Beneficial effects of Head-elevation during Controlled Automated Reperfusion of the WhoLe Body (CARL) in the pig model

Domagoj Damjanovic¹, Joerg Haberstroh², Katharina Foerster¹, Martin Wolkewitz³, Itumeleng Taunyane¹, Yechi Liu¹, Jan-Steffen Pooth¹, Rita Fastenau¹, Fabienne Frensch¹, Tabea Neubert¹, Manuela Wieser⁴, Christian Scherer¹, Patric Diel¹, Christoph Benk¹, Friedhelm Beyersdorf¹, Georg Trummer¹

¹Department of Cardiovascular Surgery, University Heart Center Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany. ²Experimental Surgery, Center for Experimental Models and Transgenic Service, University Medical Center Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany. ³Institute of Medical Biometry and Statistics, Division Methods in Clinical Epidemiology, Faculty of Medicine and Medical Center - University of Freiburg, Freiburg, Germany. ⁴Center for Experimental Models and Transgenic Service, University Medical Center Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany

INTRODUCTION

Therapy bundles rather than single interventions might improve outcomes in cardiac arrest, CA. However, studying such bundles is challenging. While failing to reproduce historic results in our porcine CA model for controlled automated reperfusion of the whole body (CARL) using extracorporeal circulation (ECC) we deconstructed the therapy bundle and identified head elevation as a confounder for neurologic outcome. Consequently, we studied head elevation as an intervention during CARL

METHODS

In 45 anesthetized pigs, after 20 minutes of normothermic CA, CARL was used as a bundle for targeted resuscitation. Neurological status was followed up for 7 days with a species-specific neurological deficit score (NDS). Animals with NDS < 50 were able to stand up independently, walk without help and eat on their own. NDS < 50 was therefore considered a good neurological outcome. Linear mixed models were used for statistical analysis.

RESULTS

44/45 pigs were successfully weaned from ECC after 1 hour of CARL. 25/45 pigs underwent CARL with head elevation, the other 20 flat supine. Animals in the heads-up group showed significantly better neurological recovery (NDS<50) compared to flat supine head position, 21/25 (84%) vs 6 /20 (30%). 11 animals in the heads-up group and 5 animals in the flat-supine group even showed no neurological impairment on day 7 (NDS 0). After adjusting for different confounders, head positioning proved to be an independent factor in neurological recovery ($p<0,00012$).

% Neurologically favorable survival

CONCLUSION

These results show for the first time, that elevation of the head as a simple intervention is beneficial in the therapy bundle of CARL, in terms of a favorable neurologic outcome even after 20 minutes of no-flow time.