Clotild® a Smart Guidewire Sensing Clot Characteristics during the Mechanical Thrombectomy Procedure - Results from the CLOT OUT study

Hal Rice[1], Aymeric Rouchaud[2], Nathan Manning[3,4], Laetitia De Villiers[1], Géraud Forestier[2], Vinicius Do Nascimento[1], Suzana Saleme[2], Julie Lafaurie-Janvore[5], Joachim Rambeau[5], Franz Bozsak[5], Dennis Cordato[4,6], Andrew Cheung[3,4]

[1]Gold Coast University Hospital, Department of Neurointervention, Southport, Australia

[2]University Hospital Centre of Limoges, Interventional Neuroradiology, Limoges, France

[3]Liverpool Hospital, Department of Neurointervention, Liverpool, Australia

[4]Ingham Institute for Applied Medical Research, Liverpool, Australia

[5]Sensome, Massy, France

[6]Liverpool Hospital, Department of Neurology and Neurophysiology, Liverpool, Australia

On behalf of the CLOT OUT investigators

Background and Aim

Mechanical thrombectomy (MT) has revolutionized the treatment of large-vessel ischemic stroke. Despite significant advances, roughly 60% of MT procedures require two or more retrieval attempts to achieve TICI 2c/3 recanalization and 20 % of MT procedures fail to achieve recanalization, negatively impacting patient outcome. In-situ thrombus features, such as thrombus composition, heterogeneity and length play a critical role in the success of MT [1]. The literature shows that red-blood-cell-poor/platelet-rich thrombi are particularly difficult to retrieve. Understanding in-situ thrombus features prior to MT could inform first-line treatment choice to increase first-pass success.

Sensome has developed the Clotild Smart Guidewire System (Clotild), a 0.014” neurovascular guidewire integrating an impedance micro-sensor in its distal part (Fig. 1), allowing to probe the impedance properties of the occlusion causing the ischemic stroke prior to MT. These properties can be analyzed by predictive algorithms to determine in-situ thrombus features. The CLOT OUT study aims to evaluate the safety and ability of Clotild to provide impedance measurements.

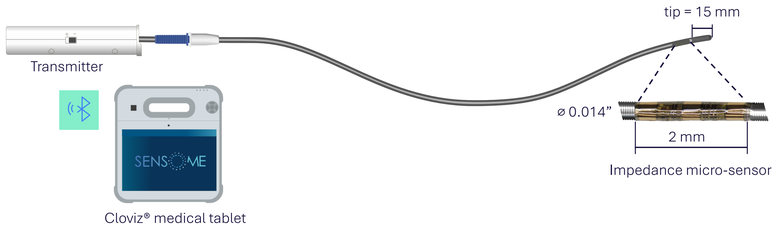

Fig. 1: Clotild Smart Guidewire System: The guidewire is 197 cm long with a 15 mm shapable, atraumatic, radio-opaque tip. Clotild is currently not approved anywhere in the world.

Materials and Methods

In this single arm, prospective, multi-center first-in-human study Clotild was used for impedance measurements before any thrombectomy pass in subjects presenting with Acute Ischemic Stroke (AIS) due to an occlusion with origin in the M1 and eligible for MT. After MT, the composition of retrieved thrombi was analyzed using Martius-Scarlett Blue (MSB) and CD42b stains.

The primary safety endpoint was defined as the proportion of patients having intracranial vessel perforation and/or dissection due to Clotild usage at the site of usage in intracranial vessels by assessment by Interventional Neuroradiologist during the procedure and final adjudication of the DSA (Angiogram) by the independent imaging corelab and the DSMB. The primary performance endpoint was defined as the ability to perform binary classification of individual impedance measurements by distinguishing local regions with substantial red-blood-cell (RBC) content from regions with negligible red-blood-cell content in the occlusion.

A major secondary endpoint was defined as the ability to perform binary classification of individual impedance measurements by distinguishing local regions with substantial platelet content from regions with negligible platelet content in the occlusion.

The collected impedance data was split into a development and a validation set. The predictive algorithms were developed blinded to the validation dataset, using data from the development dataset. All performance endpoints were evaluated on the 15-patient blinded validation set. All data shown and all analysis in this poster is performed before database lock.

Results

Enrolment has been completed at 41 treated patients. The **primary safety endpoint** was evaluated at **0% intracranial vessel perforation and/or dissection due to Clotild usage**. Out of the 12 reported serious adverse events, 0 were related to Clotild or the study procedure.

We previously demonstrated that RBCs and platelets have a characteristic impedance signature on ex-vivo measured clots [2,3,4] (Fig 2A). Comparable characteristic signatures have been identified in-vivo in the CLOT OUT study (Fig. 2B).

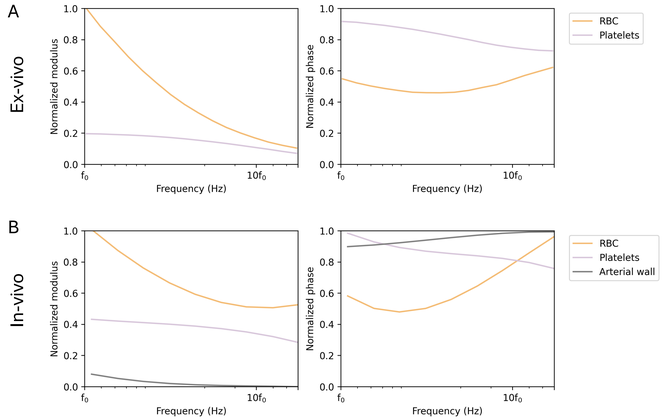

Fig. 2: Impedance spectra for RBC and platelets in human AIS clots measured A) ex-vivo and B) in-vivo

Comparing expert annotation to the output of our predictive algorithms demonstrates a **sensitivity of 95%** [95% CI, 86%-100%] and **specificity of 93%** [95% CI, 90%-96%] for the detection of RBCs, and a **sensitivity of 87%** [95% CI, 76%-96%] and **specificity of 94%** [95% CI, 90%-96%] for the detection of platelets (Fig. 3).

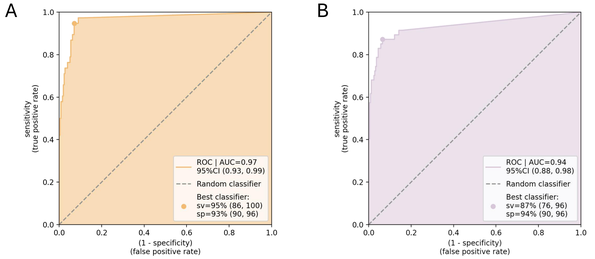

Fig. 3: Receiver operating characteristic (ROC) curves for A) red-blood-cells and B) platelets.

Finally, our results indicate that thrombus composition determined by impedance measurements is consistent with histological analysis (Fig 4).

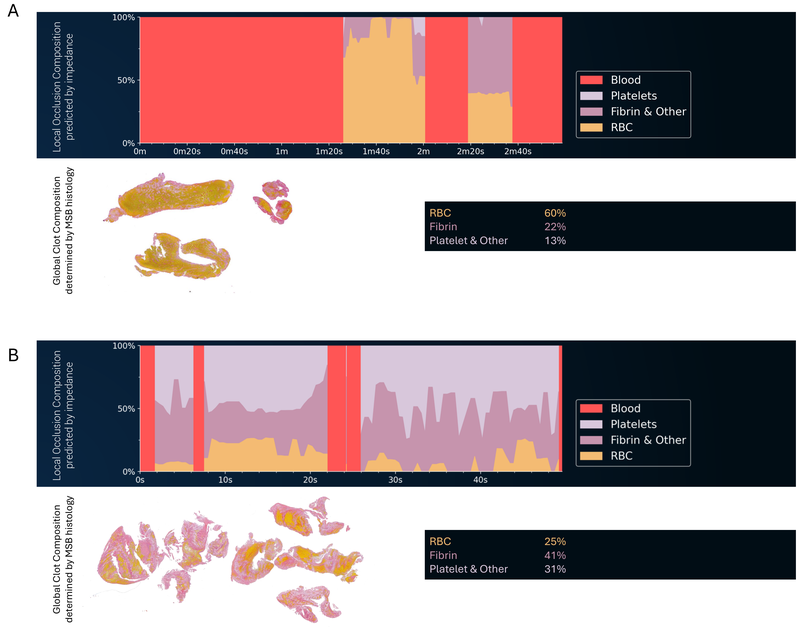

Fig. 4: Timeseries of local occlusion composition predicted based on impedance measurements compared to global clot composition determined by MSB histological analysis for patients A and B.

Conclusions

Our preliminary results demonstrate that the use of Clotild is safe. Further these results confirm that Clotild can detect red-blood-cell and platelet content in the occlusion. The CLOT OUT study confirms the feasibility to interpret impedance measurements acquired by Clotild to determine in-situ thrombus features using predictive models. This information could help neurointerventionists identify optimal first-line MT strategies to improve first-pass success and outcome for AIS patients.

References

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