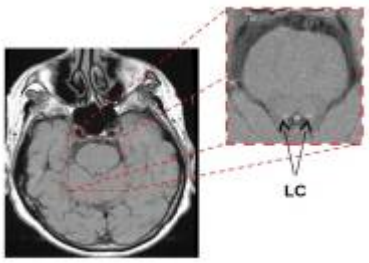
# Neuromelanin magnetic resonance imaging

Neuromelanin-sensitive MRI (NM-MRI) purports to detect the content of neuromelanin (NM), a product of dopamine metabolism that accumulates with age in dopamine neurons of the substantia nigra (SN). Interindividual variability in dopamine function may result in varying levels of NM accumulation in the SN; however, the ability of NM-MRI to measure dopamine function in nonneurodegenerative conditions has not been established.

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Neuromelanin sensitive MRI may be the method of choice for the follow-up of meningeal melanocytoma [1].

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Cassidy et al. validated that NM-MRI signal intensity in postmortem midbrain specimens correlated with regional NM concentration even in the absence of neurodegeneration, a prerequisite for its use as a proxy for dopamine function. They then validated a voxelwise NM-MRI approach with sufficient anatomical sensitivity to resolve SN subregions. Using this approach and a multimodal dataset of molecular PET and fMRI data, they further showed the NM-MRI signal was related to both dopamine release in the dorsal striatum and resting blood flow within the SN. These results suggest that NM-MRI signal in the SN is a proxy for function of dopamine neurons in the nigrostriatal pathway. As a proof of concept for its clinical utility, we show that the NM-MRI signal correlated to severity of psychosis in schizophrenia and individuals at risk for schizophrenia, consistent with the well-established dysfunction of the nigrostriatal pathway in psychosis. The results indicate that noninvasive NM-MRI is a promising tool that could have diverse research and clinical applications to investigate in vivo the role of dopamine in neuropsychiatric illness [2].

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A study aimed to evaluate the accuracy and diagnostic test performance of the U-net-based segmentation method in neuromelanin magnetic resonance imaging (NM-MRI) compared to the established manual segmentation method for Parkinson's disease diagnosis.

NM-MRI datasets from two different 3T-scanners were used: a “principal dataset” with 122 participants and an “external validation dataset” with 24 participants, including 62 and 12 PD patients, respectively. Two radiologists performed SNpc manual segmentation. Inter-reader precision was determined using Dice coefficients. The U-net was trained with manual segmentation as ground truth and Dice coefficients used to measure accuracy. Training and validation steps were performed on the principal dataset using a 4-fold cross-validation method. We tested the U-net on the external validation dataset. SNpc hyperintense areas were estimated from U-net and manual segmentation masks, replicating a previously validated thresholding method, and their diagnostic test performances for PD determined.

For SNpc segmentation, U-net accuracy was comparable to inter-reader precision in the principal dataset (Dice coefficient: U-net, 0.83 ± 0.04; inter-reader, 0.83 ± 0.04), but lower in external validation dataset (Dice coefficient: U-net, 079 ± 0.04; inter-reader, 0.85 ± 0.03). Diagnostic test

performances for PD were comparable between U-net and manual segmentation methods in both principal (area under the receiver operating characteristic curve: U-net, 0.950; manual, 0.948) and external (U-net, 0.944; manual, 0.931) datasets.

U-net segmentation provided relatively high accuracy in the evaluation of the SNpc in NM-MRI and yielded diagnostic performance comparable to that of the established manual method [3].

# References

1)
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