

CAR 2024

Embracing a New Era

April 11-14 avril 2024
Le Westin Montréal
Montréal, QC



Radiologist-in-Training Research Project Competition Presentation

At what rate do incidental pancreatic cystic lesions grow and become malignant? An evaluation of natural history and efficacy of surveillance guidelines

Subject	Abdominal
Objective	Incidental pancreatic cystic lesions (PCLs) are common and require imaging follow-up due to low malignant potential. Our objectives were to assess PCL natural growth, incidence of malignancy, and efficacy of surveillance guidelines.
Methods	A retrospective analysis of incidental PCLs discovered between 2012-2017 with ≥ 5 years of follow-up was performed. PCL size, growth, and development of high-risk features and/or malignancy were recorded. Descriptive statistics and a mixed-effects regression analysis of PCL growth were performed.
Results / Discussion	449 patients (165 males, mean age 67.1 ± 12.3 years) with 556 incidental PCLs were included. 9 patients in 21,996 patient-years of follow-up developed pancreatic cancer (4.1 cases/10,000 patient-years). Despite being less conservative than other surveillance guidelines, a similar number of pancreatic cancers were detected by CAR (3, 33.3%) compared to ACR, International Consensus, and European guidelines (3-4, 33.3-44.4%). Significant growth (defined by ACR criteria) was demonstrated in 4 patients with pancreatic cancer (44.4%) and in 93 of 440 patients (21.1%) with benign PCLs. PCL natural growth was 0.33 mm/year (0.26-0.40 mm 95% CI), which overlaps with the definitions of significant growth for CAR and ACR. High-risk features (mural nodule or duct enlargement) were found in 3 of 9 patients with pancreatic cancer (33.3%) but only 1 of 440 patients with benign PCLs (0.2%).
Conclusion	PCLs are overwhelmingly benign and grow slowly over time. Surveillance guidelines performed similarly to detect 3-4 of 9 pancreatic cancers, despite considerable differences in recommended duration and frequency of follow-up. The natural growth rate of PCLs overlaps with the CAR and ACR definitions of significant growth.
Presenting Author	Victoria Linehan, Dalhousie University Resident

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Deep Learning for Pneumothorax Detection on Chest Radiograph: A Diagnostic Test Accuracy Systematic Review and Meta Analysis

Subject	Chest
Objective	To evaluate the overall performance of deep-learning (DL) algorithms to detect pneumothorax on chest x-ray (CXR) through assessment of studies utilizing such models.
Methods	A study protocol was created and registered a priori (PROSPERO CRD42023391375). Inclusion criteria were studies that used adult patients, utilized computer-aided detection of pneumothorax on CXR, dataset was evaluated by a qualified physician, and sufficient data was present to create a 2 x 2 contingency table. Risk of bias was assessed using the QUADAS-2 tool. Bivariate random effects meta-analyses were performed to determine pooled sensitivities and specificities. Coupled forest plots and hierarchical summary receiver operating characteristic (hsROC) curves were created using the estimated model parameters. Meta-regression modelling were executed to assess for sources of variability.
Results / Discussion	Twenty-three studies were selected, including 34 011 patients and 34 075 CXRs. The pooled sensitivity and specificity were 87% (95% CI, 81%, 92%) and 95% (95% CI, 92%, 97%), respectively. The area under the curve (AUC) of the hsROC is 97% (95% CI, 95%, 98%). The meta-regression revealed that study design, use of an institutional/public data set and risk of bias had no significant effect on the sensitivity and specificity of pneumothorax detection ($p=0.07-0.86$).
Conclusion	The relatively high sensitivity and specificity of pneumothorax detection by DL showcases the vast potential for implementation in clinical settings to both augment the workflow of radiologists and assist in more rapid diagnoses and subsequent patient treatment. Our analysis supports the performance of DL in pneumothorax detection and demonstrates the exciting potential of these algorithms.
Presenting Author	Benjamin Katzman, McMaster University Medical Student

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Deep learning to rule-in multiple sclerosis as distinguished from chronic ischemic change

Subject	Neuro (incl. Neurointerventional and Head and Neck)
Objective	Evaluate the diagnostic accuracy of a pre-trained deep learning model to rule-in multiple sclerosis (MS) as distinguished from chronic ischemic change (CIC) with MRI T2 FLAIR images.
Methods	Retrospective study of 265 patients under the age of 65 with T2 FLAIR imaging for 267 MS patients and 63 CIC patients retrieved from PACS. Trained a pre-trained DenseNet-201 model to differentiate MS from CIC using 919 slices in which white matter lesions were segmented by a senior radiologist using 10-fold cross-validation (CV). The first model was used to make predictions on 13220 other slices, and these slice predictions were input features to train and test a shallow neural network for patient-level prediction using 10x3CV. Diagnostic accuracy was evaluated with measures from receiver operating characteristic (ROC) analysis and Sackett's rules for ruling in and ruling out.
Results / Discussion	The model can rule-in MS with 90% specificity (Figure 1, R-in), 95% positive predictive value and a positive likelihood ratio of 5.3. The model can attempt to rule-out MS with 90% sensitivity (Figure 1, R-out), 57% negative predictive value and a negative likelihood ratio of 0.185, but it is insufficient for that purpose. The AUC or C statistic of the mean ROC curve is 82.7%.
Conclusion	The model meets the goal of Sackett's SpPin rule to rule-in MS in the context of possible CIC. Can assist a physician in over half of MS cases. Our model distinguishes MS from CIC, whereas models in literature distinguish MS from healthy subjects. This can be used at the point of care with our hospital's routine protocols.
Presenting Author	Sri Sannihita Vatturi, University of Ottawa Resident
Co-Authors	Rafael Glikstein, University of Ottawa Gerd Melkus, University of Ottawa Shivaprakash Hiremath, University of Ottawa/ Western University Andre Carrington, Ottawa Hospital Research Institute

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A Tale of Podcasts and Papers: Assessing the Influence of Radiology Podcasts on Radiology Journal Article Metrics

Subject	Education
Objective	Podcasts have become a popular form of education and entertainment; CARJ recently released their Radiology Roundtable podcast. However, little is known about the impact of podcasts. We evaluated the influence of RSNA Radiology podcasts on the metrics of Radiology journal articles.
Methods	Ethics approval was not required because this was a retrospective study using publicly available data. Articles in the print version of Radiology from January 2021 to December 2022 were reviewed. Articles featured on Radiology podcasts were included in the podcast (P) group. Articles within the same journal issue and category were matched controls (MC). Downloads, citations, and Altmetric Attention Score (AAS) were recorded. The Mann-Whitney U-test was used to compare medians and evaluate differences between older and newer articles.
Results / Discussion	The podcast group (n=88), exhibited significantly higher median downloads (P=4521.0, MC= 2123.0, p<0.001), Google Scholar citations (P=14.5, MC= 10.0, p=0.01), Dimensions citations (P=12.0, MC=9.0, p=0.01), and AAS (P=43.0, MC=10.0, p<0.001) when compared with the matched control group (n=378). Older articles (January-June 2021) had higher median downloads (P, p=0.08; MC, p<0.001), Google Scholar citations (P and MC, p<0.001), and Dimension citations (P and MC p<0.001) than more recent articles (July-December 2022). Interestingly, AAS was significantly higher in older matched control articles (p=0.01), but markedly increased in more recent podcast articles (p=0.03).
Conclusion	Radiology podcast featured articles had significantly greater median metrics including downloads, citations, and Altmetric Attention Score. Although causality is uncertain, podcasts may effectively disseminate and amplify radiology research while boosting article metrics.
Presenting Author	Mark Wang, University of Saskatchewan Medical Student
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Phase-Contrast MRI-based Renal Blood Flow in Young Adults Born Prematurely, a Feasibility Study and Correlation with EGFR

Subject	Vascular & Interventional
Objective	Adults born prematurely are at greater risk of developing chronic renal failure. Vascular damage may be the cause. There is no standard radiological examination to detect these vascular changes. Objectives: 1) evaluate the feasibility of non-invasive MRI imaging of renal artery flow, 2) assess its reproducibility, 3) evaluate the correlation between Sq-flow data and EGFR while comparing preterm adults to their term-born controls.
Methods	Prospective observational study of a subgroup of the Health of Adults born Preterm Investigation (HAPI) cohort study. Participants underwent renal MRI (Philips 1.5T Ingenia) in phase contrast sequence to target bilateral renal artery. The renal artery was then manually located and delineated on 20 images by an operator using Intellispace interface. Anthropometric and Sqflow data: mean flow (ml/s), mean velocity (cm/s), peak velocity (cm/s) and peak pressure gradient (mmHg) were obtained and analyzed on SPSS.
Results / Discussion	35 adults born prematurely, mean age 30.14 (48.57% male) and 30 adults born at term, mean age 28.00 (50% male) were recruited. Study feasibility was 91.61% (interpretable sequences). The study demonstrated excellent reproducibility according to the Bland-Altman test. A positive correlation was demonstrated between EGFR and mean velocity ($r=0.26$), peak velocity ($r=0.27$) and peak renal artery concentration gradient ($r=0.27$). Mean velocity was significantly higher in full-term adult group, at (26.42 ± 6.14) cm/s compared with (23.92 ± 7.86) cm/s in preterm adults ($p=0.013$).
Conclusion	The renal phase contrast sequence is feasible and reproducible. Velocities measured on MRI could assess early changes in renal failure in young adults born prematurely. Further studies are required.
Presenting Author	Frédérique Leroux, Université de Montréal Medical Student
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Evaluation of Magnetic Resonance Navigation (MRN) Performance by Targeting Success of Magnetic Drug-Eluting Beads (MDEBs) in Hepatic Arteries

Subject	Vascular & Interventional
Objective	Our objective is to perform MR-guided embolization of liver tumors using magnetic resonance navigation (MRN) with magnetic drug-eluting beads (MDEBs). We demonstrate the efficacy of this approach in pig models.
Methods	The MRN procedure involved 12 pigs: 4 control, 5 left liver-targeted, and 3 right liver-targeted. Employing a particle injector, we performed 100 injections of 20 MDEB aggregates (20 MDEB per aggregate) in each liver, maintaining a flow velocity under 10 cm/s with a blood flow control system. Liver and particle segmentation utilized open-source software 3D Slicer, merged with Meshmixer software output for arterial tree segmentation. Manual identification of MDEB-induced artifacts on MR images and application of a pre-established mathematical relationship determined the actual MDEB number.
Results / Discussion	We successfully segmented 12 livers and assessed particle distribution after 25, 50, 75, 100 injections inside the magnet. Overall targeting efficiency decreased from 25 to 100 injections (80.9% to 74.5%). After 100 injections, we removed and reinserted the pigs into the MRI, imaging the disaggregated MDEB aggregates. Re-analyzing the particle distribution, the left lobe targeting improved from $52.2 \pm 8.8\%$ (control) to $84.1 \pm 11.7\%$ ($p=0.0054$), and right lobe targeting improved from $47.7 \pm 8.8\%$ (control) to $86.4 \pm 3.5\%$ ($p=0.0018$). Remarkably, targeting success rebounded (74.5% to 84.1%-86.4%) upon pig reinsertion at 100 injections, attributed to proximal blockage during MRN.
Conclusion	MRN exhibited promising results for selective liver embolization of MDEBs. Early detection of proximal blockage, prompting patient removal from the magnetic field, may enhance MRN performance by reducing non-target embolization.
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Targeted Biopsy on Unilateral mpMRI Prostate PI-RADS 4 and 5 Lesions: Time to Omit Contralateral Biopsies?

Subject	Abdominal
Objective	This study aimed to compare prostate targeted biopsy(TB) alone, TB + ipsilateral systematic biopsy (iSB) and TB + SB to assess the impact of biopsy technique on the detection of clinically significant prostate cancer(csPCa) and clinically insignificant cancers (ciPCa, Gleason 3 + 3) on PI-RADS 4 and 5 identified lesions.
Methods	A retrospective analysis identified 180 patients who underwent MRI ultrasound fusion targeted and systematic biopsy for a unilateral lesion (122 with PI-RADS 4, and 58 with a PIRADS 5 lesion) over an 18 month period. Pathology results from the patients were analyzed and subsequently separated into 3 sub-groups: TB, TB + iSB and TB+SB. The cancer detection rate (CDR) for each biopsy technique was determined, as well as the sensitivity of TB and TB+iSB in the detection of csPCa with TB+SB as the reference standard.
Results / Discussion	The CDR for csPCa for PI-RADS 4 and 5 lesions was 45/122 (37%) and 39/58 (67%) for TB; 52/122 (43%) and 44/58 (76%) for TB+iSB; and 53/122 (43%) and 45/58 (78%) for TB+SB. The sensitivity relative to TB + SB was 86% for TB and 98% for TB + iSB. TB+SB only detected an additional 2 cases (1%) of csPCa, 1 in PI-RADS 4 group and 1 in the PI-RADS 5 group.
Conclusion	This retrospective analysis provides evidence that contralateral systematic biopsy can be safely omitted in patients with a solitary targetable PI-RADS 4 or 5 lesion without patient harm. The results in this study suggest TB + iSB is non-inferior to TB + SB in the detection of csPCa.
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Meeting the face behind the medical images: Virtual radiology consultation clinics to improve patient experience

Subject	General
Objective	To assess patient experience and satisfaction after reviewing imaging results with radiologists during virtual clinics.
Methods	Patients receiving CT imaging at a tertiary care hospital were recruited for virtual radiology consultations (VRCs) with staff and resident radiologists. VRCs were conducted over Zoom, during which radiologists shared their images and answered patient questions. Patients then completed a post-consultation survey assessing their experience using 5-point Likert scale, multiple choice, and free-form text responses. This is an ongoing prospective study.
Results / Discussion	30 survey responses were collected (mean age 57.1 years, 57% female). All patients reported English as their first language. 50% of participants had reviewed their imaging with the referring physician before the consultation. Results indicated a high satisfaction level (5.0 ± 0.2), improved understanding of their diagnosis due to both the discussion (4.8 ± 0.4) and viewing their images (4.7 ± 0.5), and comfort with the virtual format (4.9 ± 0.3). 93% of patients preferred future results to be delivered over a virtual call with imaging-sharing capabilities, and 7% in-person at a medical facility. All patients expressed strong interest in participating in future VRCs.
Conclusion	This study represents the first VRC pilot in Canada. The positive feedback suggests that VRCs could improve patient experience, enhance understanding of their diagnosis, and expand the scope of telehealth in radiology. Future studies should focus on recruiting a larger pool of patients across multiple centres, consulting on other imaging modalities, embedding VRCs into patient management, and evaluating radiologist experience.
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