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CEREBRAL HYPOPERFUSIONS AND HYPERTENSIVE EVENTS DURING ATRIAL FIBRILLATION: A MECHANISM FOR COGNITIVE IMPAIRMENT?



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PURPOSE

Atrial fibrillation (AF) is associated with an **increased risk of dementia and cognitive decline**, independent of clinical strokes/TIAs. Aim of the present study was to study AF impact on the whole cerebral circulation through a **computational hemodynamic analysis**.

METHODS

Two coupled lumped-parameter models (systemic and cerebrovascular circulations) were used to simulate sinus rhythm (SR) and AF. For each simulation **5,000 cardiac cycles** were analyzed, computing main statistics (mean and standard deviation) for **different cerebral hemodynamic parameters**.

RESULTS

AF triggered a **greater variability** (represented by the standard deviation) of the parameters, especially in the deepest circulation (**cerebral arterioles and capillaries**; see Figure 1).

During AF **303 hypoperfusions** (maximum duration: **2 beats**) occurred at the **arteriolar level**, while **387 hypertensive events** (maximum duration: **5 beats**) occurred at the **capillary level** (see Figure 2). By contrast, neither hypoperfusions nor hypertensive events occurred during SR.

Figure 1

Pressure and flow time series at different levels of the cerebral circulation during SR (blue) and AF (red). P(a): systemic arterial pressure; P(MCA, left): left middle cerebral artery pressure; P(dm, left): left middle distal pressure; P(c): cerebral capillary pressure; Q(ICA, left): left internal carotid flow rate; Q(MCA, left): left middle cerebral artery flow rate; Q(dm, left): left middle distal flow rate; Q(pv): proximal venous flow rate.

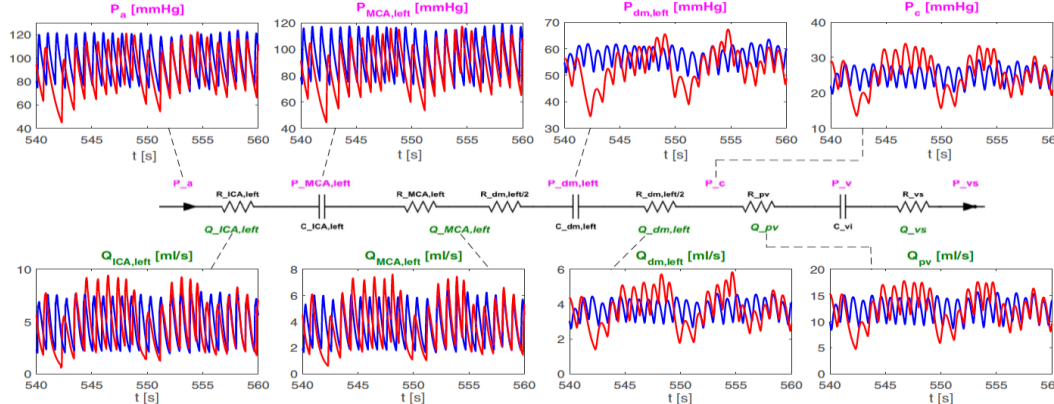
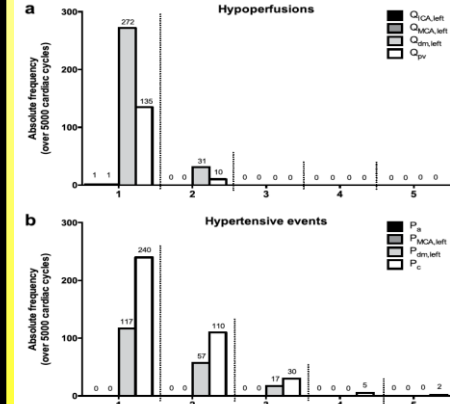


Figure 2

Absolute frequency of hypoperfusions (a) and hypertensive events (b) during AF along the ICA-MCA pathway; the abscissa indicates the number of consecutive beats characterizing the events.



CONCLUSIONS

During AF, the irregular heartbeat leads to **transient periods of excessive capillary pressure or reduced arteriolar blood flow** in the cerebral circulation. Therefore, **AF per se** candidates as a relevant mechanism into the genesis of AF-related **cognitive impairment/dementia**.