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## Reducing inappropriate therapy in defibrillators—can we count on mathematical models?

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Implantable cardioverter defibrillator  
Inappropriate shocks

### 1. Introduction

Inappropriate arrhythmia detection is a vexing clinical issue which has detrimental clinical effects. Tackling this is an important aspect in clinical electrophysiology, and innovations in device programming have been proved useful. A risk predictive model to identify those who are more likely to have inappropriate arrhythmia detection by the device would be a useful innovation that will permit tailored programming of the device and protect from the inherent drawbacks of inappropriate arrhythmia therapy.

In the study published in this issue of the journal, Lebedeva et al. have designed a predictive logistic model for detecting episodes of true ventricular tachycardia (VT) in patients who had an implantable cardioverter-defibrillator (ICD). Of the 83 patients who underwent an ICD implantation for primary prevention indication, the majority of the devices (65) had an atrial lead (45 CRT-D devices, and 20 dual chamber ICDs), and all the patients had a uniform 2-zone programming for VT detection. A change from this standard programming was reserved for those with an inappropriate VT detection. Apart from the standard discrimination algorithm used by the device, the electrograms were also reviewed by two electrophysiologists and a device support specialist. Arguably, this methodology has imparted a uniformity of device programming and also improved the diagnostic accuracy of the arrhythmia episode. The use of a decision tree model using the relevant parameters derived by logistic regression analysis predictive of inappropriate ICD therapy makes the study interesting.

During a mean 10.75 (2.3–24.5) month follow up period, there were 256 episodes of non-sustained ventricular tachycardia (NSVT), and 114 episodes of VT/Ventricular fibrillation (VF) detected by the ICDs. Of more concern, there were 181 episodes of inappropriate shocks and 22 (out of 108) episodes of inappropriate antitachycardia pacing (ATP). These figures are comparable to other studies with similar follow up, like the MADIT II trial which reported an incidence of 31.2% [1]. Further, the authors observed

that atrial fibrillation and supraventricular tachycardia were the most common factors responsible for the inappropriate arrhythmia detection. Similar to the present study, these two arrhythmias together accounted for most (80%) of the inappropriate arrhythmia detection in the MADIT II as well. Atrial fibrillation was a powerful predictor of inappropriate therapy in other studies as well [2–4]. The incidence of inappropriate therapy is higher in studies including secondary prevention indication for ICD as compared to primary prevention alone, and sinus tachycardia is more common than atrial fibrillation as the cause of inappropriate therapy in many other studies [5–8].

In an interesting turn, this study also identifies 5 predictive factors based on a mathematical model, four of which deal with atrial arrhythmias and the fifth one being a sinus rate higher than 70 bpm. Using logistic regression using these factors, a 4 zone risk estimation model is derived and subsequently validated in a matched cohort of 40 patients. It is indeed exciting to have a simple model capable of predicting inappropriate arrhythmia therapy, and atrial fibrillation being a potent predictor of inappropriate therapy the present model sounds logical as well. It is known that the arrhythmia discrimination function is inaccurate at higher arrhythmia rates, and studies have shown that programming to higher detection rates or longer detection duration has reduced the incidence of inappropriate therapy without compromising appropriate ICD interventions [9,10]. Thus, the current model may be seen as a screening tool to choose which patient may benefit from such tailored programming modifications.

Of note, there are a few limitations for the present study. Apart from its retrospective nature, the study didn't include any other predictor which is independent of the atrial arrhythmia or the rate. To be specific, the incidence of inappropriate therapy in ischemic versus nonischemic substrate may be different and is not addressed in this study. Similarly, other factors like diastolic hypertension, use of statins, antiarrhythmic drugs, and the QRS duration which were found to be predictors of inappropriate therapy in various other studies cited above were not studied. The incidence of inappropriate therapy in patients with cardiac resynchronisation devices was found to be lower than that in ICD in previous studies [3,11,12].

None the less, inappropriate therapy is an important clinical issue given its detrimental effects on the long term prognosis. Any effort in preventing it is a welcome step towards the improvement of patient care, and the current study is a good effort in this direction. Perhaps, validating the model with larger prospective studies may help to reduce inappropriate therapy which is the price paid for getting protected against sudden cardiac death.

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### Conflicts of interest

None of the authors have any competing interests or conflicts of interests to declare.

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