Conference abstract:
Tan, Y.X., Shaikh, S., Chapman, R. et al. (2023) Quantification of airway plugging on computed tomography imaging of patients with cystic fibrosis. [Conference abstract]

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Methods and materials: A retrospective review of all arbitrated screening mammograms in a single breast-screening unit from January 2021 to December 2022. All arbitrated mammogram results were recorded either as back to routine screening or as recall to assessment. Assessment outcomes were reviewed for cancer types and cancer mammographic features. Interval cancer rates were regularly monitored to ensure standards were met for the unit.
Results: A total of 815 women with discordant mammographic findings were discussed at consensus meetings. 312 women (38%) were recalled for further assessment. 38 cancers were detected in these women. Invasive ductal carcinoma was the most dominant type of breast cancer, accounting for 16 cases. Mammographic features were recorded as asymmetric density, microcalcifications, stromal deformity, mass lesion or others. The most common mammographic feature resulting in discordance and referral to consensus review was asymmetric density.
Conclusion: Consensus arbitration is proving useful to detect a range of cancer types, with invasive ductal carcinoma being the most common and asymmetric density the most common mammographic feature of cancers. Cancers detected through arbitrations are very beneficial for film readers to review, highlighting subtle cancers and film-reading traits. Interval cancer detection rates for the unit are consistently within limits of national standards, highlighting optimum cancer detection through three-yearly breast screening.

QUANTIFICATION OF AIRWAY PLUGGING ON COMPUTED TOMOGRAPHY IMAGING OF PATIENTS WITH CYSTIC FIBROSIS

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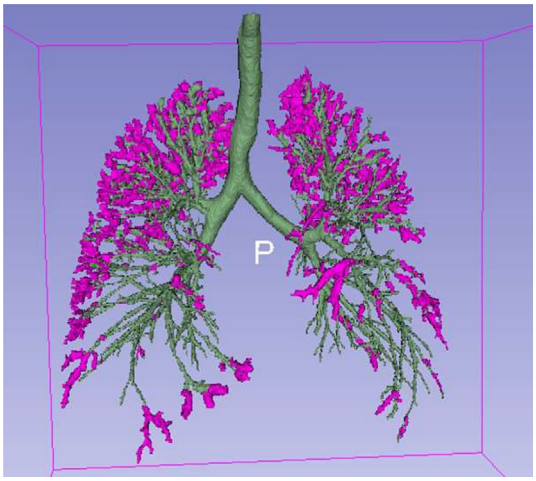
Category: Respiratory
Purpose: Cystic fibrosis is characterised in the lungs on computed tomography (CT) imaging by abnormal airway dilatation and mucus plugging of airways. Quantifying airway plugging using visual analysis of CT scans has been shown to associate with disease severity. Yet visual analysis of mucus plugging is associated with interobserver variability. To date no computer algorithms have objectively quantified mucus plugging. Our study aimed to develop a deep-learning approach to quantify mucus plugging in cystic fibrosis.
Methods and materials: CT scans of subjects with cystic fibrosis were obtained from Leeds University Hospitals. Approval for this retrospective study of clinically indicated pulmonary function and CT data was obtained from the local research ethics committees and Leeds East Research Ethics Committee: 20/YH/0120. CT scans (n=10) were manually annotated with two different labels, one for patent airways and one for plugged airways. Annotations were ratified by an expert radiologist (JJ), and corrections made to the labels as required. Case selection for the training CT dataset included subjects with a range of airway dilatation and a range of airway plugging.
A no-new-Unet (nn-Unet) deep-learning model was trained with the labelled CT scans to segment plugged and patent airways. The segmentations produced by the nn-Unet model formed the input into an airway analysis software tool called AirQuant, which skeletonised the segmentation and quantified airway metrics such as airway tapering rate, tortuosity and patent and plugged airway volume.
Results: When the nn-Unet model trained on the manual plugged and patent airway segmentations was tested on unseen data, airway plugging was characterised well by the model. The model was able to accurately discriminate plugged airways from vessels in the lung (Figure 1). Volumes of airway plugging were quantifiable on longitudinal imaging in the same patient.
Conclusion: Our study describes the development of what we believe to be the first computer algorithm to quantify airway plugging in cystic fibrosis. Accurate objective quantification of airway plugging could provide much needed estimates of disease severity and disease progression in cystic fibrosis. This could aid clinical management and therapeutic trials of medications in patients with cystic fibrosis.

Image:



DUAL-ENERGY CT AND VERTEBRAL BODY FRACTURES: A SAVIOUR IN THE DARK NIGHT ON-CALL SHIFT

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Category: Musculoskeletal
Purpose: Magnetic resonance imaging (MRI) has long been utilised to differentiate acute from chronic fractures by delineating bone marrow oedema (BME). However, its feasibility and acquisition may be limited by contraindications or impracticality during a busy night shift. Dual-energy computed tomography (DECT) can be used as an effective tool and quick alternative to depict acute vertebral fractures (VF).
Methods and materials: In this pictorial review, we briefly summarise the basic principles of DECT to refresh the minds of our readers. We discuss literature-based pearls and limitations of utilising DECT for the identification of vertebral fracture-associated BME. We provide illustrations exclusively acquired using our departmental third-generation DECT scanner with a tube voltage set at 90/150 kV. The detector collimation for spinal imaging is set at 192 × 0.6 mm with a pitch of 0.7. Low and high kV data were analysed with dual-energy software in Syngovia utilising the BME application tailored to the spine. Colour overlay and calcium subtraction images were examined for the presence of BME.
Results: DECT uses two X-ray beams to delineate BME by calculating material-specific densities and virtually subtracting and reconstructing calcium images from soft-tissue kernels. Recent meta-analyses suggest that DECT has a high diagnostic accuracy in detecting BME (sensitivity 85%, specificity 97%) and an excellent performance for spinal trauma (sensitivity 84%, specificity 98%). The single-source consecutive DECT acquisition technique demonstrates a lower specificity for detecting BME than the dual-source technique (78% versus 98%). Additionally, a wider separation of the energies of the two tubes increases material decomposition and therefore improves DECT sensitivity in BME detection.
Reconstruction of both bone and soft-tissue kernels demonstrated a better specificity than using soft-tissue kernels alone (98% and 90% respectively). Considerable inter-reader variability exists with experienced staff displaying a higher statistically significant specificity than trainees (96% versus 79%, p=0.01).
Conclusion: DECT has a high specificity for detection of vertebral BME associated with acute fractures, which may preclude the need for the generally less accessible MRI. This could improve workflow and the provision of timely reports for clinicians in an emergency setting as well as reducing unwanted stress for radiologists particularly during on-call shifts.