Imaging research in the D-Lab: Quantitative neuroimaging with Radiomics and Deep Learning

precision medicine

LIÈGE université
GIGA institute
CYCLOTRON RESEARCH CENTRE
IN VIVO IMAGING

Lisa Lavrova
Radiology Research Day
14.09.2022

Maastricht University

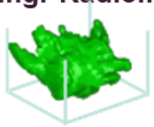
Imaging research in the D-Lab

Precision Medicine department

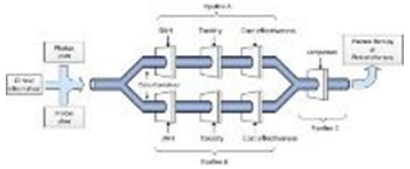
dlab

Artificial Intelligence-based Decision Support Systems

Quantitative imaging: Radiomics - Deep Learning



Multifactorial Decision Support For Dr's and/or Patients



New Biomarkers & Big Data

FAIR

mlab

Targeting the tumour microenvironment

Immunotherapy with immunocytokines

Hypoxia Activated Prodrug + Immunotherapy

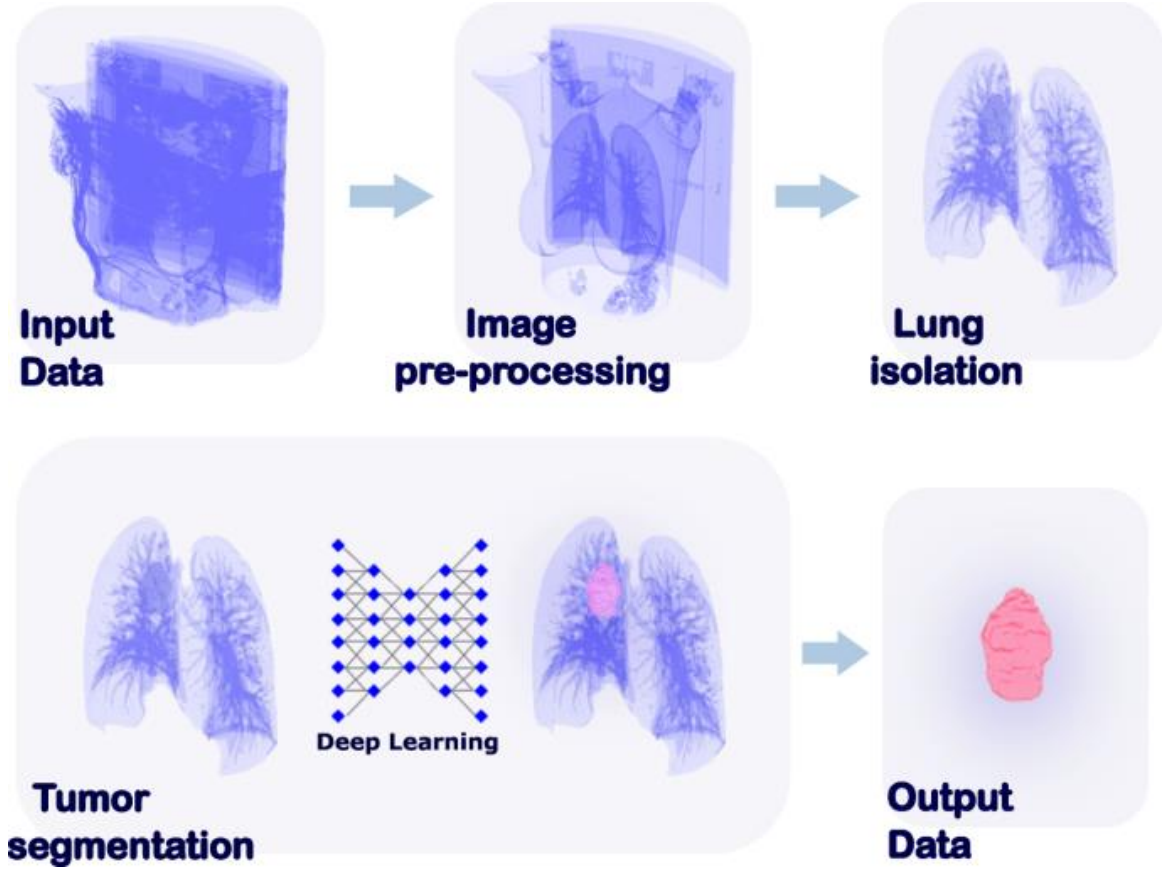
Clostridium-based therapy/vaccination

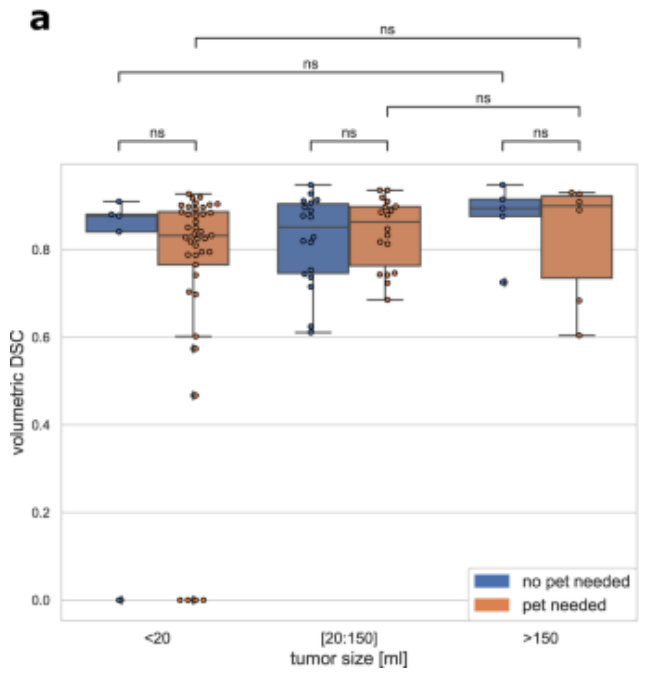
Innovative Therapies

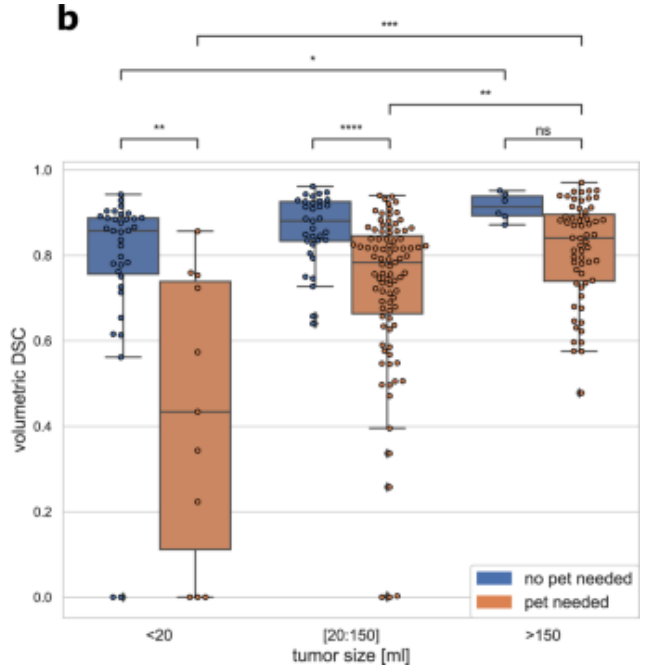
* All topics are linked to a Clinical trial

vtunit

Recent works from D-Lab



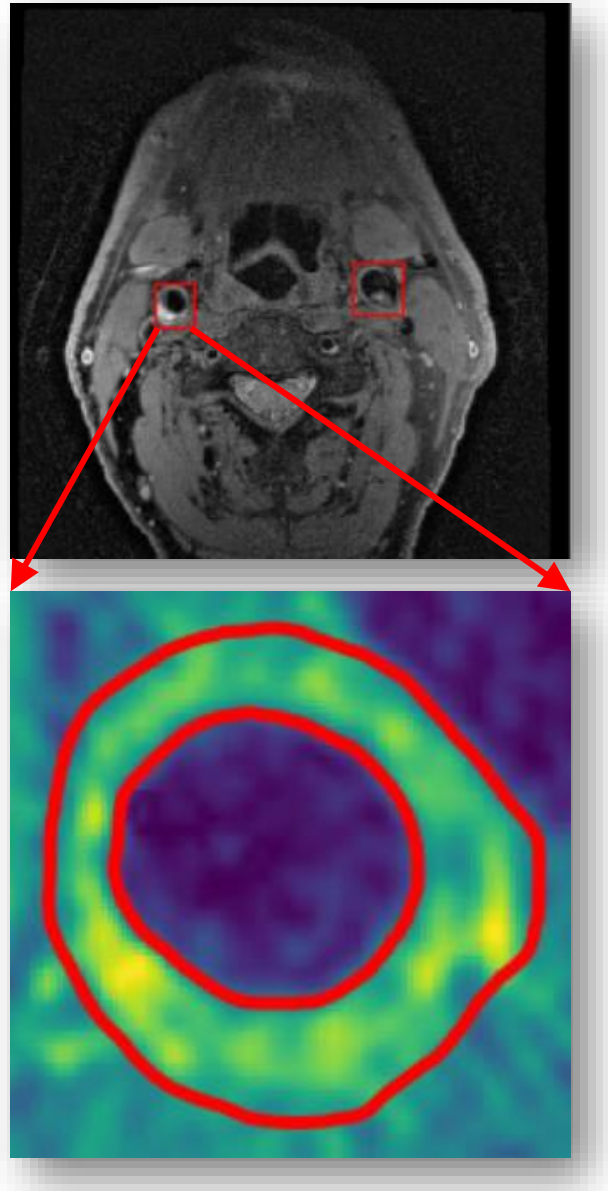




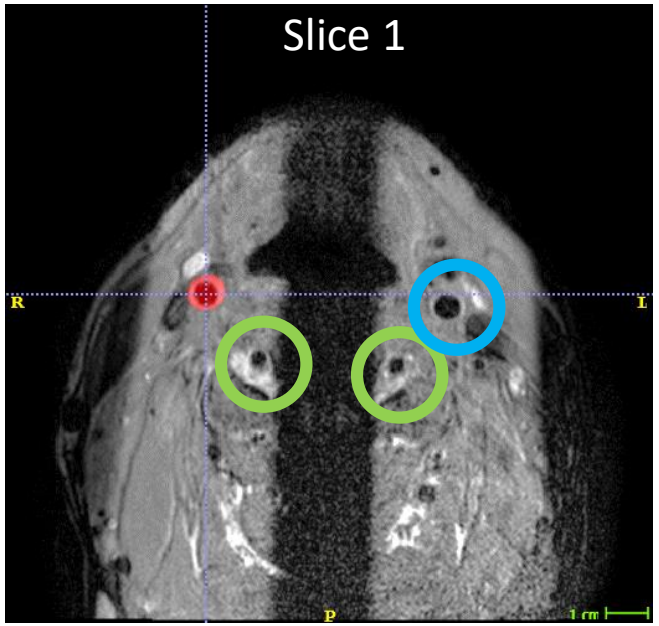
plaq-u-net: a multi-patch consensus U-Net for automated detection and segmentation of carotid arteries on black blood MRI

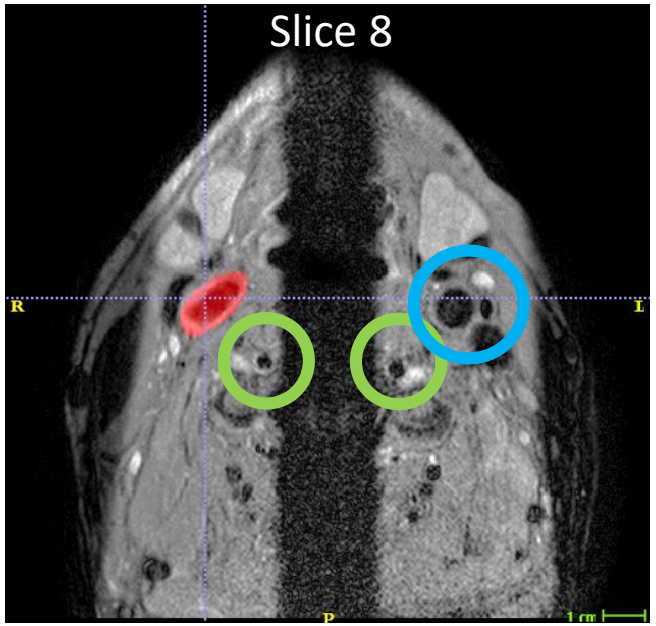
Introduction: Motivation

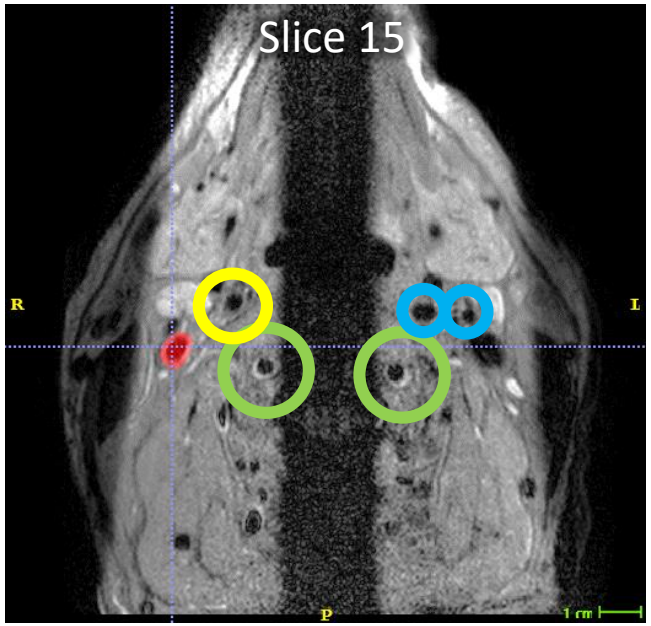
Unmet clinical need	Recurrent stroke prediction for patients with carotid artery (CA) stenosis
Prognostic information	CA plaque composition
Imaging modality	Multi-sequence MRI including black blood (BB)
Methodological gap	CA plaque analysis methods require manual CA localization
Hypothesis	CA can be detected and segmented on BB MRI with an automated Deep Learning (DL) workflow



Introduction:
Detection/segmentation on partially labelled data





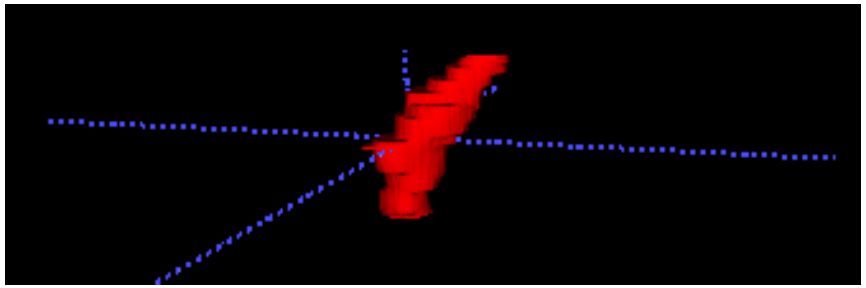


Common and internal CA (contoured)

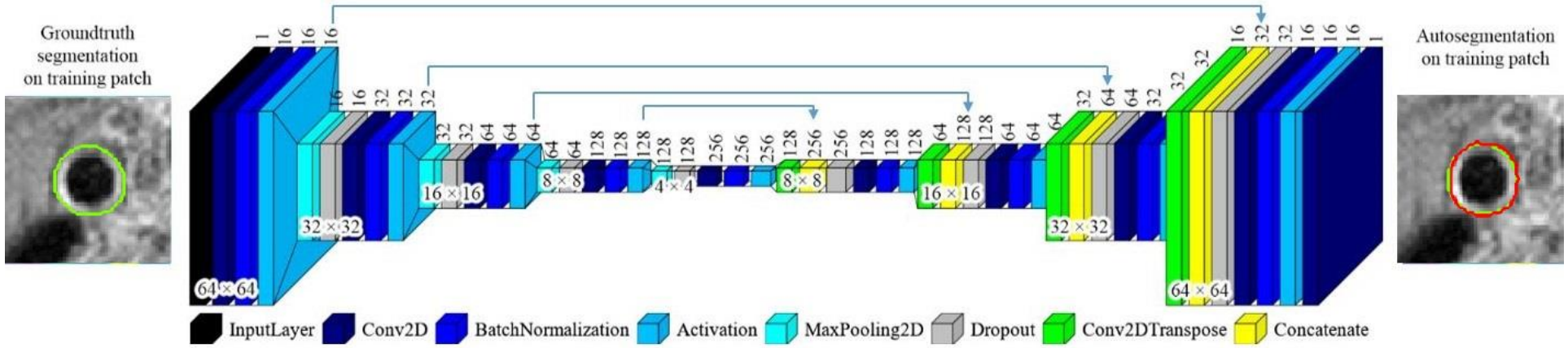
External CA

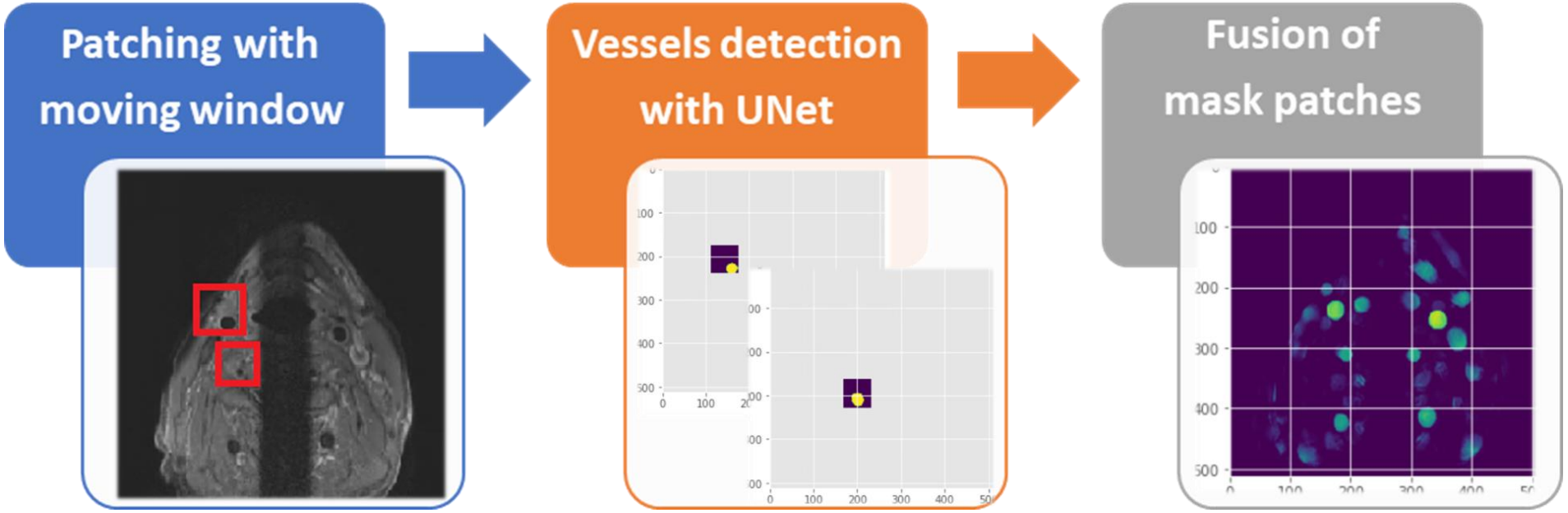
Contralateral CA

Vertebral arteries



Method: plaq-u-net

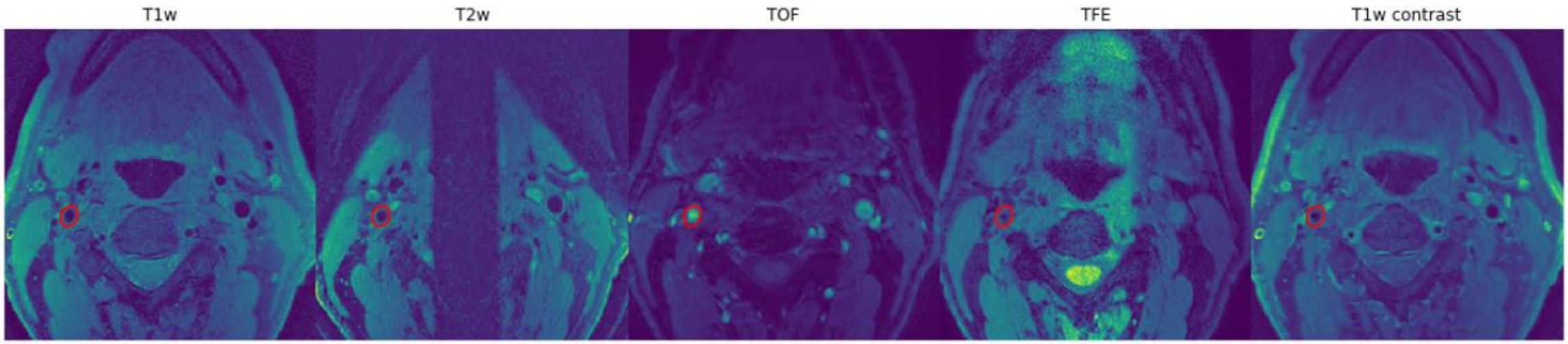




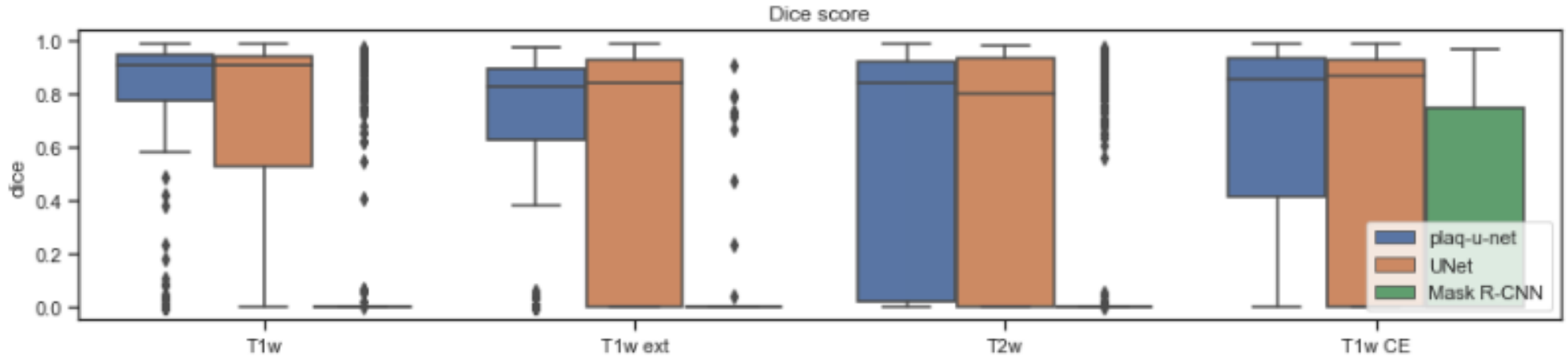
Materials: PARISK study

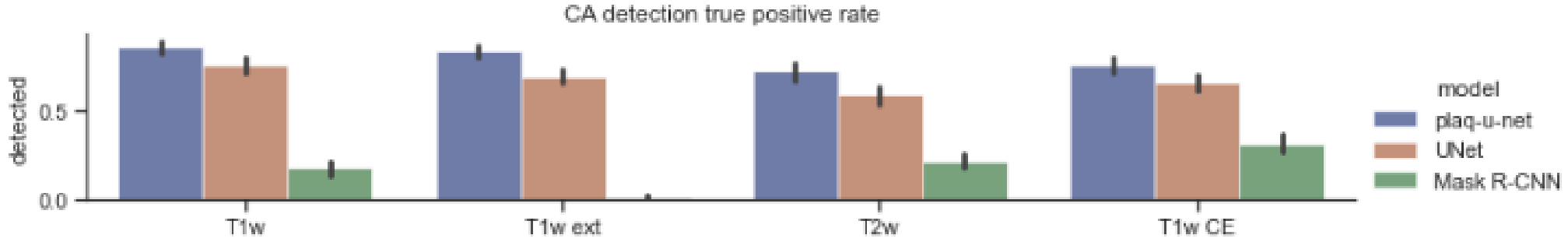
https://doi.org/10.1111/ijs.12167

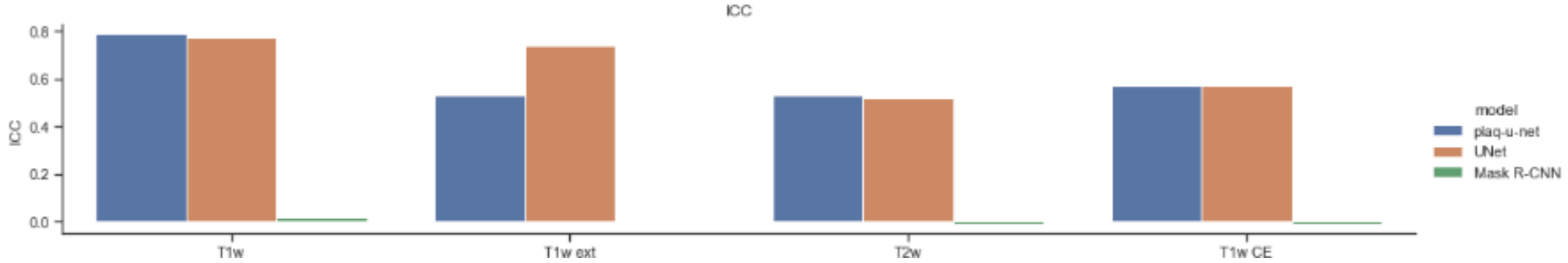
DS	Total	Train	Valid	Test
AMC T1w	13	9	2	2
MUMC T1w	115	80	17	18
UMCU T1w	25	17	4	4
EMC T1w	34	0	0	34
AMC MUMC UMC T2w	24	0	0	24
AMC MUMC UMC T1w CE	24	0	0	24
Total	187	106	23	24



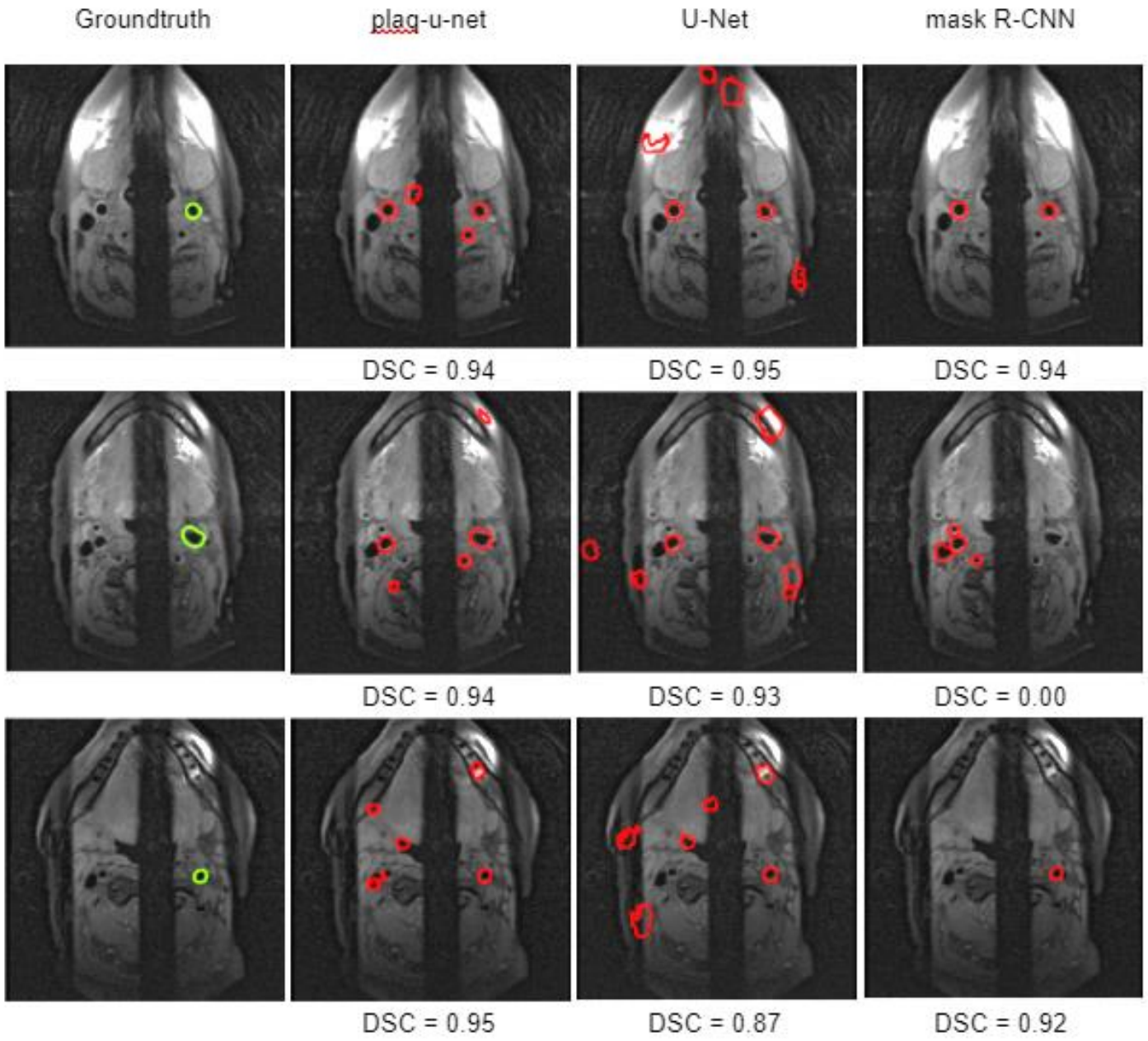
Results


Dice score
dice
1.0
0.8
0.6
0.4
0.2
0.0
T1w
T1w ext
T2w
T1w CE
plaq-u-net
UNet
Mask R-CNN


CA detection true positive rate
detected
0.5
0.0
T1w
T1w ext
T2w
T1w CE
model
plaq-u-net
UNet
Mask R-CNN


ICC
ICC
0.8
0.6
0.4
0.2
0.0
T1w
T1w ext
T2w
T1w CE
model
plaq-u-net
UNet
Mask R-CNN

Results


Groundtruth
plaq-u-net
U-Net
mask R-CNN
DSC = 0.94
DSC = 0.95
DSC = 0.94
DSC = 0.94
DSC = 0.93
DSC = 0.00
DSC = 0.95
DSC = 0.87
DSC = 0.92

Discussion

Dice comparable with recently reported in literature

plaq-u-net performs better than Mask-R-CNN but comparable to UNet

The first study with external/other sequence validation

Performance decreases on the data from the other domain

Limitation: other arteries will be detected

Limitation: 3D information is not used

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THANK YOU FOR YOUR ATTENTION!

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