Tweetable Abstracts

Importance of the Spasm Provocation Test in Diagnosing and Clarifying the Activity of Vasospastic Angina. Paper link - (Paper length - 4,000 words)

Researchers find a new way to predict **#drug-resistant** vasospastic #angina: **#SPTs** at rescue **@AuthorHandle**

#SpasmProvocationTests: Providing a new hope for patients with intractable vasospastic **#angina @AuthorHandle**

Usefulness of a Pressure Wire for the Diagnosis of Vasospastic Angina during a Spasm Provocation Test. Paper link - (Paper length - 5,000 words)

#PressureWires: Do they improve the safety of diagnosing vasospastic **#angina**? Yes, they do! **@AuthorHandle**

Japanese researchers find a novel, non-pharmacological, safe way to diagnose vasospastic **#angina @AuthorHandle**

Deep Learning Approach to Control of Prosthetic Hands with Electromyography Signals. Paper link – (Paper length – 7358 words)

#UTDallas Researchers develop **#artificialintelligence** based approach to transmit **#EMG** signals to control prosthetic hands **@AuthorHandle**

A **#neuralnetwork** based non-intrusive device will soon be available to upper limb amputees to control #prosthetic hands **@AuthorHandle**

A Novel Breakthrough Neural Network Uses Raw Electromyography Signals to Control Prosthetic Hands

Running title: EMG-based sophisticated prosthetic hands

According to recent World Health Organization reports, there are about 40 million amputees in the world and as the life expectancy and associated ageing-related diseases like diabetes are on the rise, the number of people affected by amputations is expected to increase. The quality of life for upper-limb amputees can be markedly improved by high-performance prosthetic hands. Recent advances over the past several decades, led to the development of the currently available prosthetic hands, which are able to support performing certain level of activities. However, the key issue is effectively controlling these prosthetic hands, without the use of complicated mechanics and yet providing the necessary functionality for such device, using the naturally generated electric signals from the muscles.

A group of engineering scientists at the University of Texas, Dallas, have now reported a novel artificial intelligence assisted approach to control prosthetic hands employing a newly developed deep convolutional neural network, which makes use of raw electromyography signals. Mohsen Jafarzadeh and associates from the University of Texas emphasized that among the various ways of controlling prosthetic hands electromyography (EMG), is the most convenient for amputees. The principle behind this approach is the ability of a non-invasive surface EMG electrode to read and measure the electric potential generated in muscle fibers, when they contract in response to neuronal stimulation.

In the new EMG based control system described by Jafarzadeh and associates, the raw EMG signals without preprocessing, feature extraction or spectrogram, obtained from 8 dry linearly and evenly spaced EMG surface electrodes, are used by the deep convolutional neural network. This type of architecture is an advanced form of artificial intelligence using deep neural networks and is a step closer to achieving the goal of fully end-to-end (E2E) optimization of EMG controlled prosthetic hands.

Unlike the conventional approaches which consist of four subsystems of preprocessing, feature extraction, dimension reduction (feature description), and a classifier, the present system employs only a novel convolutional neural network that uses raw EMG data as input, a FIFO memory, an aggregation unit, and a look-up table. Additionally, in this new convolutional neural network, 1D convolutional layers are used instead of 2D convolutional layers, and also the filter sizes consistently decrease in deeper layers (not fixed).

Due to the limited number of available datasets, which restricts the ability to train very deep neural networks of greater than 10 layers, the presently proposed networks consisted of 6 convolutional layers and 2 dense layers, and the input of the networks is 8 vectors, with each vector consisting of 200 elements. For the present device, Jafarzadeh's group employed NVIDIA Tesla V100 GPGPU using V100 compute nodes in the Maverick2 at the Texas Advanced Computing Center (TACC), and Python 3.5 with TensorFlow library for implementing the convolutional neural network.

Jafarzadeh's group used data from two subjects for testing and the other six subjects for training and validation. They found that the eight-layer network (six convolutional layers and two dense layers) gives

a validation accuracy of 91.26% and training accuracy of 99.98%, with the test accuracy reaching to 48.40%.

The proposed convolutional neural networks are found to run in real-time, with the ability to transmit the signal to the prosthetic hand low-level controller, with the error probability of zero, thus making the final product error-free and functional.

The article “Deep learning approach to control of prosthetic hands with electromyography signals” was published in *2019 IEEE International Symposium on Measurement and Control in Robotics (ISMCR).* DOI: 10.1109/ISMCR47492.2019.8955725

Insertion of a Pressure Wire can Improve the Safety of Spasm Provocation Tests

Running title: Use of a pressure wire to diagnose vasospastic angina

Hiroshima, Japan – Spasm provocation tests (SPTs) are important for diagnosing vasospastic angina (VSA) but are sometimes associated with severe complications. A team of researchers from JR Hiroshima Hospital and Hiroshima University Hospital may have discovered a solution.

VSA is characterized by transient narrowing of the epicardial coronary arteries and coronary spasms, which may not only result in angina occurring at rest but can even lead to a sudden ischemic cardiac arrest. Therefore, its diagnosis is pivotal.

Many patients cannot be diagnosed with VSA based on electrocardiogram (ECG) changes alone due to their symptoms being difficult to detect or atypical. Consequently, pharmacological or non-pharmacological stimuli are often used to induce coronary spasms in such patients through SPTs. However, this procedure can be accompanied by severe complications, such as shock, ventricular fibrillation, ventricular tachycardia, and bradyarrhythmia.

Pressure wires have previously been used to assess intracoronary pressure in patients with moderate narrowing of the coronary arteries, known as organic coronary stenosis. Therefore, the team, led by Dr. Teragawa, decided to test whether pressure wires could also be used in SPTs to help improve their safety.

They enrolled 190 patients in their study who presented with chest symptoms that were mostly felt at rest. All patients were evaluated using an SPT, but a 0.014-inch pressure wire was advanced into the distal segments of the right coronary artery (RCA) and left anterior descending coronary artery (LAD) prior to the SPT in 103 of these patients (Group I), while no pressure wire was used in the remaining 87 (Group II).

Although the total fluoroscopic time was on average 2.5 min longer in Group I than in Group II due to the time required to insert the pressure wire and the higher frequency of fractional flow reserve (FFR) measurements, Group I required a smaller volume of contrast medium.

The use of a pressure wire also led to significantly fewer severe complications, including ventricular fibrillation and hemodynamic instability requiring adrenaline, despite there being no significant differences in risk factors between the two groups, such as smoking, family history of coronary disease, or blood chemistry parameters, indicating that this technique may improve the safety of SPTs.

And the benefits do not end there… This novel approach also allowed the prompt detection of a reduced blood flow to the heart, termed myocardial ischemia, through constant monitoring of the pressure ratio of the distal lesion to proximal lesion (Pd/Pa). “When using a pressure wire during an SPT, it is important to monitor the Pd/Pa continuously…If the Pd/Pa index decreased gradually

during the SPT, the occurrence of coronary spasm was anticipated. Furthermore, if a coronary spasm occurred with the reduction in the Pd/Pa index, an intracoronary infusion of NTG [nitroglycerin] was given to relive the spasm and promptly elevate the Pd/Pa index to the baseline level," says Dr. Teragawa. "Indeed, given the process of myocardial ischemia, a change in the Pd/Pa index may be the earliest marker of myocardial ischemia."

Pressure wires have been used in many other clinical settings without any associated complications, and similarly it was found that they were inserted with a 98% success rate and did not cause vascular trauma or induce coronary spasm in any of the patients tested—although, as Dr. Teragawa cautions, "Naturally, a pressure wire should be inserted into the coronary artery more carefully and slowly during an SPT to avoid guidewire-induced coronary spasm."

As with all techniques, this approach has some limitations, particularly in terms of cost. However, the improved safety of this procedure holds great promise for patients who are considered more likely to experience complications during an SPT, and the increased ability to establish a firm diagnosis of VSA will be of great value to cardiologists who need to clarify the disease status through a second SPT.

The article "Usefulness of a Pressure Wire for the Diagnosis of Vasospastic Angina during a Spasm Provocation Test" was published in *Journal of Clinical and Experimental Research in Cardiology* (Vol. 3).

Spasm Provocation Tests can Predict Intractable Vasospastic Angina

Running title: Improving i-VSA prediction

Hiroshima, Japan – Researchers from JR Hiroshima Hospital, Japan, have recently identified two factors that can be used to predict the occurrence of a form of vasospastic angina (VSA) that is resistant to conventional drug treatments, offering new hope for patients.

VSA is characterized by episodes of angina at rest that are caused by coronary artery spasms, which reduce blood flow to the heart and prevent it from receiving sufficient oxygen. In most patients, these attacks can be relieved or suppressed by taking coronary vasodilators, such as calcium channel blockers or nitrates. However, one form of VSA—intractable VSA (i-VSA)—is resistant to such drugs.

VSA is often diagnosed using a spasm provocation test (SPT), which involves administration of a pharmacological or non-pharmacological treatment during a coronary angiography and determining the degree of coronary artery narrowing. However, as pointed out by the principal investigator Dr. Hiroki Teragawa, "Although several studies are investigating the clinical characteristics of patients with i-VSA, it remains difficult to predict the presence of i-VSA."

Therefore, Dr. Teragawa and colleagues set out to investigate the relationship between a range of clinical parameters and i-VSA by studying the characteristics of 155 patients with VSA at their hospital between 2011 and 2015. In addition to collecting a detailed history of these patients and measuring a range of blood chemistry parameters, they also performed SPTs by infusing incremental doses of acetylcholine (ACh) into the coronary arteries and then measured the resultant changes in the coronary artery diameter.

Follow-up interviews 1 year after discharge showed that 25% of the patients had i-VSA based on the number of coronary vasodilators they had used and angina attacks they had suffered. In terms of general risk factors, this group of patients had a lower body mass index, a significantly lower frequency of lipid disorder, and a lower estimated age of VSA onset than the treatable VSA (t-VSA) group, as has been found in previous studies, while there was no significant difference in any other risk factors between the two groups, such as smoking status and blood chemical or echocardiographic parameters.

What was of particular interest to the researchers, however, was the finding that the i-VSA group also had a higher frequency of positive SPTs induced by a low dose of ACh (L-ACh) in the right (<30 μg) and/or left (<50 μg) coronary arteries and a higher rate of total occlusion (TOC) than the t-VSA group—a finding that could help explain why i-VSA occurs: "These two factors may imply the presence of easiness in the vasoconstriction of the epicardial coronary artery, leading to the higher activity of coronary spasm," says Dr. Teragawa.

So what does this mean in the clinical setting? In the case of doctors, including primary care doctors, the ability to predict i-VSA will allow them to prescribe another vasodilator. Furthermore, as Dr. Teragawa argues, "The proposition that two or more coronary vasodilators will be needed to control the chest symptoms is important information for patients as well as doctors, as they can then understand their disease activity, leading to a high compliance of taking coronary vasodilators."

To build on these findings, the importance of multivessel spasms will be investigated in the future, as the scientists also recognized this as a factor for i-VSA but excluded it from the analysis due to difficulties associated with its assessment in a large number of patients. However, it is clear that SPT may be important not only for diagnosing VSA but also for providing prognostic information for VSA patients.

The article "Importance of the Spasm Provocation Test in Diagnosing and Clarifying the Activity of Vasospastic Angina" was published in *Interventional Cardiology Journal* at DOI: 10.21767/2471-8157.100058.