

Brain imaging in COVID-19

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Overview

There is strong evidence for brain-related pathologies in COVID-19: neurological and cognitive deficits, radiological and post mortem tissue analyses demonstrating the impact of COVID-19 on the brain, and the possible presence of the coronavirus in the central nervous system found in some studies. However, most brain imaging studies of COVID-19 to date have focussed on acute cases and radiological reports of single cases or case series based on CT, PET or MRI scans, revealing a broad array of gross cerebral abnormalities ranging from white matter hyperintensities, hypoperfusion and signs of ischaemic events spread throughout the brain. Imaging cohort studies of COVID-19, quantitatively comparing data across subjects through automated preprocessing and co-alignment of images, thus relying on spatially consistent pattern for the distribution of abnormalities, are much rarer. This session sheds light on some of these PET and MRI brain imaging studies, both cross-sectional and longitudinal in design, encompassing mild and hospitalised cases, acute, sub-acute and long COVID, as well as paediatric cases.

Lecture 1: *Dynamic brain abnormalities in recovered COVID-19 patients without neurological manifestations*

Jie Wang Presenter

After the initial surge of coronavirus disease 2019 (COVID-19), large numbers of patients are discharged from hospital without assessment of recovery. Now more and more patients report post-acute neurological sequelae, known as a part of “long COVID”, even among patients without specific neurological manifestations in the acute phase. However, little is known about the longitudinal consequences on the brain, which are important clues to both neuropathogenesis and recovery mechanism.

Lecture 2: *Brain PET imaging in long COVID*

Eric Guedj Presenter

In the context of the worldwide outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), some patients report functional complaints after apparent recovery from COVID-19. This clinical presentation has been referred as “long COVID”. The talk will present the FDG brain PET hypometabolic profile found in this context, in adults and in children, at group and individual levels, and in correlation to functional complaints, involving limbic/paralimbic regions and especially olfactory bulbs, and remotely the brainstem and the cerebellum. This profile will be discussed in comparison to those previously found in other neurological and psychiatric disorders, and also regarding possible pathophysiological considerations.

Lecture 3: *Neocortical dysfunction and cognitive impairment in COVID 19: A prospective FDG PET study*

Ganna Blazhenets Presenter

Given the rapid spread of SARS-CoV-2 and emerging evidence of neurological symptoms particularly in hospitalized COVID-19 patients, Dr. Blazhenets and colleagues from the Medical Center – University of Freiburg prospectively examined the impact of COVID-19 on the CNS in inpatients at the subacute and the chronic stage by FDG PET and neurological examination. Extensive cortical hypometabolism accompanying marked cognitive impairment was detected in two-thirds of patients at the subacute stage. Residual neocortical dysfunction was still measurable even six months after manifestation of disease, however, significant recovery of regional neuronal function and cognition was clearly stated.

Lecture 4: *Brain imaging before and after COVID-19*

Gwenaëlle Douaud Presenter

It remains unclear whether the impact of SARS-CoV-2 infection can be detected in milder cases. Moreover, all brain imaging studies to date have scanned patients after they got infected, when availability of pre-infection imaging data can help disentangle pre-existing risk factors from disease effects. Here, I will talk about our UK Biobank study, where participants were scanned twice, including 401 who tested positive for infection between their two scans. We identified significant longitudinal effects in limbic, mainly olfactory brain regions, as well as an additional diffuse atrophy in the infected participants. The infected participants also showed larger cognitive decline in executive function. Importantly, these effects were still seen after excluding the few cases who had been hospitalised, highlighting that even milder cases show brain and cognitive abnormalities.