ABSTRACT

Pacemaker and defibrillator lead wires fail stochastically, requiring the surgical implantation of a new lead. Whenever a lead fails, it may be beneficial to extract one or more of the failed leads currently implanted, including previously abandoned leads. Extracting a lead carries life-threatening risks that increase in the dwell time of the lead. However, there are situations in which extraction is not optional: the total number of implanted leads (both failed and functioning) is subject to a maximum limit, typically five, and infections can occur requiring the mandatory extraction of all implanted leads. To study the tradeoff between avoiding risky extractions and maintaining space for future leads, we develop Markov decision process models to determine patient-specific extraction policies for various types of cardiac devices as a function of patient age and the age of every implanted lead. We use clinical data to calibrate the model and present insightful numerical results, including comparisons to heuristics commonly used in practice.
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