THE CROATIAN ACADEMY OF SCIENCES AND ARTS
The Department of Biomedical Sciences in Rijeka

THE CLINICAL HOSPITAL CENTER RIJEKA

UNIVERSITY OF RIJEKA - MEDICAL FACULTY

THE CROATIAN NEUROLOGICAL SOCIETY

THE CROATIAN MEDICAL ASSOCIATION – Branch office Rijeka

Symposium

4th RIJEKA FORUM ON NEURODEGENERATIVE DISEASES NEURODEGENERATIVE DISEASES AND COVID-19 PANDEMIC

Endorsed by Associations
Parkinson i mi, Neurodeg and
European Academy of Neurology

Rijeka, December 10-11, 2020
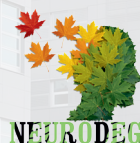
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Registration: online via [registration form](#) for online participants

Event address for ZOOM attendees will be sent to all registered participants by e-mail

Free admission for registrations.

Information

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P R O G R A M
OPENING (15,00 – 15,15)

Introduction

Daniel Rukavina, M.D., PhD, Professor Emeritus, Head of the Department of Biomedical Sciences in Rijeka, Croatian Academy of Sciences and Arts

Vladimira Vuletić, M.D., PhD, Assistant Professor, Medical Faculty, University of Rijeka, Rijeka; President of the Organizing Committee

Welcome addresses

Zdravka Poljaković, M.D., PhD, Professor, President of the Croatian Neurological Society, Medical Faculty, University of Zagreb, Zagreb

Alen Ružić, M.D., PhD, Professor, Head of the Clinical Hospital Center, Rijeka, Croatia

Goran Hauser, M.D., PhD, Associate Professor, Dean, Medical Faculty, University of Rijeka, Rijeka, Croatia

1st day – December 10th, 2020

15,15 – 18,30 h

I. CURRENT KNOWLEDGE

Chairmen: Vladimira Vuletić and Nenad Bogdanović

Elena Moro, M.D., PhD, Movement Disorders Unit, Director, Department of Psychiatry, Neurology, Neurological Rehabilitation and Forensic Medicine, Chair Centre Hospitalier Universitaire de Grenoble, Grenoble Alpes University, Grenoble, France
Neurological manifestations in patients with COVID-19

Nenad Bogdanović, M.D., PhD, Professor, Department for Neurobiology, Caring Science and Society, Division of Clinical Geriatrics, Karolinska Institute, Stockholm, Sweden
Neurodegeneration and COVID-19 pandemic

Zvezdan Pirtošek, M.D., PhD, Professor, University Hospital Centre Ljubljana, Ljubljana, Slovenia
A history lecture: neurologist comparing Spanish flu to Covid-19

Break for refreshment: 16,45 - 17,00

Kaj Blennow, M.D., PhD, Professor, Gothenburg University, Gothenburg and Mölndal Campus, Mölndal, Sweden
Update on blood biomarkers for A/T/N pathophysiology in Alzheimer Disease

Maja Trošt, M.D., PhD, Assistant Professor, University Hospital Centre Ljubljana, Ljubljana, Slovenia
Current knowledge about the effect of COVID-19 on Parkinson disease

Tomislav Babić, M.D., PhD, Professor, Neuroscience Franchise Worldwide Clinical Trials, London, UK
Management of clinical trials on neurodegenerative diseases in COVID - 19 pandemic

II. ROUND TABLE DISCUSSION

Chairman: Vladimira Vuletić

2nd day – December 11th, 2020

15,00 – 19,15 h

I. CLINICAL EXPERIENCE AND STATE OF ART

Chairmen: Mario Habek and Nenad Bogdanović

Robert Živadinov, M.D., PhD, Professor, Director, Center for Biomedical Imaging at Clinical Translational Science Institute, Director, Buffalo Neuroimaging Analysis Center, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, State University of New York, Buffalo, NY
Imaging biomarkers of disease progression in patients with multiple sclerosis

Mario Habek, M.D., PhD, Professor, University Hospital Centre Zagreb, Zagreb, Croatia
COVID - 19 pandemic and multiple sclerosis

Paolo Manganotti, M.D., PhD, Professor, Direttore Clinica Neurologica, Azienda Ospedaliero-Universitaria, Ospedale di Cattinara Trieste, Italy
Peripheral neurological complications in COVID-19 pandemic- our experience

Break for refreshment: 17,00 – 17,15

Nataša Klepac, M.D., PhD, Assistant Professor, University Hospital Centre Zagreb, Zagreb, Croatia
Cognitive training in Covid - 19 pandemic time

Fran Borovečki, M.D., PhD, Professor, University Hospital Centre Zagreb, Zagreb, Croatia
Management of pumps treatment for Parkinson's disease in COVID - 19 pandemic

Vladimira Vuletić, M.D., PhD, Assistant Professor, Clinical Hospital Center Rijeka, Rijeka
Management of deep brain stimulations for movement disorders in COVID - 19 pandemic

Slavica Kovačić, M.D., PhD, Department of Radiology Clinical Hospital Center Rijeka, Rijeka
Management of neuroimaging for movement Disorders and dementia in COVID - 19 pandemic

19,15 – 20,00 h

II. ROUND TABLE DISCUSSION

Chairman: Vladimira Vuletić

ABSTRACTS

Neurological manifestations in patients with COVID - 19

Elena Moro
Grenoble University Hospital Center, Grenoble, France

The infection of SARS-CoV-2 (COVID-19) has been affecting for the first time the human race for one year. Although the most severe symptoms are respiratory and are the most important cause of death, this virus can basically affect all human body. Neurological symptoms are frequent and present in all the stages of the infection, like headache, anosmia, augesia, myalgia and dizziness. However, more severe neurological disorders, like encephalopathy, stroke, encephalitis, GBS and other peripheral nervous system diseases are often evident in the severe forms of COVID-19 that require hospitalization. Some co-morbidities are associated to increase risk of infection, whereas previous cardiovascular disorders have bee associated with stroke in patients with COVID-19. Several hypotheses of mechanisms of central and peripheral nervous system pathophysiology have been made so far, but the isolation of the virus in the brain and CRF has been very rare and in small quantity. Patients with concomitant neurological disorders do not seem to be at higher risk to develop more severe COVID-19. Nevertheless, efforts have to be made to collect most patients with neurological manifestation from COVID-19 to better analyze risk, phenomenology and prognosis. For this, international retrospective and prospective Registries are mandatory.

Key words: COVID-19, neurological manifestations of COVID-19

Neurodegeneration and COVID - 19 pandemic

Nenad Bogdanović[1,2]
[1]Karolinska University Hospital, Stockholm, Sweden
[2]Karolinska Institute, Stockholm, Sweden

Evolving evidence indicates that severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the etiologic agent of coronavirus disease 2019 (COVID-19), can cause neurological complications. Given the global dimension of the current pandemic, it is important to consider the possible long-term impact of COVID-19, potentially including neurodegenerative disorders. Since acute respiratory syndrome is the hallmark feature of severe COVID-19, most initial studies on COVID-19 have focused on its impact on the respiratory system. Previous studies demonstrating that various viruses, including in the wide CoV family , can have effects on the central nervous system thus it is a high possibility that SARS-CoV-2 infection could promote or enhance susceptibility to different forms of CNS changes that may lead to neurodegeneration as a long-term effect. The current knowledge of COVID-19 and its neurotropism is thin since it is not yet clear what is the mechanism of infection; direct or via secondary effects relating to enhanced systemic inflammatory/proinflammatory signaling. Moreover, other viral infections suggest that systemic inflammatory mediators may access the CNS and trigger

damage via impaired BBB function. Aystemic inflammation triggered by SARS-CoV-2 infection may further contribute to neuroinflammatory processes to promote the development of neurodegenerative disease in individuals already at risk. In addition, investigation of post-mortem brain and spinal cord tissue from deceased COVID-19 individuals (where possible) may provide evidence for parenchymal infection. The hypothesis of direct neuroinvasion of COVID-19 is based on extrapolated biological plausibility of CNS involvement where angiotensin-converting enzyme-2 (ACE-2), a potential receptor for SARS-CoV-2 entry plays an important role. ACE-2 is expressed on various brain cells and cerebral parts, i.e., subfornical organ, paraventricular nucleus, nucleus of the tractus solitarius, and rostral ventrolateral medulla, as well as in non-cardiovascular areas such as the motor cortex and nuclei raphe. The resident CNS cells like astrocytes and microglia also express ACE-2, thus highlighting the vulnerability of the nervous system to SARS-CoV-2 infection. The hematogenic pathway is an additional probable route of virus entry into the nervous system that includes the vagus nerve, the olfactory nerve, or the enteric nervous system. Furthermore, a Th17-mediated cytokine storm is seen in COVID-19 cases with higher levels of different cytokines where some of them can cross the blood-brain barrier and activate the brain's immune cells to produce neural cytokines, leading to neuronal dysfunctions, delirium and neurodegeneration as a late long-term effect. Accordingly, the anecdotal descriptions and clinical records of serious deterioration of the clinical picture in patients with Alzheimer dementia, Parkinson disease and Lewy body dementia who survive COVID-19 infection were reported. Whether COVID-19 induces exclusively neurodegenerative forms of dementia or not is unknown and speculative. In patients who develop severe neurological complications, whenever possible, long clinical follow up and investigation of CSF samples for the presence of viral antigen/RNA and inflammatory mediators would be valuable to determine direct CNS infection. Thus, the nervous system's involvement in COVID-19 may be more than the current situation apprehends, therefore referring to the virus as an underestimated pathogen. Clinicians' and researchers' collective expertise may untie the potential of SARS-CoV-2 infection to prevent short-term and long-term CNS damage. After identifying initial neurological damages, careful monitoring of COVID-19 patients in the long term is mandatory.

Key words: COVID-19, neurodegenerative diseases, neurodegeneration

A history lecture: neurologist comparing Spanish flu to Covid - 19

Zvezdan Pirtošek
University Hospital Centre Ljubljana, Ljubljana, Slovenia

The SARS-CoV-2 virus of the ongoing COVID-19 pandemics and the A/H1N1 influenza virus of the 1918–19 pandemics share several common properties, e.g. (i) they both are transmitted via respiratory droplets; (ii) both were considered "novel," as nobody in either era had any immunity to them; (iii) both have similar basic reproductive number (R0), ranging from 2 to 4; (iv) similar patterns of viral shedding from infectious patients; (v) similar latent period; (vi) comparable 'k' dispersion parameter, which shows contribution to total infections from super-spreaders; (vii) comparable case fatality rates; (viii) comparable temporal patterns of outbreak waves (the extraordinarily strong second wave); (ix) in both pandemics, nonpharmaceutical responses like isolation, quarantine, disinfectants and limiting public gatherings were recommended, although then as now, they were applied erratically.

Main differences between the 1918 influenza and the COVID-19 include (i) differences between the biology of SARS-CoV-2 and influenza viruses; (ii) different age patterns for infection and mortality (the most affected groups in the 1918 pandemic were healthy adults between the ages of 20 to 40), (iii) the pre-existing immunity, and conditions; (iv) different age structure for pneumonia & influenza deaths which in 1918–19 comprised three peaks, the famous W shape (younger than 5 years, 20-40 years and older than 65 years); (v) for neurologist's interest, it should be noted that, in contrast to the 1918 influenza pandemic, reports of encephalopathy in COVID-19 have been slow to emerge, and there are so far (still) relatively rare documented reports of parkinsonism, mainly as single case reports. In the talk, updated neurological signs & symptoms will be reviewed for both infections.

Of course, key divergences between the two epidemics are in vastly different medical knowledge and technology, uncomparable possibilities of (for now, symptomatic) management, and in the sociopolitical contexts (although in 1918 the world was much less connected and there was no air travel, people lived in crowded conditions, hygiene was extremely poor and the world was thrown in the turmoil of the First World War).

Fundamental differences between the biology of both viruses and very different medical & technological settings make it hard to chart the future of COVID-19 based on what happened a hundred years ago. Although the influenza vaccine became available 25 years after the outbreak of the 1918 pandemic and at the time, there were no molecular or serologic tests, no effective antiviral therapy, no mechanical ventilation, the pandemic of 1918 ebbed after a final, third wave in the spring of the next year. Unfortunately, this fact does not portend a similar end for COVID-19. However, on an optimistic note, it is amazing to see how quickly and globally scientists are working on developing vaccines against the SARS-CoV-2 virus. The first vaccine safety trials in humans started in March and at the time of writing this Abstract for the Rijeka Forum on Neurodegenerative Diseases, 13 have reached the final stages of testing.

Key words: Spanish flu, covid19, pandemics, differences, similarities.

Current knowledge about the effect of Covid - 19 on Parkinson disease

Maja Trošt[1,2]
[1]University Medical Center Ljubljana, Ljubljana, Slovenia
[2]Faculty of Medicine, University of Ljubljana, Ljubljana, Slovenia

COVID-19 pandemic has major consequences on our society and way of life. Individuals with Parkinson's disease (PD) are particularly vulnerable to experiencing the negative squeals, not only because of changed life style, which causes an increased stress and reduction in physical exercise, but also because of compromised respiratory system that put them at higher risk of COVID-19 pneumonia: rigidity of respiratory muscles, common dyspnea and reduced cough reflex. Since PD affects elderly population the risk factors for a more severe COVD-19 presentation in general population, apply to many of PD patients: age above 50 years, hypertension, cardiovascular and cerebrovascular disease, diabetes and immunosuppression. Furthermore, changes in current daily routine require constant adaptation to new circumstances, which is a cognitive operation that depends on normal dopaminergic functioning.

According to the current literature the prevalence of COVID-19 infection among PD patients seems to be equivalent to that of the general population and PD patients should not be necessarily considered at higher risk for developing COVID-19. However, they might be at higher risk for a worse course and outcome, especially if they are frail, institutionalized, have neoplasm, dementia and a lower frequency of dopamine agonists, as has been shown in a recent study. The mortality rates among COVID-19 infected PD patients vary considerably between studies. The common risk factors for higher mortality are older age, longer disease duration, use of advanced therapies, dementia and hypertension.

The current pandemic brings us unimaginable challenges but also provides us with various opportunities for better understanding and management of PD in the future. One is the opportunity to investigate the hypothesis that viral infections can precipitate neurodegeneration. Another one is the development of settings for telemedicine based communication with our patients that may be more user friendly for patients, then we might have previously thought.

Key words: Parkinson's disease, neurodegeneration, COVID-19, prevalence, risk factors, disease course.

Management of clinical trials on neurodegenerative diseases in COVID - 19 pandemic

Tomislav Babić
Neuroscience Franchise Worldwide Clinical Trials, London, UK

How has your neurodegenerative research fared since the beginning of COVID-19? In the clinical research industry, therapeutic priorities have shifted to focus on the search for treatments and vaccines for the novel coronavirus. And, the emergence of new safety protocols like social distancing have introduced additional complexity to non-COVID studies. Particularly within neurological indications, where in-person contact has traditionally been imperative to assessments, these new safety measures may appear to be insurmountable obstacles to successful completion of an ongoing clinical trial.

We have experienced first-hand the sudden requirement to pivot on a dime. At the outset of the pandemic, we were in the midst of an international, 6,000-patient, Phase III clinical trial addressing a neurodegenerative disease. Immediately, the team had to re-evaluate processes: How much could be done without in-person contact? How many adjustments could the study protocol bear while maintaining data consistency? Could the trial be adapted midstream without compromising scientific and safety standards? We addressed these questions and came up with contingencies that enabled the clinical trial to carry on. With sites in 14 different countries and spread of COVID-19 impacting the sites' ability to carry out protocols and the patients' ability and willingness to participate, the study was adapted according to local conditions. Treatment administration methods were modified to limit the need for travel. In close collaboration with the sponsor, the team worked with institutional review boards and ethics committees to develop new guidance for trial sites. Electronic solutions were introduced to enable increased remote assessments. Third-party vendors were engaged to carry out home visits. Adaptations were made to suit local needs, and the clinical trial was able to maintain continuity on a global scale. The industry is still in flux due to the uncertain-

ties around COVID-19. Now more than ever, ongoing clinical trials demand the agility of a team that understands the dynamics of trial design and is capable of managing unexpected upsets and landing on its feet.

Maintaining continuity of any study during this period of unpredictability demands a deep understanding of clinical trial dynamics, an ability to deftly deploy new methodologies, and a capacity to engage proactively with vendors and regulatory agencies.

Key words: Covid-19 pandemic; clinical trials, neurodegenerative disorders, study management

Imaging biomarkers of disease progression in multiple sclerosis

Robert Živadinov [1,2]

[1]Buffalo Neuroimaging Analysis Center, Department of Neurology, University at Buffalo, State University of New York, Buffalo, NY, USA

[2]Center for Biomedical Imaging at the Clinical Translational Science Institute, University at Buffalo, State University of New York, Buffalo, NY, USA

Background: Conventional imaging measures remain a key clinical tool for the diagnosis multiple sclerosis (MS) and monitoring of patients. However, most measures used in the clinic show unsatisfactory performance in predicting disease progression and conversion to progressive form of MS.

Methods: Sophisticated imaging techniques have facilitated the identification of imaging biomarkers associated with disease progression, such as global and regional brain volume measures, and with conversion to secondary-progressive MS, such as leptomeningeal contrast enhancement, atrophied lesion volume, slowly expanding lesions and microglia activation using novel MRI contrast agents and radiotracer-based imaging techniques. The relevance of emerging imaging approaches partially overcoming intrinsic limitations of traditional techniques will be discussed.

Expert opinion: Imaging biomarkers capable of detecting tissue damage early on in the disease, with the potential to be applied in multicenter trials and at an individual level in clinical settings, are strongly needed. Several measures have been proposed that exploit advanced imaging acquisitions and/or incorporate sophisticated post-processing can quantify irreversible tissue damage. The progressively wider use of high-strength field MRI and the development of more advanced imaging techniques will help capture the missing pieces of the MS puzzle. The ability to more reliably identify those at risk for disability progression will allow for earlier intervention with the aim to favorably alter the disease course.

Key words: Multiple sclerosis, disease progression, imaging biomarkers, MRI

COVID - 19 pandemic and multiple sclerosis

Mario Habek[1,2]
[1]University Hospital Center Zagreb, Zagreb, Croatia
[2]University of Zagreb, School of Medicine, Zagreb, Croatia

Multiple disease-modifying therapies (DMT) have been approved for the treatment of relapsing-remitting form of MS (RRMS). There are two approaches to treating MS. One approach is the continuous application of therapy (so-called maintenance therapy), which can then be optimized depending on the course of the disease. Maintenance therapy includes interferon beta, glatiramer acetate, teriflunomide, dimethyl fumarate, natalizumab, S1P receptor modulators (fingolimod, siponimod), and B-cell depletion therapy (rituximab, ocrelizumab). Another recent approach in the treatment of MS is immunoreconstitutional. Immunoreconstitutional therapy includes alemtuzumab and cladribine. It can be generally said that, with the exception of beta-interferon and glatiramer acetate, all other DMTs are associated with varying degrees of the risk of infection. It is this increased risk of infections in MS with various DMTs that has become very relevant due to the COVID-19 pandemic. It should be emphasized that most of the published cohort studies so far suggest that age, level of disability measured with EDSS, and obesity are independent risk factors for severe COVID-19 in people with MS. Although most reports suggest that DMTs should not necessarily expose people to severe SARS-CoV-2-related issues, recently presented data has shown that compared with dimethyl fumarate, rituximab was associated with significantly higher risk of hospitalization, ICU admission, and ventilation. Weaker but similar associations were seen for ocrelizumab, although these did not always reach statistical significance. It is clear that any decision to initiate DMTs during the COVID-19 pandemic will need to be carefully made and will depend on the state of the COVID-19 pandemic, not only in the specific country but also in the specific area where the person lives and receives therapy. In doing so, care should be taken to take a proactive approach to MS treatment, focus on the person with MS at all stages of the disease in order to minimize the effects of the disease and maximize quality of life.

Key words: multiple sclerosis, disease modifying therapy, infections, COVID-19

Cognitive training in Covid - 19 pandemic time

Nataša Klepac[1,2]
[1]Clinical University Hospital Zagreb, Zagreb, Croatia
[2]Faculty of Medicine, University of Zagreb, Zagreb, Croatia

Increasing age is associated with a natural decline in cognitive function and is also the greatest risk factor for dementia. Cognitive decline and dementia are significant threats to independence and quality of life in older adults. Therefore, identifying interventions that help to maintain cognitive function in older adults or to reduce the risk of dementia is a research priority. It is known that being mentally active throughout life is associated with lower risk of dementia. Therefore, it has been suggested that encouraging mental activity might be an effective way of maintaining good cognitive function as people age. Cognitive training comprises a set of standardized tasks intended to 'exercise the brain' in various ways. Cognitive training, especially computerized ver-

sion to improve cognitive functioning is of enormous interest and has been applied in a broad range of populations with goals of improving cognition and functioning in everyday activities. The core of computerized cognitive training is software designed to engage and practice cognitive functions. Some programs are explicitly aimed at a single cognitive domain, while others target an array of domains. Some computerized cognitive training interventions also include interactions with trained facilitators. One role of a facilitator is to provide coaching to help improve training performance. Other add-ons to computerized cognitive training include training of metacognitive strategies and strategic monitoring. Data from large RCTs and meta-analyses show that certain cognitive training regimens can improve cognitive and functional abilities in older adults. To be effective, cognitive training programs must be intensive and prolonged over time; however, the current COVID-19 containment measures are hampering their implementation. Remote communication technologies are increasingly regarded as potential effective options to support health care interventions, including cognitive training. Definitive data on the utility of cognitive tools during the pandemic awaits the results of ongoing clinical trials, but there is accumulating preliminary evidence. A recent survey of elderly mild cognitive impairment subjects during the pandemic demonstrated potential for cognitive stimulation via assistive technology but its application was associated with many obstacles. High cost of the hardware and software required for these techniques limits their wide application outside the research setting. Further research on how allow application of this sophisticated techniques outside the research setting and how to translate it into the ordinary clinical setting is needed.

Key words: Cognition, Computerized cognitive training, Mild cognitive impairment,

Management of deep brain stimulations for movement disorders in COVID - 19 pandemic

Vladimira Vuletić[1,2]
[1]University Hospital Center Rijeka, Rijeka, Croatia
[2]University of Rijeka, Faculty of Medicine, Rijeka, Croatia

Deep brain stimulation (DBS) is a well-established, safe and effective treatment for the management of patients with advanced Parkinson's disease and other movement disorders. Patients with DBS require often visiting DBS centers and life-long management of the medical device as well as medications. Such management is depending on geography, socioeconomic factors, and support systems. The COVID-19 pandemic has changed the way we practice
neurology, especially movement disorders and, nevertheless, our management of patients with deep brain stimulation implanted for movement disorders worldwide. The global lockdown has forced movement disorders patients (Parkinson's disease, essential tremor, dystonia) to stay at home or they became infected by virous or became worse due to interruption of therapy due to neurostimulator battery reaching end of life, device malfunction or infection. They can develop due to COVID 19 infections other movement disorders symptoms like myoclonus or confusion and encephalic symptoms.
In first wave of COVID-19 pandemic, the most medical centers were postponing elective procedures and prevent spread of COVID-19 what presented unique challenges

for management of DBS patients and transitioning to predominantly telemedicine or remotely by smartphone consultations for outpatient care. Urgent intervention to maintain or restore stimulation were required mostly for patients with Parkinson's disease who could develop a rare but potentially life-threatening complication known as DBS-withdrawal syndrome and patients with generalized dystonia with potential developing status dystonicus. Also, DBS system infection required urgent, and rarely emergent surgery (like lead fractures, electrical malfunction). Elective interventions including new implantations and initial programming were postponed in first wave but not so much in the second and we will observe the consequences in the future. Since public health guidelines and bad capacity vary across countries and rapidly change, each medical and DBS center needed to develop quickly strategies and clear recommendations how to care for DBS patients.

In this lecture an overview of challenging experiences on management of DBS implanted patients for movement disorders in COVID-19 pandemic time will be presented.

Key words: Deep brain stimulation, movement disorders, Covid-19 pandemic

Management of neuroimaging for movement disorders and dementia in COVID - 19 pandemic

Slavica Kovačić
University Hospital Center Rijeka, Rijeka, Croatia

The diagnosis of neurodegenerative diseases, although a frequent, almost daily indication in the neuroradiological imaging of the patients, remains a challenge. Unlike other neuroradiological conditions, when the diagnosis taking into account the clinical picture and morphological changes in the brain is established with great reliability, in neurodegenerative conditions the role of imaging is to guide the clinician to or from the diagnosis, not to make a firm diagnosis.

A good clinical history is paramount if the importance of subtle findings is to be appreciated while not over emphasising non-specific features.The analysis involves structural and volumetric changes primarily by magnetic resonance maging (MRI) but it is possible to use CT examination.

There are several systems for evaluation and assessment. Scoring systems and measurements are useful to know even if only as guides on which features have been found useful and reliable. In addition to systematically going through each scan, it is worth specifically looking for some signs, which will ensure as not miss a diagnosis which will in retrospect be obvious.

Recently COVID-19 has dramatically altered practice patterns around the world. The mechanism of action for SARS-CoV-2 neurological invasion is not yet specified, perhaps the leading current theory is direct seeding and trans-synaptic infiltration via the olfactory nerve or perineuronal cells with subsequent spreading to medial brain structures including the medial temporal lobe, basal ganglia, thalami, and midbrain.These findings would be consistent with the limited case report data available to date.

The potential long-term neurodegenerative and psychological effects of COVID-19 have yet to be determined.

Key words: neurodegenerative diseases, magnetic resonance maging (MRI), scoring systems, COVID-19