

Abstract

Cardiac repolarization abnormalities are strongly associated with channelopathies, cardiomyopathies, and sudden death at all ages. Currently, the only method available for monitoring the underlying electrical activity of the fetal heart is a fetal magnetocardiogram (fMCG). A unique and important capability of fMCG is assessment of fetal cardiac repolarization; however, repolarization has not been extensively investigated, even in normal fetuses. We examined the repolarization characteristics of normal and Long QT Syndrome (LQTS) fetal populations. Marked prolongation of the QT interval is a defining characteristic of LQTS. The only way to noninvasively detect LQTS *in utero* is by performing an fMCG. In this study, we documented and compared the repolarization characteristics of the two groups. We also analyzed the incidence of severe arrhythmias associated with LQTS and the different presentations of LQTS by LQTS type. Although our findings imply that many high-risk fetuses would benefit from an fMCG, the technique is not widely used. FMCG is unlikely to transition into the clinic in its current state due to the high cost of purchasing and operating a superconducting quantum interference device (SQUID) in a magnetically shielded room (MSR). Cheaper, more practical technology need to be developed. We have assembled an fMCG system that combines a new type of sensor, known as an optically pumped magnetometer (OPM), with a person-sized cylindrical shield (CS). We show that the OPM-CS system can perform as well as a SQUID-MSR system at a small fraction of the cost. We believe this advance can enable fMCG to be much more widely available in the future.