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Calculation of Optical Signal using Bidomain/Diffusion model Reveals Exponential Decay of Transmembrane Potential PHIL PRIOR, BRAD ROTH, Oakland University — The understanding of how the transmembrane potential is affected during ventricular defibrillation is important in electrocardiology. One way of experimentally determining the potential is through optical mapping using voltage-sensitive fluorescent dyes. The fluorescent light of these dyes originates from a few millimeters below the tissue surface as well as at the surface, causing the optical signal to be averaged over a depth. In our study, the transmembrane potential is calculated in a 3-D cube of cardiac tissue located between two point electrodes. The transmembrane potential and optical signal have been numerically calculated using a Bidomain / Diffusion model. This model has the advantage of combining the electrical properties of cardiac tissue represented by the bidomain model with the equations that describe photon diffusion in turbid media. Our results show that the average transmembrane potential is greatly affected by lateral optical averaging as well as averaging over depth. We conclude that the effect of averaging is greater near the electrode than far from it. The result is that the averaged signal falls off more readily as a single exponential than does the surface transmembrane potential.

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