the T-score classification, performed by the dual energy X-ray absorptiometry (DXA) technique, whose value assesses the BMD. As it is a systemic disease, osteoporosis also affects the maxillary bones. Thus, the study aims to evaluate imaging parameters in female patients undergoing treatment with AIs and referred for investigation of bone mass loss in a reference hospital in the treatment of these patients. Forty women undergoing therapy with AIs were evaluated. Radiomorphometric indices (RI) of cone beam computed tomography (CBCT) and fractal dimension (FD) were evaluated for some regions of interest (ROI), mandibular cortical width (MCW) and mandibular cortical index (MCI) in digital panoramic radiographs (DPR). All patients underwent the DXA exam to assess the status of BMD and divided into groups: normal and low BMD. The AUC values for the DPR indices ranged from 52.6%-75.8%. The index with the highest AUC was the mandibular cortical width ([MCW]; sensitivity: 38.1%-100.0%; specificity: 36.8%-84.2%). For FD, the total trabecular index had the greatest sensitivity, while the index anterior to the mental foramen (MF) had the highest specificity. In CBCT analysis, the values of AUC ranged from 51.8%-62.0%. The indices with the highest AUC were the molar index (M, sensitivity: 18.1%-61.6% and specificity: 66.9%-98.7%) and anterior (A, sensitivity: 25.7%-70.2% and specificity 48.8%-90.9%). The symphysis (S) index had the highest sensitivity, and the posterior (P) index presented the highest specificity. Sensitivity and specificity reasonable were obtained to computed tomography index (Inferior) [CTI (I)]. The MCW, FD of ROI of the mandible angle and total mandibular in the DPR, as well as the CTI (I), M, P, and A indices in the CBCT are useful to identify postmenopausal women who were using AI with low BMD. (author)

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Resources. Day 4

3 Radiological Analysis of a Bone Defect Model for Local Application of Drugs to the Osteoporotic-Induced Rat Femur. A Pilot Study

Vackiner, Elisabeth Anne (2022), Marburg University (Germany). Fachbereich Medizin Fakultät; (German)

Abstract

Osteoporosis belongs to the worldwide endemic diseases caused by the sheer number of incidences. Due to the increase of life expectancy, the occurrence of Osteoporosis and therefore the osteoporosis induced fractures will increase within the following years. Consequently, the improvement of the prophylaxis, diagnostic and therapy of Osteoporosis belongs to the medical challenges of the 21st century. The outlined study examines for the first time the effect of a local application of Osteoprotegerin (OPG) into the fracture gap during fracture healing using the model of osteoporotic rats (Wistar-Hannover). Supplementary, the experiment serves as a pilot study to verify the suitability of the method being used of the following main attempt. Three attempt groups had been included (ovariectomized rats without OPG (OV-OPG), ovari-ectomized rats with OPG (OV+OPG), non-ovariectomized rats without OPG (control-group), each n = 10). The rats had been given an osteotomic gap within the right femur (1mm), in which the OPG was implanted using a carrier matrix (Spongostan®). An external fixator was used as osteosynthesis. After four weeks the rats had been euthanized. Post mortem the fracture areas had been analyzed by using quantitative computerized tomography (pQCT), imaging procedures (native x-rays, micro-computertomographie (µCT) as well as histological procedures (Toluidinblue-, Masson-Goldner-Trichrom-coloration). The plantation of the external fixator and the placing of the Spongostan® within the osteotomic gap were easily installed and conducted without problems. The anaesthesia problems which appeared predominantly by ovariectomized rats, could most likely be traced back to a more slowly metabolism of the i.m. applicated anesthetic drugs referring to higher body fat percentage. An offset of the femoral ends that were found by 10% of the animals underlines the importance of regular x-ray examinations in order to supervise the proper positioning of the external fixator. The highly defined 3D µCT pictures enhances a detailed view on the fracture gap. A more resilient infiltration of the Spongostan® and a conformation of bone braces caused a better bone healing within the OV+OPG group. The pQCT results imply that OPG by osteoporosis increases the bone surface and bone mass rather than the bone density. The histological analysis certified the µCT results and allowed an insight view on the proceeding within the bone fracture (cell infiltration, angiogenesis, infiltration of the Spongostan®, formation of bone tissue and bone braces, missing necrosis).The low occupation of sub-groups as well as the short test period of only four weeks limited the validity of the pilot study. Most likely, an increase in the test animal laboratory number as well as the duration of the main experiment will increase the efficiency of the OPG.

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4

Determinants of Therapeutic Success in Radioiodine Therapy of Multifocal and Disseminated Autonomy of the Thyroid Gland

Nalbach, David (2022), Marburg University (Germany). Fachbereich Medizin; (German)

Abstract

Radioiodine therapy is an established treatment option for benign thyroid diseases since the 1950s. However, not all factors influencing the success and outcome of this therapeutic measure have been clarified, yet. The aim of this study was to identify and describe the underlying determinants of success and outcome in patients with multifocal and disseminated autonomy. Data from 131 consecutive patients treated in the Clinic for Nuclear Medicine at the University Hospital Marburg were collected from 2001 to 2016 due to multifocal or disseminated autonomy. Before therapy, gender, patient age, thyroid volume, current thyroidmedication, thyroid hormone fT3, fT4 and TSH, values of the radioiodine uptake test after 24 hours, of the technetium uptake test after 20 minutes, the administered 131I activity and achieved focal dose were recorded. Six months after therapy, the abovementioned thyroid hormones, drugs, thyroid volume and measured values of the technetium uptake test were measured and documented again. A classification according to the therapeutic outcome (hypo-, eu- and hyperthyroidism) was performed, whereby hypo- and euthyroidism were evaluated as therapy success. The factors influencing outcome and success were analyzed by using the Kruskall-Wallis-test, Mann-Whitney-U-test and logistic regression. Patients received, after calculation of activity by the Hänscheid-Bockisch formula, 286 to 2075 megabecquerel with an averagelesion dose of 351.37 Gray. Of the therapies were 93.13% successfully completed, thereof 22.13% with hypothyroid outcome. An association between increased pretherapeutic fT4 levels and hypothyroid outcome was demonstrated. In addition, this study confirmed that low 131I activity is more related to lead to a hyperthyroid outcome. Finally, there is a correlation between a low RIU and a hypothyroid outcome. The results underline the relevance of the pre-therapeutic euthyroid metabolism for the success of therapy. An optimal adjustment of the endocrine function of the thyroid gland prior to therapy is therefore an important determinant of therapeutic success. In addition, the 131I dose to be administered should be questioned on the basis of the calculated RIU and the number of measurements and their timing after the administered 131I bolus should be further investigated to improve the informative value of the RIU. On the basis of these results, the relevance of the pre-therapeutic metabolic adjustment as a direct influencing factor on the RIU should be emphasized. This study demonstrates the endocrine function of the thyroid gland prior to radioiodine therapy as a determinant for its therapeutic success. Accordingly, the outcome of radioiodine therapy could be improved in the future by optimizing this determinant.

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Resources. Day 4

5 Assessment of Head and Neck CT Protocol to Reduce the Absorbed Dose in Thyroid in Some Selected Hospital in Kaduna State, Nigeria

Abdulhamid, Musa, Abdulhamid, Abdulqadir, Shaaibu, Abdullahi S., Joshua, Jibrin, Brai, Andrew E., Ibrahim, Umar, & Dlama Z, Joseph (2021), 21 international symposium on solid state dosimetry, Mexico: Sociedad Mexicana de Irradiacion y Dosimetria, Ciudad de Mexico, Mexico

Abstract

Thyroid has been classified as an organ with a relatively low sensitivity to ionizing radiation, the use of computed tomography (CT) had inclined significantly and provides accurate, timely information and the radiation dose from CT procedures may be too high with the appreciation of the concern that ocular exposure effects from CT scan includes possible induction of thyroid cancer. The study estimates the absorbed doses of thyroid gland and proposed a Diagnostic Reference Levels (DRL) for thyroid examinations by comparing the current research result with the international standard. The incurred doses to the thyroid of 60 patients who are randomly selected, who had cranial CT procedures of head and neck CT at some selected hospitals were measured using thermoluminescent dosimeters (TLD-100), the protocols adopted in this research study were brain (sequential and spiral), sinus (sequential and spiral), neck-brain (spiral) and brain (spiral).The scanning parameters of the protocols such as the CT dose index (CTDI), dose length product (Dlp), tube current-exposure time product (m As), kilo voltage peak (k Vp), pitch factor, for each patient were recorded. The patients were divided into two age groups years for Pediatric patients and >18 years for adult patient TLD chips were placed on the patients skin surface (thyroid gland) locations to measure the absorbed dose of the thyroid. The mean absorbed dose to the thyroid and the standard error were 8.003529412 ± 4.398485864 and 3.143333333 ± 0.93319531 for the pediatric patients and 3.143333333 ± 0.93319531 for adults patients. The finding of this study reveals that the mean absorbed dose to the thyroid were lower compared with other studies and the international standard, while CT scan remains a crucial tool, further dose reduction can be achieved by justification and optimization of patient doses. (author)

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Atoms for Peace and Development

Resources. Day 4

6 Evaluation of 4DCT Simulation Compared with Conventional 3DCT Simulation in Radiotherapy for Non-Small Cell Lung Cancer (NSCLC) at Military Hospital 175

Đặng Quang Huy, Trần Đức Linh, Nguyễn Đức Công, Phạm Viết Hoạt, Trương Vũ Mạnh Dũng, Hoàng Thị Kiều Trang, & Châu Văn Tạo (2023), Vietnam Conference on Nuclear Science and Technology VINANST-15 Agenda and Abstracts; 241 p. Viet Nam; (Vietnamese)

Abstract

The study was to evaluate the effectiveness of dose distribution of four-dimensional computed tomography (4DCT) simulation. The gross tumor volume (GTV) and clinical target volume (CTV) were contoured in all 10 respiratory phases of 4DCT in 30 patients with non-small cell lung cancer (NSCLC). Both 3D and 4D treatment plans were made individually for each patient using the planning volume (PTV). The PTV3D was taken from a single CTV plus the recommended margin, and the PTV4D was taken from the 4D internal target volume, including all 10 CTVs plus the setup margins. The mean PTV was 460.25 ± 179 for 3DCT and 401.81 ± 167 for 4DCT (P = 0.0018). The dose distribution (DD) of organs at risk, especially the lungs, was lower for the 4DCT simulation. The V5%, V10%, and V20% of the total lung dose for 4DCT were significantly lower for the 3DCT. However, lung V30% the heart, esophagus, and spinal cord was not significantly different. In addition, the conformity index and the dose heterogeneity index ofthe PTV were not significantly different. The normal tissue complication probability (NTCP) of the lung and heart was significantly lower for 4DCT than for 3DCT.The 4DCT simulation gives better results on the NTCP. The organs at risk, especially the lungs, receive a significantly lower DD compared with the 3DCT. The CI, the dose HI and the DD to the heart, spinal cord, and esophagus were not significantly different between the two techniques. However, with Normal Tissue Complications Probability is the 4DCT technique gives lower results than 3DCT. (author)

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7 Neutron Dosimetry in Lung Cancer Treatment Using MCNP and ICRP Phantom

Thalhofer, Jardel, Silva, Ademir, Pereira, Paula, Lima, Inaya, Barbosa, Leandro, Paiva, Kuster, Lopes, Jose, Reis, Juraci, Rebello, Wilson, Pereira, Wagner, & Silva, Leonardo (2023), 23 international symposium on solid state dosimetry, Mexico

Abstract

Radiotherapy planning systems perform the construction of dose volume histograms for photons and their algorithms have photons with the only type of radiation present in the radiotherapy environment, estimating doses in healthy organs only due to photons. However, for treatments with high energies, especially above 6.7 MeV, photoneutrons are produced from the interaction of radiation with high atomic weight materials present in the shielding structure of the linear accelerator gantry. Thus, the values of equivalent dose and the effective dose are underestimated, as they do not consider the doses due to neutrons. And according to ICRP 103 publications, the radiation weight for neutrons are one of the highest. In this work, the tissue and radiation weighting factors established in ICRP 103 were used. The model performed in MNCPX has the radiotherapy room and the head of the Varian 2300 C/D Linear Accelerator operating at 18 MeV energy with three gantry inclination angles (0°, 45° and 180°), as established in the lung cancer treatment protocol of a patient treated at the National Cancer Institute. The patient was simulated by the anthropomorphic phantom Rex. The results of this study indicate that the organs the breasts received the highest dose value 3.87 mSv/Gy, followed by the Thymus (1.97 mSv/Gy), Bronchi (1.76 mSv/Gy), with the main organs affected by the dose due to neutrons. (author)