in order to provide uniform circular illumination spot. Cell viability was evaluated by MTT assay. Fluorescent microscopy was used to study PS intracellular localization and Reactive oxygen species (ROS) generation using a special fluorescent probe. Image analysis methods have been used to quantify wound closure rates and ROS production as a result of PDT.
Results: Optimization of PDT dose was performed in order to find PS concentration (0.25 μM and 0.5 μM) and energy dose (3 mW/cm^2, 30 s and 60 s) that did not affect cell viability. Incubation time for sufficient Ps loading to fibroblasts was found to be 90 min. Wound healing rates were significant higher in groups that were loaded with either 0.25 or 0.5 μM and were irradiated for 30 s with 3 mW/cm^2 compared to control ones. ROS production was higher in PDT treated groups than in controls.
Conclusion: Low dose PDT using AlClPc and red laser at 661 nm enhance wound healing in the fibroblast scratch wound model in a ROS dependent process. Present study shed light to low dose PDT as a non-invasive treatment approach of wound healing.

Medical Informatics and Artificial Intelligence (AI)

O.6.1
BRAIN LESIONS SCREENING TOOL BASED ON DEEP LEARNING

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Background: Brain lesions detection and diagnosis from Magnetic Resonance Imaging (MRI) are time-consuming tasks in clinical routine and require experienced radiologists. Typically, examinations come as consecutive 2D slices that the radiologists need to evaluate through the whole sequence. However only a small amount of them contains useful clinical information. A tool that would autonomously screen the entire examinations and pre-select the slices of interest would therefore be useful to save time and resources for the clinicians. Our purpose is to develop a screening tool based on pretrained convolutional neural networks.
Materials and Methods: Two identical pretrained VGG16 networks with two dense top layers were trained on 39 MRI examinations and initially evaluated on 37. The first one -brain detector- trained for classification between brain containing and no-brain containing slices and the second one -abnormality detector- for classification between normal and abnormal slices among the brain containing ones. During inference, models were used sequentially. Successive 2D axial slices used from FLAIR modality. Image augmentation was used for preventing the models from over-fitting. The categorical cross entropy was used as loss function.
Results: The brain detector and the abnormality detector have a per slice accuracy of 98.9% and 95.4%, respectively. The cascade pipeline accuracy is 96.2%. The mean error on prediction of abnormalities width, along z-axis, is 13.4%.
Conclusion: We have developed a robust screening tool for the radiology community to detect brain abnormalities from MRI examinations. It is easy to use and provide fast and accurate results with comprehensive visualizations. It based on deep learning and image analysis methods for processing the whole Flair-Axial sequence.

O.6.2
DEVELOPMENT OF A RADIATION DOSE PREDICTION DEEP NEURAL NETWORK FOR PERSONALIZED LUNG DOSE ASSESSMENT IN CHEST CT

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Background: Deep learning techniques have been used, in a limited number of studies, for radiation dose assessments. The purpose of this study was the development of a machine learning (ML) – based methodology for patient-specific lung dose assessment in chest CT.
Materials and Methods: Ninety-seven diagnostic chest CT examinations and 120 radiotherapy planning chest CT examinations were retrospectively collected. The methodology proposed by Tzanis E and Damilakis J was implemented for the development of a radiation dose prediction deep neural network (DNN). For the training and validation of the DNN, 67 and 30 diagnostic chest CT examinations, respectively, were used. Dose images produced using the ImpactMC software (CT Imaging© GMBH) were employed as “ground truth” for the DNN model training. Furthermore, a 3D-UNet was trained to automatically segment the lungs of the patients. 120 radiotherapy planning chest CTs with the respective lung contours were used. A python script was developed to utilize the aforementioned models for the production of lung dose images in one-to-one correspondence with the CT images and automatically estimate the lung doses.
Results: The mean percentage difference between the DNN lung doses and the respective doses estimated with the Monte Carlo (MC) simulations was 9.4% (range: 0.1% to 19.8%). The average time (in the order of minutes) to estimate the lung doses with the ML methodology was 91% less than the time needed for respective laborious MC computations.
Conclusion: The current study presents a machine learning-based methodology for rapid and accurate estimation of lung radiation doses from chest CT examinations.

O.6.3
DEEP LEARNING FOR THE DETECTION AND LOCALIZATION OF ABNORMAL PARATHYROID GLANDS IN PATIENTS WITH HYPERPARATHYROIDISM

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Background: Preoperative imaging methods for the localization of abnormal parathyroid glands are widely used to facilitate ensuing surgery. Parathyroid scintigraphy with 99mTc-sestamibi (MIBI) is an established technique. However, little has been investigated regarding MIBI scan and Deep Learning (DL) algorithms for parathyroid gland identification.
Materials and Methods: This retrospective study enrolled 418 patients, 397 with primary and 21 with secondary or tertiary hyperparathyroidism, who underwent parathyroid scintigraphy with double-phase and thyroid subtraction techniques. Data were collected from the archive of our laboratory. The study proposes a three-path network approach, employing the state-of-the-art Convolutional Neural Network called VGG-19. Image input to the model involved a set of three scintigraphic images in each case: MIBI early phase, MIBI late phase and 99mTcO4 thyroid scan. A medical expert’s diagnosis provided the ground truth for positive/

negative results. Moreover, the image produced by the model was compared with the original scintigraphic images to examine the exact localization of findings.

Results: Medical experts identified 391 abnormal glands in 296 patients. On a patient basis, the DL model attained an accuracy of 95.0% (sensitivity 94.6%; specificity 96.2%) in distinguishing normal from abnormal scintigraphic images. On a parathyroid gland basis and in achieving identical positioning of the findings with experts, the model correctly identified and localized 324/391 glands (82.9%) and yielded 74 false focal results (false positive rate 18.6%). These numbers correspond to an 81.4% positive and a 60.4% negative predictive value on a parathyroid gland level.

Conclusion: Deep Learning in parathyroid scintigraphy can potentially assist medical experts in identifying abnormal findings. Future research should be directed mainly towards false positive reduction methods.

O.6.4

AUTOMATED BRAIN VOLUMETRY: ACCURACY AND RELIABILITY

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Background: Automated brain volume analysis from MRI images, is gaining an important role in computer-aided diagnosis tool. We investigate the accuracy and reliability of this tool by comparing brain measurements from two known software: NeuroQuant and volBrain.

Materials and Methods: A sample of 45 patients (17 Male/28 Female), average age 44y, scanned under the same sequence 3D/GRE, Thickness=1.2mm, TE/TR= minimum/5.7ms, TI=600ms, frequency/phase=192/192, BandWidth 31.25 kHz. The produced images analyzed by both NeuroQuant (NQ) and volBrain (VB) software. We compared the volumes of basic anatomical brain structures such as intracranial cavity (ICV), whole brain, white matter, cerebellum, and the thalamus. The Interclass correlation (ICC), model of same ratters and type of absolute agreement, used to test inter-method reliability between NQ and VB and linear regression analysis used to examine the ability to qualitatively recognize the size of a structure. Analysis produced with IBM SPSS software.

Results: We found differences, expressed as a percentage of NQ greater than VB, followed by the ICC value and reliability meaning for each structure: ICV 8.73%, 0.7063 moderate; whole brain 1.81%, 0.98 excellent; White Matter 7.10%, 0.74 good; Cerebellum 2.82%, 0.96 excellent and Thalamus 41.94%, 0.002 poor. Linear regression analysis for the same structures found R2: 0.96, 0.98, 0.72, 0.81 and 0.83 respectively.

Conclusion: The comparison presented no or quite significant differences for the larger brain structures but extremely significant differences for the smaller structure of thalamus. This indicates that the absolute values of the measurements cannot be considered reliable in all cases, so such software are not a good quantitative tool. The good linear correlation determined in most measurements indicates that both software packages can detect the relative size of each brain segment. Therefore, automated brain volumetry software can be a good qualitative tool.

O.6.5

C3DTRANS: A DEEP LEARNING APPROACH FOR SURGICAL GESTURE RECOGNITION

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Background: Surgical gesture recognition is a crucial step in computer assisted surgery. By building networks capable of detecting individual gestures in surgical videos we are able to construct systems that aid surgeons during their training procedure or in the operating room.

Materials and Methods: The aim of this study is to develop a deep learning method for online segmentation of laparoscopic training videos into the individual gestures performed by the operator. We introduce a novel architecture called C3DTrans that consists of two models: a Short Term (ST) Model and a Long Term (LT) Model. The ST model employs a 3D Convolution Neural Network that encodes spatial and short-term temporal features, extracted from a short video segment (video clip), into a latent vector space. The LT model employs a Transformer network and its task is to capture long term dependencies in the latent vectors produced by the ST model and then classify the input video clip to the corresponding gesture class. We evaluated our method against a dataset that consists of 80 videos of two laparoscopic tasks: Peg Transfer (PT) and Knot Tying (KT) consisting of five gestures and four gestures, respectively. The input to the proposed model was a 15-frame video clip extracted sequentially from the raw video of the training task. In order to examine the added benefit of the transformer network we used the 3D convolution model as a baseline.

Results: Our network achieves 88% and 95.2% clip-level accuracy and 96% and 99% frame-level accuracy for the PT and KT tasks respectively, outperforming the baseline model on both tasks.

Conclusion: Our model achieved a state-of-the-art accuracy both on clip-level and frame-level metrics indicating the benefits of the LT transformer compared to the 3D convolution model.

Biophysics and Radiobiology (BRB)

O.7.1

THE DECAPEPTIDE PROTHYMOSIN α(100-109) AS A POTENTIAL BIOMARKER OF IMMUNOGENIC APOPTOSIS AND RESPONSE TO RADIOTHERAPY

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Background: Ionizing radiation can potentially induce immunogenic cell death (ICD). In addition, the concentration of the decapeptide of prothymosin α, proTα(100-109) correlates with the levels of early apoptotic cells. The purpose of this study is to correlate immunogenic apoptosis with the levels of proTα(100-109) i) in vitro, by exposing cancer cells to irradiation and determining the percentages of early apoptotic cells and the concentration of proTα(100-109) and ii) ex vivo, by analyzing blood samples of a lung cancer patient, treated with robotic stereotactic radiotherapy. To confirm our results, we also determined the levels of the known DAMPs, calreticulin (CRT) and high mobility group box 1 protein (HMGB1).