



## H164 Postmortem Cardiac-Magnetic Resonance (PMCMR) Protocol in Sudden Cardiac Deaths (SCDs)

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**Learning Overview:** After attending this presentation, attendees will better understand the advantages and limitations of postmortem imaging techniques in the study of SCDs. A protocol for an adequate image acquisition and its preliminary results will be presented.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by pointing out the importance of PMCMR and its ability to detect pathological myocardial alterations. It will be demonstrated that PMCMR is useful in the study of SCDs, showing a good correlation with autopsy results.

SCD is defined as abrupt and unexpected death that occurs due to cardiac causes, with sudden loss of consciousness within 1 hour from the onset of symptoms when death is witnessed, and within 24 hours of last being seen alive and well when it is unwitnessed. Its main characteristics are related to the non-traumatic genesis and the immediate precipitation of events. Sudden deaths account for 15%–20% of forensic cases. The most frequent causes of SCD are represented by Ischemic Heart Disease (IHD) secondary to Coronary Artery Disease (CAD), followed by primary cardiomyopathies (10%–15%; most frequently hypertrophic cardiomyopathy and arrhythmogenic right ventricular dysplasia), valvular heart disease (5%), and coronary artery anomalies (e.g., anomalies of origin, myocardial bridging). In 5% of cases, no structural cardiac alterations can be documented, but ion channel gene alterations (i.e., channelopathies) can be detected. However, in a minority of cases (5%–20%), the heart appears macroscopically and microscopically normal and no diagnosis can be established (*mors sine materia*).

In order to reduce the cases of death *sine materia*, it is necessary to adopt a correct and rigorous autopsy procedure, collecting and examining the clinical-anamnestic and circumstantial data. Also, Postmortem Magnetic Resonance (PMMR)—in addition to autopsy and classic gross/histological/immunohistochemical investigations—has proven useful in better detecting diagnostic possibilities, especially in the case of SCD.<sup>1</sup> PMCMR has been successfully applied as an ancillary exam to identify myocardial pathological findings, allowing visualization of thin transverse sections of myocardial tissue, which are not possible with routine autopsy and gross examination.<sup>2</sup>

Despite the fact that PMCMR has shown high sensitivity and specificity in the identification of heart diseases, it is currently performed only in a few select cases rather than routinely. The main reasons for its limited application seem to be related to the time of execution and the complexity of the MR technology. Moreover, most of the studies in literature describe PMCMR conducted prior to autopsy with the heart *in situ*. However, examining hearts *ex situ* shows considerable advantages, including overcoming logistical problems of body transport, time constraints, and interference with routine clinical activity. As an adjunct, fixation of the heart in formalin, as required by the autopsy protocol for SCDs, allows for preservation of the organ at room temperature, preserving from postmortem alterations and allowing for PMCMR examination a second time after the autopsy.<sup>3</sup>

Presented is a PMCMR study protocol of the entire formalin-fixed heart *ex situ* using high-resolution 2D-Steady-State Free Precession (SSFP)/3D-SSFP sequences, and T1-weighted (T1w), T2-weighted (T2w), and Proton Density (PD) Fast Spin Echo (FSE) sequences to obtain information on cardiac morphology, to identify ventricular anomalies (e.g., intramyocardial coronary bridging, aneurysms, symmetric or asymmetric hypertrophy of the ventricular wall, papillary muscle abnormalities, valvular anomalies, etc.) and to obtain quantitative parameters (i.e., Left Ventricular/Right Ventricular [LV/RV] mass, ventricular mass, atrial dimensions, aortic and pulmonary root diameters).

### Reference(s):

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2. Guidi B., Aquaro G.D., Gesi M., Emdin M., Di Paolo M. Postmortem cardiac magnetic resonance in sudden cardiac death. *Heart Fail Rev.* 2018;23(5):651-665.
3. Basso C., Aguilera B., Banner J., et al. Guidelines for autopsy investigation of sudden cardiac death: 2017 update from the Association for European Cardiovascular Pathology. *Virchows Arch.* 2017;471(6):691-705.

### Sudden Cardiac Death, Postmortem Imaging, PMCMR