

# Neurological Complications of COVID 19

K. Jeffrey Miller, DC, FIANM (us), MBA

[jeffmillerpc87@gmail.com](mailto:jeffmillerpc87@gmail.com)

# Neurological Complications of COVID

- **Findings:** Among 236379 patients diagnosed with COVID-19, the estimated incidence of a neurological or psychiatric diagnosis in the following 6 months was 33.62%, with 12.84% receiving their first such diagnosis.
- *6-month neurological and psychiatric outcomes in 236379 survivors of COVID 19: retrospective cohort study using electronic health records*
  - Maxime Taquet, John R Geddes, Masud Husain, Sierra Luciano, Paul J Harrison

The Lancet

# Our Current Level of Knowledge

- The amount of information already available is impressive. Case reports and studies are being generated almost daily.
- There are drawbacks though.
  - COVID has only been present for just over 18 months. Everything available is based on short term results. Long term studies and accurate prognosis will take time, years.
  - We only have data on acute patients.
  - Most studies to date are hospital based. Tracking the progress of individuals who were never admitted for care is not being done consistently and is harder to accomplish.
  - The numbers of deaths often exceed the number of autopsies facilities are capable of handling

# Neurological Signs and Symptoms and Complications

# Common Neurological S/S-Complications

## Central Nervous System

- Dizziness (1 of 2 most common)
- Headache (1 of 2 most common)
- Acute Cardiovascular Disease
- Impaired Consciousness
- Transverse Myelitis
- Acute Hemorrhagic Necrotizing Encephalopathy
- Encephalopathy
- Encephalitis
- Epilepsy
- Ataxia

## Peripheral Nervous System

- Hypogeusia
- Hyposmia
- Neuralgia
- Guillain Barre' Syndrome
- Skeletal Muscle Injury
- Adapted from: *Neurological manifestations and complications of COVID 19: A literature review*, Ahmad and Rathore, Journal of Clinical Neuroscience, Elsevier, 2020

# Mechanisms

# Mechanisms

- COVID 19 is primarily a respiratory virus. It attaches to angiotensin converting enzymes-2 receptors (ACE 2) on the respiratory epithelium cells.
- However there are ACE 2 receptors on Glial cells in the brain and spinal neurons.
- Entry to the CNS is considered to be through the nose, olfactory epithelium/cribriform plate/blood brain barrier.
- Entry to the PNS is postulated to be through peripheral nerve terminals (synapses)

# Mechanisms

- Hypoxic Brain Injury
  - Respiratory dysfunction and distress lead to systemic hypoxia thus hypoxia of the brain. The result is swelling and brain edema (encephalitis)
- Immune Mediated Injury
  - Immune reaction results in toxic chemicals that cause vascular leakage which results further in end organ damage.



# Rates of Occurrence

# Rates of Occurrence

- Sample Study
- Complication rates in more severe cases
  - Cost common CNS symptoms
    - Dizziness 16.8 %
    - Headache 13.1 %

*Neurologic manifestations of hospitalized patients with Coronavirus disease 2019 in Wuhan, China, Mao-Jin-Wang, HU, Chen-He-Chong-Hong-Zhou-wang-Miao-Li-Hu, JAMA Neuro 2020*

# Rates of Occurrence

- Another Sample Study

- 58 patients average age 63
- 49/58 had neurological complications

- Agitation 69%
- Confusion 65%
- Corticospinal tract dysfunction 67% (Motor tract/motor function in the limbs)
- Dysexecutive syndrome (Frontal lobe damage: emotional, motivational, behavioral and cognitive dysfunctions)

Adapted from:

*Neurological manifestations and complications of COVID 19: A literature review*, Ahmad and Rathore, Journal of Clinical Neuroscience, Elsevier, 2020

*Neurologic Features in Severe SAR-CoV-2 Infection*, Helms, Kremer-Merdi-Jehl-Schenck-Kummerlen, N Eng J Med, 2020

# Rates of Occurrence and Mechanisms

- *It can be said here that the mechanisms and rates of occurrence discussed could all be qualified with the statement, "A far as we know so far"*

# Neurological Signs and Symptoms and Complications

# Headache and Dizziness

- Headache

- 94% of Chiropractic Cases involve
  - Back pain
  - Neck pain
  - Headache
- Headache is one of the most common S/S of stroke
- It is estimated that only 18% of headaches are cervicogenic

- Dizziness

- Very common complaint complaints in chiropractic practice
- One of the 5Ds and 3 Ns
  - Diplopia, dizziness, drop attacks, dysarthria, dysphasia
  - Ataxia
  - Nausea, numbness, nystagmus
- Headache and dizziness are more symptoms than pathologies

# Skeletal Muscle Damage

- The reason for severe muscle aches and pains ?
  - We are not sure if this is due to direct infection of the muscle or due to immune response.
- High levels of muscle and liver enzymes have been associated with this complication

# Dysfunction of Smell and Taste

- In the bullet system associated with E & M coding, CNs 1 and 10 are not assigned bullets or counted in the examination process.

The reasons...

- The most common dysfunctions associated with CN 1 are due to common, colds, flus, allergies and loss of smell with aging
  - An isolated lesion of CN 10 is rare
- Now...testing these nerves is of more importance



# Ataxia

- Uncoordinated gait such as seen in cerebellar problems
  - Obvious if observed
    - Slow shuffle and wide stance
  - Coordination tests are applicable

# Encephalitis and Meningitis

## Encephalitis

- Inflammation of the brain
- -Suspected to be from systemic inflammation
  - Not likely to see this complication in a chiropractic practice, acutely sick
  - Altered consciousness and related S/S
  - Demyelination similar to MS can occur
  - MR and spinal fluid analysis to diagnose

## Meningitis

- Inflammation of the meninges
  - Not likely to see this complication in a chiropractic practice, acutely sick
  - If you did some of the physical tests for meningitis that you would likely never see positive, may be positive
  - Meningitis is very contagious, here COVID-19 is the contagion
  - MR and spinal fluid analysis to diagnose
  - Personal example

# Impaired Consciousness

- This is more a symptom than a condition.
  - It can be an alteration without a complete loss of consciousness (coma)
  - Usually accompanied by cognitive defects, confusion
  - This patient isn't likely to seek chiropractic care
  - Seen in the complications involving the CNS

# Acute Cerebrovascular Complications

- Primary concern – stroke
  - Higher frequency in the elderly and the more seriously ill
  - Some studies say stroke of the most common cerebrovascular complication
  - It may be the first sign of COVID 19. Thus, this may be the initial reason for hospital admission despite not being the underlying problem
  - The infection may trigger inflammation that leads thrombosis, intracerebral hemorrhage, or subarachnoid hemorrhage

# Acute Cerebrovascular Complications

- Despite COVID adding to average stroke numbers in the US and other countries, admissions for stroke are down.
- This is attributed to the following possibilities
  - Isolation where stroke was not recognized and COVID became the major concern
  - Patients with milder stroke s/s do not seek care for fear of catching COVID in the hospital
- This situation adds to the conspiracy that claims COVID admissions are up and admissions for other conditions are down, because doctors and hospitals receive more funding if the reason for admission is COVID

# Acute Cerebrovascular Complications

- The same emergency situations are in play here as those for any stroke
- A personal thought here...

# Acute Cerebrovascular Complications

- This popped into my head while reading about COVID and stroke...not backed by studies, don't know if this has happened yet...
- Chiropractors are sometimes accused of causing a stroke that onset days, weeks or months after cervical adjustment. With this concern in mind consider, "What if a patient is adjusted, develops COVID a few days later and has a stroke?"
- Neurological complications are often delayed with COVID (as much as 6 month). "What if a patient recovers from COVID, tests negative, seeks chiropractic care, then has a stroke or neurological complications related to COVID?"

# Acute Cerebrovascular Complications

- What would the defense process look like here?
  - Is the injury due to vertebral artery or one of the vascular problems associated with COVID, thrombosis, subarachnoid hemorrhage, intracerebral hemorrhage etc.
  - Can intubation/ventilation contribute to a stroke?
    - Duroi, I., Van Durme, F., Bruyns, T., Louage, S., & Heyse, A. (2020). Fatal Ischaemic Stroke During COVID-19 and Acute Lung Injury. *European journal of case reports in internal medicine*, 7(6), 001732. [https://doi.org/10.12890/2020\\_001732](https://doi.org/10.12890/2020_001732)



# Oculomotor Nerve Palsy

- The most common **cause** of isolated **oculomotor nerve palsy** is microvascular infarction which is **caused** as a result of diseases, such as diabetes mellitus, hypertension, atherosclerosis, and collagen vascular disease.
- COVID is now included in this list
  - Injury to the third cranial nerve controlling most of the muscles that move the eye
  - The injury can affect the entire nerve or just a branch of the nerve
  - Strabismus (diverging), ptosis, abnormal or lack of eye movement, **diplopia**
  - The pupil is spared
  - DDX – stroke, Horner's syndrome

# Guillain-Barre' Syndrome

- A **rare** autoimmune condition that results from immune damage to the peripheral nervous system and later the autonomic nervous system
- It damages the myelin covering of peripheral nerves
- Fast onset – hours, days, weeks
- Starts distally in the hands and feet and moves proximal, typically bilateral
- Motor weakness can effect respiratory muscles and lead to the need for ventilation
- It is curable but there is a 7% death rate

# Other More Rare Complications

- Miller Fisher Syndrome
  - A form of Guillain-Barre' syndrome
- Polyneuritis cranialis
- Seizures

# Actions

# Screening for COVID 19 and Neurological Complications of COVID 19

- Fever (temperature over 100.4 F)
- Cough
- Sore throat
- Shortness of breath
- Chills
- Headache
- Unexplained muscle aches
- Loss of taste and smell
- Gastrointestinal symptoms
- Close contact with anyone with symptoms, quarantined or diagnosed with COVID 19
- Travel to a “hot spot” area

# Screening for COVID 19 and Neurological Complications of COVID 19

- **New questions:**
  - It took a little while initially to encounter patients who had recovered from COVID 19. Now encounters are common. So, we have to ask if the patient has experienced COVID 19.
    - If yes, we have to ask about residual sign and symptoms
- **We must also ask:**
  - Have you been vaccinated?
  - Are you using PPE and when

# Screening for COVID 19 and Neurological Complications of COVID 19

- In addition to temperature, the remaining vital signs are also important.
  - Respiratory rate
  - O<sub>2</sub> Level-pulse
  - Blood pressure
  - Pulse
  - Height
  - Weight

# Mental Status & Cranial Nerve Examination

Practical Assessment of the Chiropractic Patient

K. Jeffrey Miller, DC, FIANM(us), MBA



# Observation and The Conversation

K. Jeffrey Miller, DC, FIANM(us), MBA

# Indirect Assessment of Mental Status and the Cranial Nerves

- Orientation
  - Person: the patient writes and signs his own name, demographic information
  - Place: the patient showed up at the correct office, answers health questions
  - Time: the patient dates the forms correctly, knows the date of onset for his condition, knows past and family history

# Indirect Assessment

- Short Term Memory
  - The patient knows the date of onset for his condition, the mechanism and the details of the HPI
- Long Term Memory
  - The patient knows past and family history
- Spelling
  - The patient completed paperwork (there are exceptions)
- The use of numbers
  - The patient knows dates and phone numbers

# Indirect Assessment

- CN 2
  - The patient was able to see: the paperwork, read office signs, where they are going
- CN 3, 4 & 6
  - Eye movements: move together, all ranges
- CN 5
  - Facial sensation: if there is a loss of facial sensation the patient will note it while washing their face, brushing their teeth, shaving, applying make-up
  - Muscles of Mastication: the patient will notice problems chewing
  - They will report these abnormalities

# Indirect Assessment

- CN 7
  - Facial expressions: can the patient smile, frown, blink, raise the brow, annunciate
- CN 8
  - Could the patient hear you, answer questions appropriately
- CN 9 & 10
  - Phonation: voice changes
  - Swallowing-difficulties reported
  - A lesion of CN 10 is rare

# Indirect Assessment

- CN 11
  - Can the patient shrug his shoulders
  - Can the patient rotate his head
- CN12
  - Articulation of speech

# Exceptions

- There are times when the patient is too young to be the source of information and/or cannot complete paperwork etc. Parents or guardians must provide information and complete paperwork.
- There are also times when a patient's degree of literacy may interfere with the assessment of mental status through completion of paperwork.
- An altered mental state is known/documented and consent to care is solely determined by a guardian.
- The advent and continuance of patient generated information in EMR systems, i.e. kiosks, iPads...

# Mental Status Note

- The patient is oriented times three. Demographic and history information provided by the patient included the patient's full name and showed the patient is aware of being in a healthcare facility. Signatures and dates were provided accurately. Spelling and the use of language are within normal limits and appropriate.



# Cranial Nerve Note

- The first cranial nerve was not tested. The patient was able to see and complete paperwork. Eye movements during the history and examination process were within normal limits. No reports were made of abnormal sensations or numbness of the face. Problems chewing are not reported. TMJ and temporal pain are not reported. Facial expressions are within normal limits. The patient responded to questions appropriately and did not ask for questions or information to be repeated. Difficulties with swallowing and voice changes are not reported or observed. Shoulder and head movements are within normal limits. Movements of the tongue and articulation of speech are within normal limits.

# Two Major Points

- Look at and listen to the patient.
- The observations are important aspects of diagnosis and clinical decision making and they become intuitive.
- It must be remembered that these observations can and should be documented.

Updated notes can be downloaded from the landing page of

**EXAMDOC.COM**

# Mental Status

Neurological Testing

# Why is Mental Status Important?

- Informed Consent
- Mood
- Emotional State
- Pain Identification
- Pain behavior
- Examination findings/coding
  - Bullets

# Mental Status

- Orientation
  - Person
  - Place
  - Time
- Mood
  - Pleasant, Agitated, Corporative, Nervous, Friendly etc.

# Mental Status

- General Information
- Spelling
  - World-dlrow
- Numbers
  - 100 back by 3's
  - Seven Digit Number (office #)

# Mental Status

- Orientation
  - Person
    - Who are you?
    - Who am I?
  - Place
    - Where are we?
  - Time
    - What is the year, season, month, day?



# Mental Status

- General Information
  - Current Event
    - News items
    - Popular songs
    - Current movies

# Mental Status

- Spelling
  - Spell the word “world” forward and backward
  - Why backward

# Mental Status

- Numbers
  - Use especially if the patient cannot read
  - People who cannot read are often able to use numbers
    - From 100 backward by 3's
    - Repeat a 7 digit number (office #)
      - Don't use 867-5309

# Cranial Nerves

Neurological Testing

# Cranial Nerves

- CN 1 – Olfactory Nerve
  - Sensory only-sense of smell
  - Usually not tested routinely
  - Why?

# Cranial Nerves

- CN 2 – Optic Nerve
  - Sensory only-Sense of Sight
  - Multiple Possible
    - Eye Charts
    - Light Reflexes
    - Peripheral Vision
    - Ophthalmoscope\*                      \*Not Included Here

# Optic Nerve

- Rosenbaum Chart
  - Used from 14 inches
  - For Refractive Problems
  - Near Vision
- #Snellen – Far Vision





# Optic Nerve

## Peripheral Vision



# Optic Nerve

Direct Pupillary Light Reflex

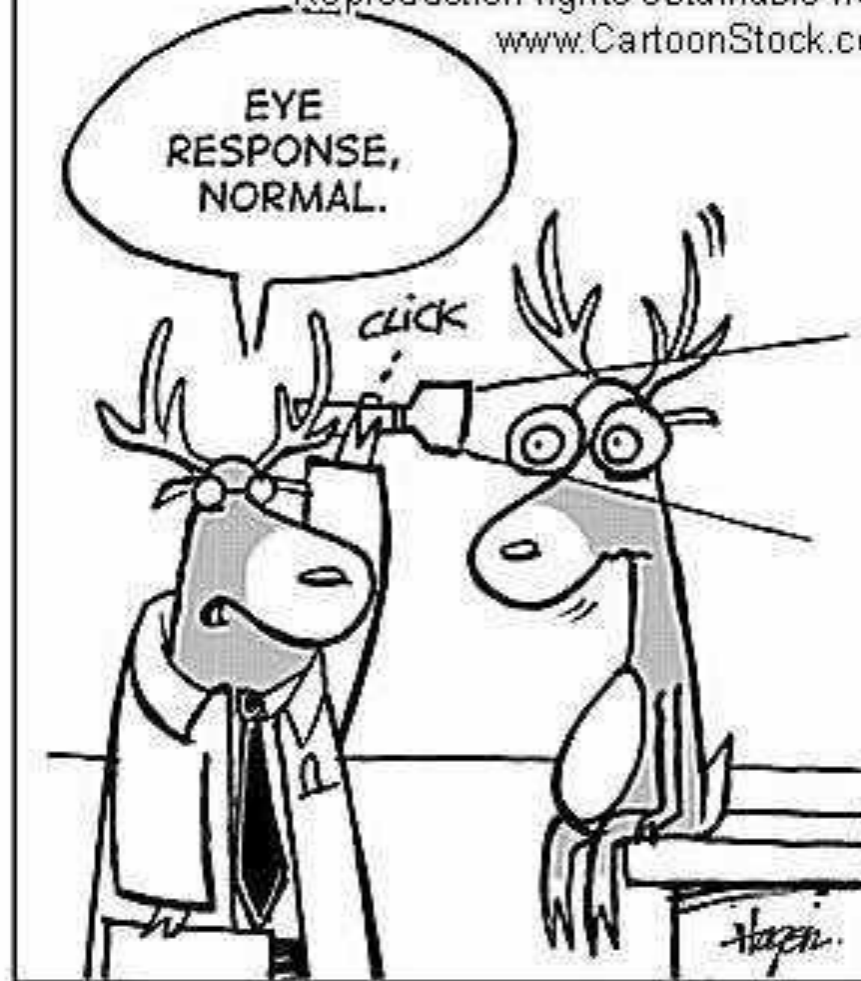


Indirect Pupillary Light Reflex



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DEER PHYSICALS

# Cranial Nerves

- CN 3 – Oculomotor Nerve
  - Motor only-eye movements, pupil reactions and blinking
  - Tests
    - Cardinal Planes of Gaze
    - Papillary Light Reflexes
    - Ptosis

# Cranial Nerves

- CN 4 & 6 - Trochlear & Abducens Nerves
  - Motor only-eye movements
  - Tests
    - Cardinal Planes of Gaze

# Oculomotor, Trochlear and Abducens Nerves

- Cardinal Planes of Gaze
  - Patterns
    - The letter H
    - Circle



# Cranial Nerves

- CN 5 - Trigeminal Nerve
  - Motor and Sensory
  - Tests
    - Motor
      - Muscles of mastication
    - Sensory
      - Facial sensation
    - Motor/Sensory
      - Jaw Jerk Reflex

# Trigeminal Nerve

- Muscles of mastication



# Trigeminal Nerve

- Facial Sensation
- Toothpicks
- Tissue
- Many Daily Activities Involve Facial Sensation
- Maxillary is primary
  - Involved 94% of pathologies





# Cranial Nerves

- CN 7 – Facial Nerve
  - Motor and sensory-muscles of facial expression and taste
  - Tests
    - Facial expressions
      - Smile (show teeth), raise eye brows
    - Taste (Shared with CNs9-10)

# Facial Nerve

Smile



Raising the brow



# Cranial Nerves

- CN 8 - Acoustic Nerve
  - Sensory Only-hearing and balance
  - Tests
    - Watch/Finger Rubbing
    - Forced whisper at no less than five feet
    - Webber/Rinne
    - Hum Test
    - Audiometer

# Acoustic Nerve

- Finger Rubbing



# Acoustic Nerve

- Webber
  - Patient humming is the same with the exception of the method of vibrating the head
    - Tuning fork
    - Voice box



# Cranial Nerves

- CN 9 & 10 – Glossopharyngeal & Vagus Nerves
  - Motor and Sensory-muscles of the pharynx and taste
  - Tests
    - Motor
      - Gag reflex
      - Swallowing
    - Sensory
      - Taste (shared with CN 7)

# Glossopharyngeal & Vagus Nerves

- Gag Reflex
  - Touch the uvula/soft palate



# Glossopharyngeal & Vagus Nerves

- Swallowing Test
  - History of Dysphagia
  - Osteophytes or DISH





# Cranial Nerves

- CN 11 - Spinal Accessory Nerve
  - Motor only-shoulder and neck muscles
    - Trapezius - shoulder shrugging
    - SCM – head rotation
  - Tests
    - Trapezius and SCM movement and strength

# Spinal Accessory Nerve

Trapezius Testing



SCM Testing

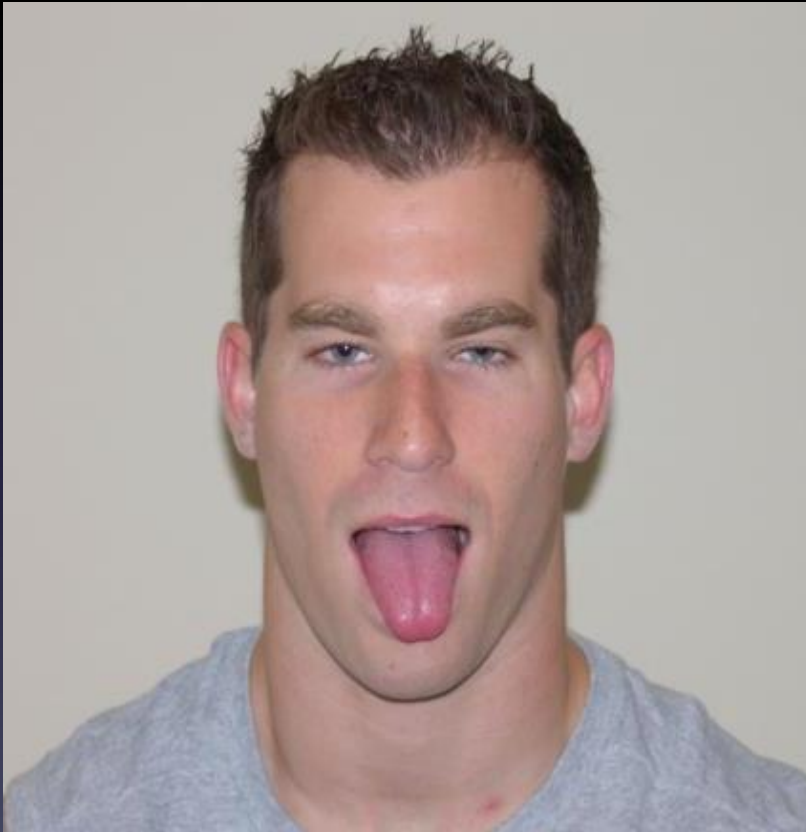


# Cranial Nerves

- CN 12 - Hypoglossal Nerve
- Motor only-Tongue movements
  - Tests
    - Tongue protrusion (Tongue points to pathological side)
    - Articulation of Speech

# Hypoglossal Nerve

**Tongue Protrusion Normal**



**Abnormal**

