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IDENTIFYING AND UNDERSTANDING CEREBRAL ANEURYSMS RISK FACTORS AND THEIR INTERACTIONS

Philippe Bijlenga*, Juan R. Cebral, Sven Hirsch***, Anne M. Robertson†, and Paul Watton‡**

*Neurosurgery, Department of Clinical Neurosciences, Faculty of Medicine, Geneva University Hospital, philippe.bijlenga@hcuge.ch

**Bioengineering Department, Department of Mechanical Engineering, George Mason University, Fairfax, Virginia, jcebral@gmu.edu

***Institute of Applied Simulation, ZHAW University of Applied Sciences, Switzerland, hirc@zhaw.ch

† Department of Mechanical Engineering and Material Sciences, Department of Bioengineering, University of Pittsburgh, Pittsburgh, Pennsylvania, rbertson@pitt.edu

‡ Department of Computer Science and INSIGNEO Institute for In Silico Medicine, University of Sheffield, Sheffield, U.K., P.Watton@sheffield.ac.uk

MINI-SYMPOSIUM PROPOSAL

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1 BACKGROUND

Balancing the risk of rupture of incidental cerebral aneurysms and the risks associated with their preventive interventions poses a critical dilemma for clinicians and patients when they have to decide whether to intervene or to conservatively follow a given aneurysm [1]. Many studies have identified several risk factors including patient and demographic characteristics, aneurysm anatomical and geometric characteristics, hemodynamic factors, and aneurysm wall properties [2]. However, the relative importance and interactions between these factors as well as the underlying mechanisms driving the progression of aneurysms towards rupture or stabilization remain poorly understood [3]. One important challenge in the study of aneurysm risk is the proper definition of end points for the analyses. Different end points may be used to assess 1) predisposition for having aneurysm by comparing healthy volunteers with patients diagnosed with aneurysms 2) susceptibility for aneurysms comparing patients diagnosed with solitary or multiple aneurysms 3) stability of aneurysms comparing changes of morphology, wall properties, clinical symptoms or rupture overtime 4) risk of suffering of the aneurysm comparing characteristics of patients and aneurysms after diagnosis as ruptured vs. unruptured, or decision taken by multidisciplinary teams whether to treat or not and finally 5) result of the performance of the overall management of patients assessing the impact of the disease on patients comparing difference of management and outcomes over a life time [4,5]. The combination and cross-comparison of data from studies based on different end points to characterize aneurysm rupture risk holds the promise to identify common factors associated with different processes contributing to the destabilization and rupture of aneurysms and to provide a unifying view of the underlying mechanisms governing these processes.

2 PURPOSE

We bring together cerebral aneurysm researchers with expertise in clinical management of aneurysms, surgery and interventional radiology, vascular biology, computational modeling, vascular imaging, radiomic description, and biomechanics, focusing on the interaction between the flow and biomechanical environment of intracranial aneurysms and structural, mechanical and biological characteristics of aneurysm walls.

The goal is to provide a picture of the current knowledge in this field, describe current research efforts, and in particular discuss the role of different factors and processes in the progressive weakening or effective remodeling of the wall. Topics to be considered include: the role of hemodynamics, the role of biomechanics, effects of growth and remodeling, the role of inflammation, the role of lipid accumulation, the role of atherosclerotic changes of the wall, mechanical and structural characteristics of the aneurysm walls, histological and biological characteristics of the aneurysm walls, imaging the aneurysm wall, morphometric analysis using radiomic methods, and statistical and machine learning approaches for outcome prediction. The mini-symposium will conclude with a dedicated slot for an open-forum discussion on consolidating a roadmap to achieve clinical impact.

REFERENCES

[1] Thompson BG, Brown RD, Amin-Hanjani s, Broderick JP, Cockroft KM, Connolly ES, Duckwiler GR, Harris CC, Howrd VJ, Johnston SC, Meyers PM, Molyneux A, Ogilvy CS, Ringer AJ, Torner J (2015). "Guidelines for the Management of Patients With Unruptured Intracranial Aneurysms: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association." Stroke 46(8): 2368-2400.

[2] Toth G, Cerejo R, “Intracranial aneurysms: review of current science and management”, Vascular Medicine, 23(3), 276-288, 2018.

[3] Cebral JR, Raschi M, “Suggested connections between risk factors of intracranial aneurysms: a review”, Annals of Biomedical Engineering, 41, 7, 1366-83, 2013.

[4] Bijlenga P, Morel S, Hirsch S, Schaller K, Rufenacht D (2019). "Plea for an international Aneurysm Data Bank: description and perspectives." Neurosurg Focus 47(1): E17.

[5] Suarez JI and Macdonald RL (2019). "The End of the Tower of Babel in Subarachnoid Hemorrhage: Common Data Elements at Last." Neurocrit Care 30: 1-3.