The Intersection between Parkinson's Disease and Japanese Encephalitis Virus

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Background:

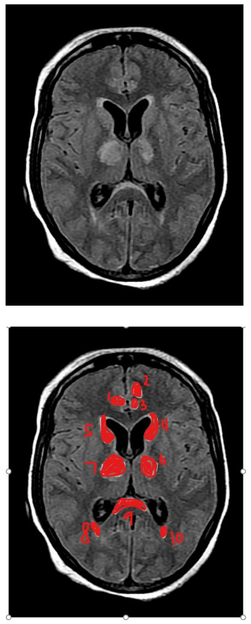
Japanese encephalitis B virus (JEV) is the leading cause of vaccine-preventable encephalitis in Asia and the western Pacific, and Parkinson's Disease (PD) is the fastest growing neurodegenerative disease in the world. Despite primarily impacting two different age groups(JEV mostly harms children and PD mostly adults and the elderly), both diseases are characterized by damages in the substantia nigra (SN) region of the brain, and cause similar symptoms in patients such as loss of motor function and brain inflammation. This study anatomically compares the brain damages caused by JEV and PD using MRI images of JEV and PD patients. The ultimate goal of this poster is to raise awareness about the intersection between Parkinson's Disease and other neurological diseases.

Methods:

- This study used midbrain FLAIR and T2 MRI images of JEV, PD, and healthy patients, gathered from Radiopaedia, a radiology database, and MRI patient data from the Affect and Cognition Lab.
- The ages of patients compared ranged from 20 to 80 years old. This due to the fact that JEV is most prevalent among children, who are extremely vulnerable to viral infections, while PD is more prevalent among older individuals, who tend to develop vulnerabilities to neurodegeneration with age.
- FLAIR, or Fluid-Attenuated Inversion Recovery, is a special MRI imaging technique that is used to reveal lesions in the brain that are in close proximity to cerebrospinal fluid (CSF).
  - FLAIR can be performed rapidly and has improved MRI diagnosis of brain disorders, and can be a key medical tool for fast, reliable diagnoses of diseases like JEV.
- MRI brain images of male and female JEV patients were matched with comparable images from male and female PD and healthy patients.
  - Lesions and hyper intensities in these MRI brain images, which represent identifiable areas of brain damage due to disease or injury, were identified following a well-published diagnoses protocol from 2017.
- Using ImageJ, a simple Java image processing program, these features were measured for area and scaled based on the pixel size of the MRI image.
  - The area of each lesion or hyper intensity relative to the whole brain was recorded as a percentage.
  - The average area of a lesion was also calculated.

Results:

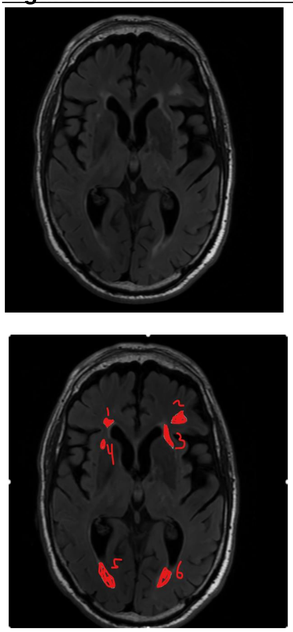
Figure 1: 25 Year-Old Male with JEV



Lesion	Area of the brain
1	0.225%
2	0.196%
3	0.076%
4	0.344%
5	0.385%
6	0.427%
7	0.882%
8	0.127%
9	0.307%
10	0.088%

Average area of a lesion: 0.306%

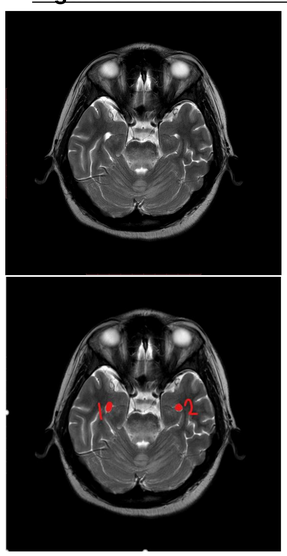
Figure 2: 80-Year Old Male with PD Stage 3



Lesion	Area of the brain
1	0.128%
2	0.155%
3	0.256%
4	0.057%
5	0.344%
6	0.271%

Average area of a lesion: 0.202%

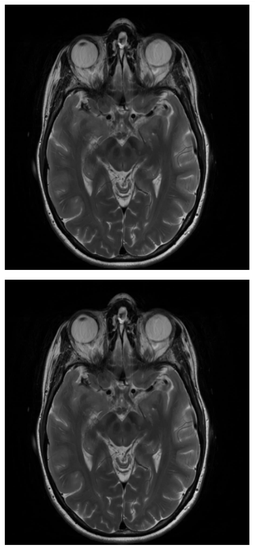
Figure 3: 20 Year-old Female with JEV



Lesion	Area of the brain
1	0.167%
2	0.066%

Average area of a lesion: 0.117%

Figure 4: 50-year old Female with Family History of PD



Takeaways from Results

- More lesions were found in the male JEV patient's FLAIR scan(Figure 1) compared to the PD patient's(Figure 2).
  - The relative size of the lesions in the JEV patient were also significantly larger on average.
  - Lesions were located in similar areas, except in one central area in the image where the JEV patient had large lesions while the PD patient did not.
- Evidence that JEV has causes more acute, widespread symptoms and impacts in the brain compared to PD that can be detected in MRI scans.
- A couple lesions were found in the T2 midbrain of the 20 year-old female JEV patient(Figure 3).
  - No lesions were found in a comparable midbrain scan of a healthy patient(Figure 4).
- The presence of comparable hyper intensities between JEV and PD patients provide evidence of possible links between the diseases.

Conclusions:

- There is evidence of larger average lesions in the brains of JEV patients around the midbrain compared to those of older PD patients.
  - JEV is known to be a far more immediate, acute disease compared to PD.
  - The large lesions in the JEV patient's brain can indicate evidence of encephalitis, or brain inflammation, a common symptom of JEV.
  - In PD patients, physical brain damages tend to vary with multiple factors including age and severity of illness.
- The areas in which lesions localized also evidently overlapped in some areas.
  - Looking at the male JEV and PD patients, both had multiple lesions in similar areas, such as around the frontal and occipital horns of the lateral ventricle.
  - Indicates that both diseases impact similar areas in the brain.

Translational Impact:

Researchers are currently exploring if JEV can trigger idiopathic PD, or PD without a known cause. The threat of these two diseases acting at once on the same group of people is a legitimate concern. Researchers are additionally concerned over the recent spread of JEV to Australia, fearing that other nations like the USA could face larger outbreaks next. Considering treatment methods, doctors should study whether existing PD treatments such as drugs or exercise therapy can be cross applied to neurological diseases like JEV. This can produce immediate benefits for JEV-impacted nations like Japan, or India by introducing novel treatment methods. This research also demonstrates how MRI technology can be incredibly useful to JEV-impacted communities as it can provide a fast, reliable diagnosis tool for patients. The relationship between PD and JEV should also stress the importance of additional research on the possible intersections between PD and other neurological diseases.

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