Atrial fibrillation is a risk factor for cerebrovascular disease: A diffusion tensor imaging study

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Introduction

- Atrial fibrillation (AF) is directly associated with cognitive decline and dementia[1,2]. AF can alter cerebral blood flow[3], which may disrupt white matter (WM) integrity, and lead to cerebral vascular disease (CVD).
- Cerebral free water (FW), derived from Diffusion Tensor Imaging (DTI), can predict most subtle WM microstructural changes in young healthy adults[4,5] and is strongly associated with WM injury in older adults[6].
- Fractional anisotropy (FA), also derived from DTI, is a sensitive measure of brain connectivity. Decreased FA is associated with poorer cognitive and executive function[7].
- This study aimed to investigate whether AF is a risk factor for CVD in non-demented individuals using two biomarkers: cerebral FW and FA.

Sample and Summary

- 361 non-demented individuals (Clinical dementia rating (CDR) < 1) from the University of California, Davis, Alzheimer's Disease Research Center (ADRC) cohort were included (Table 1).
- Exclusion criteria were unstable major medical illness, major psychiatric disorders, and substance dependence in the last 5 years.
- The cohort received standardized MRI including DTI acquisition and underwent comprehensive clinical evaluations.

	Atrial Fibrillation	
	-	+
N	322	39
Age (years)	74.37±6.7[49;92]	78.46±6.5 [62;92]
Gender, N (%)	128;39.8	20;51.3
Education (years)	14.48±4.1[0;20]	14.85±3.5[6;20]
Hypertension, N (%)	211;65.5	30;76.9
Diabetes, N (%)	85;26.4	9;23.1
Cerebral stroke event	0.18±0.56[0;2]	0.28±0.60[0;2]
FW	0.21±0.04[0.13;0.39]	0.25±0.06[0.16;0.46]

Table 1: Subjects' characteristic by AF category. AF = Atrial fibrillation, FW = Free water. Continuous variable: mean ± sd [min; max]

Analysis

- The medical history of AF served as the independent variable (AF+/AF- group), and mean FW and FA, derived from DTI, served as the dependent variables.
- Two linear regression models were used for each independent variable to investigate the association with AF, with control for confounding variables.
- In model 1, age, sex, and education were adjusted.
- Model 2 consisted of model 1 with the addition of adjustment for diabetes, hypertension, and history of cerebral stroke events.

Results

- A medical history of AF was independently associated with increased cerebral FW (β_1 = 0.017, p = 0.010) and decreased FA (β_2 = -0.015, p = 0.034) (Figure 1).
- Additional adjustment for vascular risk factors did not significantly change these associations (p < 0.05).

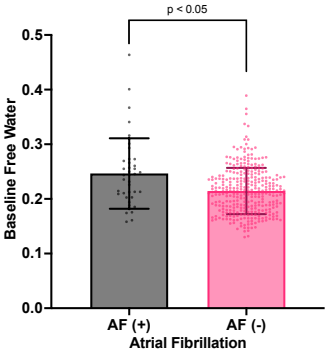

Figure 1 – a: FW according to AF groups. FW is significant higher in AF(+) group (p < 0.05). FW measures were residualized against age, sex, education

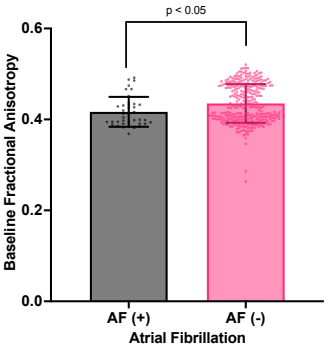

Figure 1 – b: FA according to AF groups. FA is significant lower in AF(+) group (p < 0.05). FW measures were residualized against age, sex, education

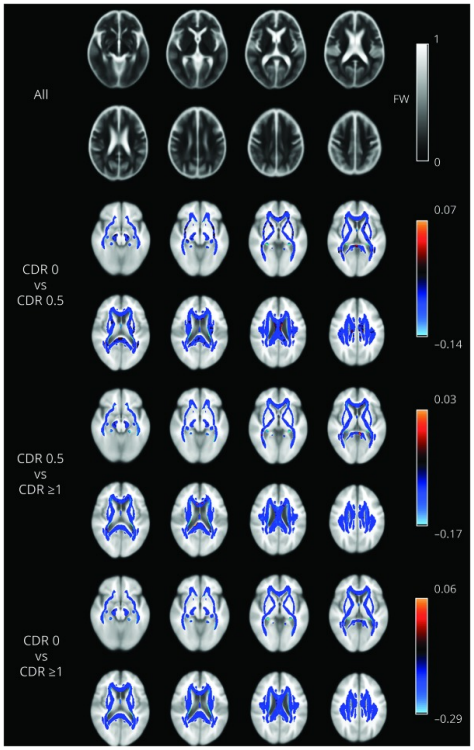

Figure 2: Average map of FW values across ADRC cohort and differences in FW values between CDR stages[6]. FW = free water, CDR = Clinical Dementia Rating

Conclusions

- Our results suggest that AF is a risk factor for CVD, independent of common vascular risk factors.
- The novelty of this study lies in using FW and FA as biomarkers to investigate the relationship between AF and CVD.
- The strength of this study includes the large sample size and diverse patient sample representative of the population.
- A limitation is the lack of control for additional vascular risk factors related to lifestyle, including smoking history and exercise habits.
- Future direction includes controlling for additional vascular risk factors and Further investigation of the pathophysiological mechanisms of how AF may potentially lead to CVD.

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