Light transmittance in human atrial tissue and transthoracic illumination in rats support translatability of optogenetic cardioversion of AF

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Funding Acknowledgements: Type of funding sources: Public grant(s) – EU funding. Main funding source(s): European Research Council (Starting grant 716509 to D.A.P.) the Netherlands Organization for Scientific Research (Vidi grant 91714336 to D.A.P.)

Background: Optogenetics could offer a solution to the current lack of an ambulatory method for rapid automated cardioversion of AF, but key translational aspects remain to be studied.

Objective: To investigate whether optogenetic cardioversion of AF is effective in the aged heart and whether sufficient light penetrates the human atrial wall.

Methods: Atria of adult (7 weeks old) and aged (2 years old) rats were optogenetically modified to express light-gated ion channels (i.e. ReaChR), followed by AF induction and atrial illumination to determine effectivity of optogenetic cardioversion. The irradiance level was determined by light transmittance measurements on human atrial tissue.

Results: AF could be effectively terminated in remodelled atria of aged rats (97%, n=6). Next, in terms of ReaChR activation, it was shown that light pulses of 25mW/mm² are expected to fully penetrate the human atrial wall (~2 mm). Applying such irradiation onto the chest of adult rats resulted in full transthoracic illumination (also ~2 mm) as evidenced by optogenetic cardioversion of AF (90%, n=4).

Conclusion: Optogenetic cardioversion of AF is effective in the aged rat heart and can also be realized with irradiation levels compatible with human atrial transmural light penetration.