

NEU-01

### **Effectiveness of Ultrasound Screening Program on Carotid Arteries in High-risk Population in Taoyuan City**

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Atherosclerosis is the leading pathogenesis precipitating stenosis of the coronary, carotid and cerebral arteries. Carotid atherosclerotic plaques could be detected by non-invasive carotid ultrasonography and has been reported as an independent predictor of ischemic stroke and cardiovascular disease. Carotid and vertebral plaques, flow velocity measured by duplex ultrasonography has been widely used to help evaluate the burden of atherosclerosis and the risk factor control.

The ultrasonographic screening of carotid atherosclerosis in the general population is not recommended because of low prevalence of asymptomatic carotid artery and screening for carotid stenosis in asymptomatic general population has not shown significant benefits. However, individuals with high cardiovascular risk factors, such as hypertension, diabetes, smoking and hyperlipidemia, have a higher prevalence of carotid artery stenosis. This makes carotid artery screening more beneficial in the high-risk groups compared with in general population. Early detection of carotid stenosis in high-risk individuals allows for timely intervention, including lifestyle modification and medication for cardiovascular risk factors control or interventional procedures to prevent stroke. A recent study involving 985 elderly people in Taiwan showed 23% having moderate to severe carotid stenosis. Current guidelines recommend carotid ultrasound screening for individuals with multiple cardiovascular risk factors or those with a history of cardiovascular events. Studies have shown that managing carotid stenosis screened by carotid ultrasonography in high-risk populations through medical therapy or revascularization can

significantly reduce the risk of stroke and other cardiovascular events.

Taoyuan City is the first local government in Taiwan to implement the ultrasonographic screening of carotid artery stenosis, besides low-dose computerized tomography scan screen for lung cancer in high-risk groups. At the initial stage of screening, moderate to severe carotid stenosis was detected in 19% screened subjects. The preliminary results and possible direction of carotid screening program will be further investigated.

NEU-02

### **POCUS in Neuropathy Diagnosis**

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Neuromuscular ultrasound is a technique that uses sound waves to visualize specific nerves and muscles in the body. When nerves and muscles become injured or diseased, they undergo changes in shape, size, and appearance, which can be detected using ultrasound. This technique is performed in an outpatient clinical setting, is painless, does not involve radiation, and typically takes around 5 minutes to complete.

Ultrasound is often combined with other electrodiagnostic methods such as nerve conduction studies or electromyography, along with the clinical exam, to help localize neuromuscular diseases. It serves as a feasible alternative to MRI for imaging superficial structures, being both portable and readily available for use in children and adults. Additionally, ultrasound enhances the ability to detect conditions such as carpal tunnel syndrome and other focal nerve entrapments, as well as pathological nerve enlargements in genetic and acquired neuropathies. It is increasingly used to assist in the evaluation of polyneuropathies, particularly when a demyelinating neuropathy is

suspected.

hemodynamics.

NEU-03

### **Application of POCUS Ultrasound in Transcranial Doppler (TCD) for Neurocritical Care Patients**

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Point-of-care ultrasound (POCUS) has emerged as a versatile diagnostic tool in neurocritical care settings, particularly in the application of transcranial Doppler (TCD) ultrasound. POCUS offers the advantage of being a bedside, non-invasive imaging technique that provides real-time hemodynamic assessments, making it valuable for patients with neurological conditions.

In neurocritical care, TCD is primarily used to monitor cerebral blood flow velocity, detect vasospasm, and assess the risk of ischemia, particularly after events such as subarachnoid hemorrhage or traumatic brain injury. POCUS enables early detection of critical changes in intracranial hemodynamics, allowing for prompt interventions. It also aids in the diagnosis of cerebral autoregulation impairment and increased intracranial pressure, crucial for managing conditions like stroke, severe head injury, and hydrocephalus.

The integration of POCUS in neurocritical care not only enhances the ability to conduct TCD at the bedside but also reduces the dependence on more complex imaging modalities like CT or MRI, which may be less feasible for unstable patients. Additionally, POCUS-guided TCD can facilitate ongoing monitoring, ensuring that timely therapeutic decisions can be made to improve outcomes in critically ill neurological patients.

In summary, the application of POCUS for TCD in neurocritical care represents a significant advancement in patient management by providing immediate, dynamic insights into cerebral

NEU-04

### **Impact of Arterial Stenosis on Waveforms of the Carotid Arteries: An Analysis Using Machine Learning**

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**Background:** Intracranial artery stenosis (ICAS) is an important cause of stroke in Asia. We tried to use the machine learning methods to predict ICAS from the flow velocity wave (FVW) of extracranial carotid Doppler (ECCD).

**Methods:** Envelope curves of FVW on ECCD were extracted to make two major feature types. One is dataset of 34 features extracted from the five turning points of FVW. The other is that the entire time series data can be analyzed using Long Short-Term Memory (LSTM), or 23 features in time and frequency domains can be extracted for machine learning. Machine learning with nested cross validation as well as Conditional Tabular Generative Adversarial Network (CTGAN) and random up-resampling were used to establish the prediction model and address this imbalanced dataset (stenosis group is around 15%).

**Results:** For the dataset of 34 features from the five turning points of FVW, the best sensitivity of 0.81, specificity of 0.75, and accuracy rate of 0.76. The entire waveform can be analyzed directly with LSTM, achieving the best sensitivity of 0.77, specificity of 0.90, and accuracy of 0.85. Using a data set of 23 features in time and frequency domains, the optimal sensitivity was 0.80, the specificity was 0.92, and the accuracy was 0.87.

**Conclusions:** The preliminary results revealed hemodynamic presented in the ECCD reflects its downstream stenosis and can be used to establish the ICAS prediction model.

NEU-05

## **Do Ultrasonographic Findings Performed after Endovascular Thrombectomy Correlate with Functional Outcomes in Patients with Successful Recanalization?**

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Endovascular thrombectomy (EVT) is a key intervention for the treatment of acute ischemic stroke, aimed at restoring blood flow to occluded cerebral arteries. Despite successful recanalization, a significant proportion of patients still fail to achieve good functional outcomes. Previous studies have utilized CT and MRI to assess cerebral perfusion status, including the presence of postischemic hyperperfusion (also known as luxury perfusion), which may be associated with subsequent neurologic outcomes. However, the use of ultrasound for evaluating cerebral perfusion status remains underexplored.

In this study, we retrospectively analyzed patients with an acute ischemic stroke in the anterior circulation who achieved successful recanalization following EVT between 2018 and 2023 at MacKay Memorial Hospital. These patients underwent extracranial and transcranial color-coded duplex sonography examinations after thrombectomy. We compared hemodynamic parameters, such as flow velocities and pulsatility index, with the functional outcomes of the patients.

Our study aimed to elucidate the potential correlation between ultrasound findings after EVT and functional outcomes in patients with successful recanalization. By incorporating ultrasound-based assessments of cerebral hemodynamics, this study seeks to enhance the understanding of recovery trajectories and potentially identify predictive markers of functional outcomes following EVT.

NEU-06

## **Application of POCUS in Neurological**

## **Diseases: Carotid Web Syndrome**

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The carotid artery web, a shelf-like tissue typically protruding from the posterior wall of the internal carotid artery (ICA) bifurcation, is often classified as an atypical form of fibromuscular dysplasia. Over the past few years, there have been inconsistent results regarding its association with cerebrovascular events, largely attributed to its low prevalence. The use of accessible diagnostic tools to detect carotid web syndrome has become increasingly important. Our study highlights the effectiveness of extracranial carotid ultrasound in identifying carotid webs within an asymptomatic population undergoing health check-ups.

NEU-P01

## **Change of Visual Hallucinations after MRgFUS Treatment of Parkinson's Disease- a Case Report**

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**Background:** Parkinson's disease (PD) is a common neurodegenerative disease worldwide, characterized by symptoms such as tremor, slowness of movement, and rigidity. Medication is the front-line treatment, but one of the side effects is hallucinations, with visual hallucinations being common in PD, affecting up to 75% of patients over the disease course.

**Materials and Methods:** Our case involves a 67-year-old man with PD who has been on medication therapy for over 7 years. His daily levodopa equivalent usage is 488 mg, and he has

already experienced visual hallucinations. He chose tcMRgFUS treatment for motor symptoms. The pre-tcMRgFUS examination included brain CT, brain MRI, and assessment using the MDS-Unified Parkinson's Disease Rating Scale (MDS-UPDRS). The exam results showed a skull density ratio (SDR) of 0.40, and the difference in off/on MDS-UPDRS part III medication scores (levodopa dose responsiveness) was 45.2%. The tcMRgFUS treatment targeted the pallidothalamic tract (PTT).

**Results:** Post-surgery, we followed up on his MDS-UPDRS scores at 1, 3, and 6 months. We found that the MDS-UPDRS score improved, but visual hallucinations worsened, with tactile hallucinations appearing during the 1 to 3-month follow-up. This case was then hospitalized for about a week to address the hallucinations, and he is still being followed up in the outpatient clinic.

**Conclusion:** Unfortunately, current therapies for hallucinations offer only limited clinical effect. This experience suggests that hallucinations should be considered as an exclusion criterion for PTT MRgFUS surgery.

**(Key words:** Parkinson's disease, tcMRgFUS, pallidothalamic tract, visual hallucinations horax)

## NEU-P02

### Prognostic Factor of MRgFUS Thalamotomy for Treating Parkinsonism, a Single Center Experience

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**Background:** We know that the tcMRgFUS(transcranial Magnetic Resonance guided Focused Ultrasound) operation could treat Parkinson's disease (PD) by thermoablation targets including VIM (ventralis intermediate nucleus), PTT (pallido-thalamic tract), STN(subthalamic tract)

and GPi (Globus Pallidus Internus). The above targets all showed improvement in parkinsonism as rigidity, tremor and bradykinesia, but there seemed to be no obvious factor for good prognosis. Besides, there was no case report for other parkinsonism. This time, we had included 6 parkinsonism patients, and performed the PTT thermoablation through tcMRgFUS, and we followed up 6 months for evaluating the parkinsonism.

**Materials and Methods:** 6 patients with parkinsonism (5 PD, 1 progressive supranuclear palsy—parkinsonism predominant, PSP-P) had received the thermoablation to the PTT Forel's H1 zone through tcMRgFUS. We at least repeat 4 bouts of sonication which made the target over 54 Celsius in every patient. The patients received the UPDRS part III score evaluation in pre-operation, post-op 1 month, post-op 3 months, and post-op 6 months.

**Results:** The table 1 showed the patient's basic data. The table 2 showed the post OP UPDRS part III scores after operation. The results showed obvious improvement in parkinsonism as rigidity, tremor frequency and bradykinesia in 5 PD patients ( $P < 0.05$ ). The only 1 PSP-P patient got no improvement after operation.

**Conclusion:** The PTT tractomy through tcMRgFUS seemed to be only effective in PD patient. The table 3 revealed the LDCT response as a good prognostic factor, but the only 1 PSP-P patient got no improvement after operation.

Although the PSP-P patient had LDCT response  $> 30\%$  improvement, not yet the prognostic factor seemed to be used in PD patient not all the parkinsonism patients.

**(Key words:** tcMRgFUS, parkinsonism, thalamotomy)

## NEU-P03

### A Rare Case Report of Newly Onset Writing Tremor after Contralateral tcMRgFUS Thalamotomy for Tremor

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**Purpose:** Transcranial magnetic resonance-guided focused ultrasound surgery (tcMRgFUS) thalamotomy has become an innovative option for individuals suffering from Essential Tremor (ET). We report a case of a 72-year-old man with medication-refractory left thumb tremor who underwent tcMRgFUS right ventral intermediate nucleus (Vim) thalamotomy. Unexpectedly, right-hand writing tremor was noticed 4 weeks after the procedure. We present this rare case of newly onset writing tremor following contralateral tcMRgFUS thalamotomy for task-specific tremor and review related literature.

**Materials and Methods:** This 72-year-old man with medication-refractory left thumb tremor underwent tcMRgFUS right Vim thalamotomy. The left thumb tremor stopped immediately. Follow-up MRI showed mild peri-focal edema after 24 hours. A series of examinations, including the Clinical Rating Scale for Tremor (CRST) and the Quality of Life in Essential Tremor Questionnaire (QUEST), were conducted to quantify the degree of improvement. However, the patient noted a newly onset right-hand writing tremor 4 weeks later. We recalled him for a clinical survey, and the newly diagnosed right-hand writing tremor was confirmed.

**Results:** We separately recorded both hands' rating scales for CRST and QUEST, showing significant improvement in the left hand. A 24-hour follow-up MRI confirmed a correctly placed lesion on the right Vim. We then reviewed published articles about contralateral tremor worsening after dominant side treatment, but newly onset contralateral tremor was rare.

**Conclusion:** Gait and hand ataxia are the most commonly noted neurological side effects, followed by sensory deficits. The complication rate is related to the size of the Vim and the accuracy of targeting. Worsening contralateral tremor has been increasingly recognized by physicians. Newly onset contralateral tremor can occur and should be discussed with patients considering this technique for tremor control. Additionally, staged bilateral thalamotomy should be researched for its potential

adverse effects and unpredictable side effects.

**Key Words:** tcMRgFUS, ET, QUEST

NEU-P04

### tcMRgFUS Thalamotomy for Essential Tremor Combined Parkinson's Disease- A Case Report and Review

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**Introduction:** Essential tremor (ET) involves an action tremor (8-12 Hz), while Parkinson's disease (PD) presents with a tremor (4-6 Hz), muscle rigidity, and bradykinesia. ET is four times more likely to progress to PD than in the general population. Transcranial Magnetic Resonance guided Focused Ultrasound (tcMRgFUS) is a new technique that lesions the basal ganglia to help patients with ET or PD. We present a 73-year-old male with both ET and PD (ETPD) who underwent MRgFUS treatment.

**Methods:** The patient underwent a CT scan for Skull Density Ratio (SDR) calculation, MRI, and Clinical Rating Scale for Tremor (CRST) assessment. He then received MRgFUS right-side thalamotomy. Pre- and post-operative CRST scores and adverse effects were documented. Two months later, as the resting tremor worsened, a second MRgFUS thalamotomy was performed.

**Results:** The patient's SDR was 0.57. His main symptoms affected his left hand. CRST scores showed significant improvement after the first treatment, with no adverse events, and he was discharged the next day. Symptoms recurred in the second month. After the second operation, with a lesion 1-2 mm lateral and superior to the first target, the tremor stopped. Post-MRI showed larger lesions with some edema over the internal capsule. The patient experienced a mild unsteady gait for a week.

PD symptoms were controlled with L-dopa during follow-up.

**Conclusion:** ETPD is more complex than ET or PD alone. Postural tremor from ET and resting tremor from PD involve different brain pathways. While Vim thalamotomy can stop both types of tremors, ETPD combined with other PD symptoms complicates clinical outcomes. MRgFUS for Vim thalamotomy is a feasible treatment for ET, but for ETPD, further studies are needed to determine if additional targets are required to control PD symptoms.

**Keywords:** magnetic resonance guided focused ultrasound, Essential tremor, Parkinson's disease.

NEU-P05

#### Non-Invasive Focused Ultrasound Ablation to Treat Essential Tremor and Quantitative Evidence Up to 5 Years

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**Introduction:** The ventral intermediate nucleus of the thalamus (Vim) is a key target for tremor relief. Previously, radiofrequency ablation (RFA) with a skull burr hole was used to treat tremors. Magnetic Resonance-guided Focused Ultrasound (tcMRgFUS) achieves the same without an incision. This technique uses a head frame to focus ultrasound energy, raising tissue temperature at the Vim under MRI guidance. We used the Clinical Rating Scale for Tremor (CRST) to evaluate improvement and T2-weighted MRI to confirm the ablation lesion one day post-tcMRgFUS.

**Materials and Methods:** We retrospectively analyzed 48 patients who underwent unilateral Vim thalamotomy for essential tremor (ET) using tcMRgFUS. The group included 31 males and 17

females, with an average age of  $59.2 \pm 13.5$  years. 43.8% had a family history of tremors. Right-hand treatments numbered 41, and left-hand treatments numbered 7. CRST scores were recorded at baseline, 1 week, 1 month, 3 months, 6 months, and 1 to 5 years post-tcMRgFUS. Total and dominant tremor scores were compared with baseline scores using one-way repeated measures ANOVA. MRI scans were performed 1 day post-tcMRgFUS. The average ablation temperature was  $57.0 \pm 2.4$  °C, the average skull density ratio was  $0.5 \pm 0.1$ , and the average skull surface area was  $366.2 \pm 24.9$  cm<sup>2</sup>.

**Results:** Average total CRST scores before and after tcMRgFUS were 45.7, 28.7, 21.8, 29.3, 31.2, 29.5, 31.2, 28.8, 25.9, and 18.4. Average dominant tremor scores were 15.7, 4.7, 3.9, 7.1, 7.5, 7.6, 7.0, 7.7, 7.4, and 5.1. Post-tcMRgFUS scores showed significant improvement.

**Conclusion:** tcMRgFUS significantly suppresses ET without a skull incision, reducing infection risk. The significant differences in CRST scores before and after tcMRgFUS provide strong quantitative evidence. tcMRgFUS can replace RFA in some clinical conditions without loss of efficacy.

**Keywords:** Transcranial magnetic resonance guided focused ultrasound, essential tremor

NEU-P06

#### Change of Diffusion Metrics after tcMRgFUS Thalamotomy

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**Purpose:** Transcranial magnetic resonance-guided focused ultrasound (tcMRgFUS) thalamotomy at the ventral intermediate nucleus (VIM) of the thalamus is an effective treatment for suppressing hand tremors. However, follow-up MRI scans often show no visible lesion, which does not

align with expected ablation results. To investigate potential nerve damage post-tcMRgFUS, we employed tract-based spatial statistics (TBSS) to analyze diffusion tensor imaging (DTI) metrics, commonly used to evaluate nerve injury.

**Method:** We retrospectively analyzed DTI images from 7 patients who underwent tcMRgFUS at the left VIM. DTI scans were performed at three time points: before, 1 day, and 1 year after tcMRgFUS. The average maximum ablation temperature was  $57.7 \pm 0.7$  °C, and the average skull density ratio was  $0.5 \pm 0.09$ . Transverse DTI images were obtained using a 1.5 Tesla MRI. Metrics such as fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD), and radial diffusivity (RD) were measured using the FMRIB Software Library (FSL). TBSS was used to generate white-matter skeletons, and group-comparison paired T-tests calculated p-values for metrics between the three time points. Significant results were identified by the peak voxel p-value in clusters with more than 5

voxels.

**Results:** MD, RD, and AD significantly increased 1 day after tcMRgFUS, with p-values of 0.009, 0.005, and 0.014, respectively. Significant clusters for these metrics were predominantly located in the internal and external capsules, corpus callosum, corticospinal tract, superior longitudinal fasciculus, thalamic radiation, corona radiata, and cerebellar peduncle, according to the JHU-ICBM-DTI-81 atlas.

**Conclusion:** tcMRgFUS VIM thalamotomy did not significantly affect nerve integrity, as FA did not show significant changes. The elevation in other metrics is likely due to temporary edema rather than Wallerian degeneration, suggesting tcMRgFUS differs from traditional ablation surgery.

**(Keywords:** Transcranial magnetic resonance-guided focused ultrasound, tract-based spatial statistics, essential tremor)