Detection of Na+ Stores in the Myocardium and Skeletal Muscle of DOCA Treated Mice Using 23Na-MRI

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- Fluid and Electrolytes: Basic - I
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Background

Disturbances in Na^+ homeostasis with accumulation of Na^+ in tissue are present in salt sensitive hypertension. Tissue Na^+ distribution could be recently visualized in vivo by ^{23}Na-MRI. If Na^+ accumulation occurs also in organs of the cardiovascular system is unknown. We hypothesized that the myocardium is able to absorb significant amounts of Na^+ that could be detected by ^{23}Na-MRI.

Methods

DOCA-pellets were implanted in 10 male FVB mice while a sham procedure was performed on 10 FVB mice. Subsequently, both groups received 1% NaCl water for 2 weeks. ^{23}Na-MRI at 7Tesla was used to quantify Na^+ in heart and skeletal muscle. Furthermore, electrolytes were determined chemically in both tissues. In a fraction of mice intracellular Na^+ of the myocardium was measured by electron beam microscopy. Echocardiography was performed and blood pressure determined.

Results

Compared to control mice DOCA treated mice showed a significantly higher Na^+ content in skeletal muscle (27.0 ± 5.7 vs. 46.6 ± 8.9 mmol/l, $p<0.001$) and in heart muscle (61.6 ± 9.1 vs. 73.7 ± 11.7, $p<0.05$, figure 1). The fraction of bound Na^+ was increased in DOCA skeletal muscle (6.4 ± 0.8 vs. 13.0 ± 4.3 a.u., $p<0.05$) suggesting intracellular Na^+ accumulation. Electron beam microscopy of heart muscle also detected a higher intracellular Na^+ amount in DOCA animals compared to controls (0.12 ± 0.03 (n=4) vs. 0.29 ± 0.01 a.u. (n=3), $p<0.001$).

Chemical electrolyte analysis confirmed Na^+ accumulation in both tissues. A reduced ejection fraction (74 ± 4 vs. 46 ± 15%, $p<0.05$) and hypertension was found in DOCA animals.

Conclusion

Na^+ accumulation occurs intracellularly in skeletal muscle and in heart muscle in vivo upon DOCA salt treatment indicating Na^+ uptake rather than extracellular accumulation. Increased Na^+ content of the myocardium might directly contribute to cardiac dysfunction.

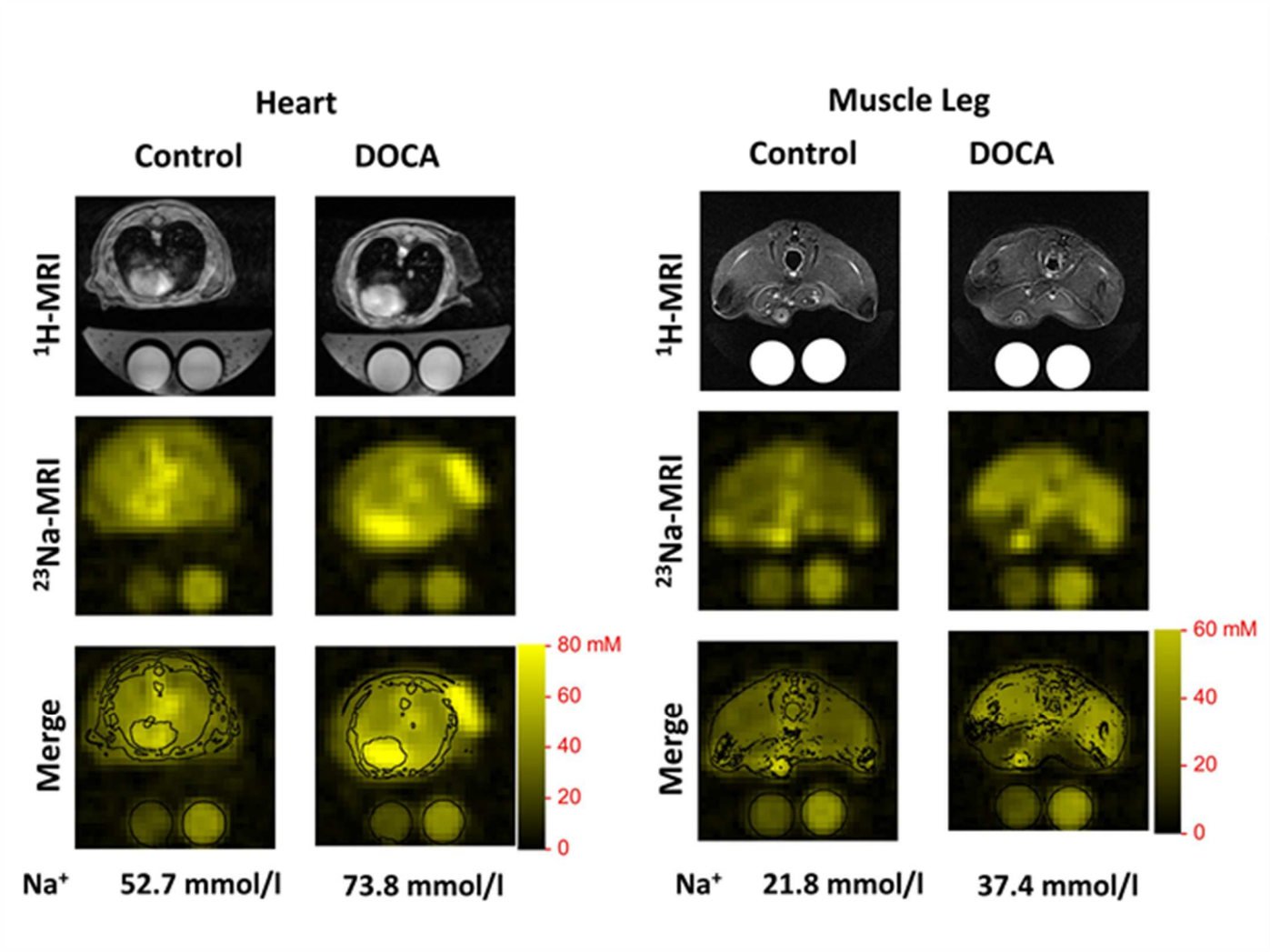

Figure 1, representative MR images.

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