Cardiac arrhythmias during epilepsy linked to alterations of the adrenergic regulation of the cardiac sodium current

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Introduction: Evidence indicate that cardiac arrhythmias are involved in sudden death during epilepsy (SUDEP) and Dravet Syndrome and suggest that expression of non-cardiac sodium channels (neuronal) in the heart contributes to them. We will present an overview of the latest developments on the role of these channels to arrhythmia linked to epilepsy and non-cardiac diseases.

Methods: We used a rat model of temporal lobe epilepsy (the most common form) to study how expression of neuronal sodium channels in the heart may alter the cardiac adrenergic response of the sodium current (INa) during epilepsy. We used the patch clamp technique to measure INa response to isoproterenol in acutely dissociated ventricular and atrial cells.

Result: Epilepsy triggered expression of neuronal sodium channels in the heart. This overexpression of non-cardiac sodium channels increased the late sodium current by more than 50% and the sensitivity of the cardiac sodium current INa to isoproterenol. As a consequence, the duration of the ventricular action potential was prolonged by 40% during epilepsy. These changes are likely to alter cardiac conduction. Moreover, prolongation of the action potential duration is likely to result in increase the QT interval on the electrocardiogram at rest but also during an epileptic ictus. Long QT interval is a well-known trigger of Torsade de pointes arrhythmias.

Conclusion: Our results provide a basis to explain the QT prolongation and the conduction problems observed in epileptic patients and suggest that their heart may be prone to develop arrhythmia during adrenergic modulations commonly observed during seizures. Our data provide a potential link between alterations of INa, arrhythmia during epilepsy and SUDEP.