Cerebral blood flow: possible hemodynamic links between atrial fibrillation and cognitive decline

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Atrial fibrillation (AF), the most common cardiac arrhythmia leading to irregular and faster heartbeat, has been recently and independently associated to the risk of dementia[1]. Among the potential hemodynamic mechanisms - such as microembolisms, blood flow impairment, hypoperfusion and microbleeds - the hypothesis of altered cerebral blood flow dynamics during AF is the least investigated so far[2,3]. In particular, it is unknown how AF rate influences the cerebral microcirculation. We propose a modeling approach to compare the cerebral fluid dynamics during normal sinus rhythm (NSR) and AF at different heart rates (HRs), ranging from 50 to 130 bpm. The computational algorithm, as shown in Fig. 1, combines a stochastic extraction of the heart beating, RR [s], with a lumped parameter modeling of the cardiovascular and cerebral circulations. AF is able to trigger a higher variability of the cerebral blood flow variables which increases towards the distal circulation, reaching the maximum extent at the arteriolar and capillary levels. The recurrence of extreme events - such as excessive pressure or reduced blood flow - increases with HR, suggesting that the physiological phenomena at microcerebral level ruled by periodicity (e.g., regular perfusion and mean pressure per beat) are dramatically compromised at higher HRs. Awaiting further clinical evidences, AF candidates *per se* as a relevant mechanism into the genesis of AF-related cognitive decline/dementia.

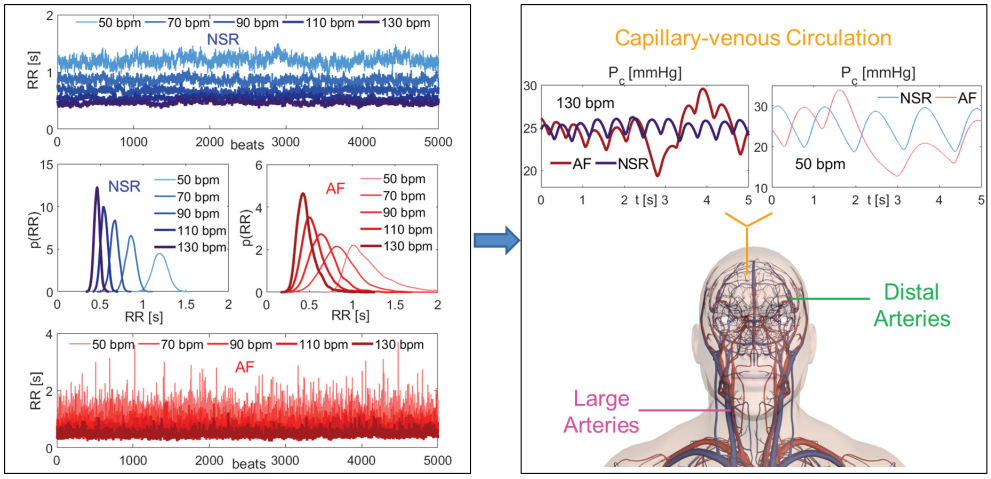

Figure 1: Scheme of the modeling approach: blue (NSR), red (AF), HR=50, 70, 90, 110, 130 bpm, 5000 RR beats are simulated for each configuration. (left) RR beats and corresponding PDFs. (right) Cerebral model with representative capillary pressure time-series, P_c.

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[1] Jacobs et al., *Trends Cardiovasc. Med.* **25**, 4451 (2014).
[2] Anselmino et al., *Sci. Rep.* **6**, 28635 (2016).
[3] Scarsoglio et al., *J. R. Soc. Interface* **14**, 20170180 (2017).