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Development and Validation of a novel image software for automatic semiquantitative analysis of Tc-99m Trodat-1 SPECT in patients with suspicious Parkinson's Disease- Chun-Che Hung - Chang Gung University

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Introduction:

Parkinson disease (PD), parkinsonian syndromes (PS) and essential tremor (ET) are different types of movement disorders which share some symptoms resulting in a difficulty of certain diagnosis. Parkinson's disease is a brain disorder that leads to shaking, stiffness, and difficulty with walking, balance, and coordination. Parkinson's symptoms usually begin gradually and get worse over time. As the disease progresses, people may have difficulty walking and talking. No cure for PD is known; treatment aims to reduce the effects of the symptoms. Initial treatment is typically with the medications levodopa (L-DOPA), MAO-B inhibitors, or dopamine agonists. As the disease progresses, these medications become less effective, while at the same time producing a side effect marked by involuntary muscle movements. At that time, medications may be used in combination and doses may be increased. Diet and certain forms of rehabilitation have shown some effectiveness at improving symptoms. Surgery to place microelectrodes for deep brain stimulation has been used to reduce motor symptoms in severe cases where drugs are ineffective. Parkinson's disease occurs when nerve cells, or neurons, in an area of the brain that controls movement become impaired and/or die. Normally, these neurons produce an important brain chemical known as dopamine. When the neurons die or become impaired, they produce less dopamine, which causes the movement problems of Parkinson's. Scientists still do not know what causes cells that produce dopamine to die.People with Parkinson's also lose the nerve endings that produce norepinephrine, the main chemical messenger of the sympathetic nervous system, which controls many functions of the body, such as heart rate and blood pressure. The loss of norepinephrine might help explain some of the non-movement features of Parkinson's, such as fatigue, irregular blood pressure, decreased movement of food through the digestive tract, and sudden drop in blood pressure when a person stands up from a sitting or lying-down position.Many brain cells of people with Parkinson's contain Lewy bodies, unusual clumps of the protein alpha-synuclein. Scientists are trying to better understand the normal and abnormal functions of alpha-synuclein and its relationship to genetic mutations that impact Parkinson’s disease and Lewy body dementia.Although some cases of Parkinson's appear to be hereditary, and a few can be traced to specific genetic mutations, in most cases the disease occurs randomly and does not seem to run in families. Many researchers now believe that Parkinson's disease results from a combination of genetic factors and environmental factors such as exposure to toxins.Evidence for treatments for the nonmovement-related symptoms of PD, such as sleep disturbances and emotional problems, is less strong. Nigral dopaminergic projections to the striatum are targeted in Parkinson's disease (PD). The extent of the degeneration of the dopaminergic system in PD can be visualised by dopamine transporter imaging using single-photon emission tomography (SPET)99mTc-TRODAT-1 is a type of drug that can bind to dopamine transporters in living organisms and is often used in SPCT imaging for observation of changes in the activity uptake of dopamine in the striatum. Therefore, it is currently widely used in studies on clinical diagnosis of Parkinson’s disease (PD) and movement-related disorders. In conventional 99mTc-TRODAT-1 SPECT image evaluation, visual inspection or manual selection of ROI for semiquantitative analysis is mainly used to observe and evaluate the degree of

striatal defects. 99mTc-TRODAT-1, which binds to the dopamine transporter, could be used to image the dopaminergic system in diagnosis of Parkinson's disease (PD). This study was conducted to determine the value of (99m)Tc-TRODAT-1 scan to differentiate PD from ET and other PS cases.99mTc-Trodat-1 SPECT had been widely used in Asia to assistclinical diagnosis of Parkinson's Disease (PD)and evaluatethe severity of parkinsonism. However, it is subjective and time-consuming to calculate specific uptake ratio (SUR) by manual fusion of MRI/SPECT imagesin clinical settings. QTRODAT is a software which is applied for semiquantitative analysis of 99mTc-Trodat-1 image. Parkinson's disease is the most common form of parkinsonism and is sometimes called "idiopathic parkinsonism", meaning parkinsonism with no identifiable cause. Scientists sometimes refer to PD as a type of neurodegenerative disease called synucleinopathy due to an abnormal accumulation of the protein alpha-synuclein in the brain.The synucleinopathy classification distinguishes it from other neurodegenerative diseases, such as Alzheimer's disease, where the brain accumulates a different protein known as the tau proteinThe purpose is to compare the difference of SURs of striatum and putamen to occipital background generated by traditional manual fusion of MRI/SPECT and QTRODAT respectively to validate whether QTRODAT a proper substitute for traditional manual fusion method.One hundred patients who had prior 99mTc-Trodat-1 SPECT studies were recruited in this study. Each case of 99mTc-Trodat-1 SPECT was analyzed by both manual fusion of MRI/SPECT and QTRODAT. Regions of interest (ROI) were placed in both (right and left) striatum, putamen, caudate, and the background of the occipital lobe. The SURs are the count ratios of respective ROI to background. Pearson linear correlation (r) was used to evaluate correlations between each SUR of the two methods, and Paired-Sample T test was applied to compare the SUR of the two methods ($p < 0.05$). QTRODAT in dealing with SUR is not significantly different than manual analysis. High correlation was found between QTRODAT and manual analysis. QTRODAT can be applied for improving the efficiency to evaluate the severity of PD and the possible response after treatment intervention by 99mTc-Trodat-1 SPECT. Therefore, it may assist nuclear medicine physicianto improve the clinical efficiency with confidence.