New Implantable Technologies Improve Prognosis of Patients With CHF

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The prognosis of patients with chronic heart failure (CHF) can be influenced greatly by new technology in cardiovascular implantable electronic devices, including nontransvenous implantable cardioverter defibrillators (ICDs), leadless pacing, and cardiac resynchronization therapy (CRT).

NEW SENSORS IN CARDIOVASCULAR IMPLANTABLE ELECTRONIC DEVICES

An ICD can be used to collect high-quality physiologic data in patients with CHF, alerting physicians to CHF decompensation, said John P. Boehmer, MD, Penn State College of Medicine, Hershey, Pennsylvania, USA. Implantable device technology in ICDs and CRT-defibrillators with associated remote monitoring systems may better identify worsening status than systems with single sensors. Data show that S3 subaudible frequency, tidal volume, and rapid shallow breathing can predict a heart failure event.

The MultiSENSE clinical trial [NCT01128166], with 900 enrolled patients, collected data simultaneously from multiple sensors in CRT-defibrillators to develop algorithms for early detection of worsening HF. In preliminary data, differences in combined S3 audible and subaudible frequencies (6-70 Hz) between the CHF group and non-CHF group were statistically significant ($P = .03$), demonstrating that this parameter appears superior to the audible-alone component in distinguishing patients with CHF from those without CHF. Rapid shallow breathing worsened prior to heart failure events; relative tidal volume and minute ventilation did not change significantly. Index of rapid shallow breathing (respiratory rate/tidal volume) showed even greater change than respiratory rate. In addition, a high variability in respiratory rate carried a 4.9-fold increased risk of heart failure events within 30 days, said Dr Boehmer.

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In another trial, PRE-SENSE [Klodas E et al. *J Card Fail.* 2013], S3 amplitude significantly correlated with several key echocardiographic parameters. Significant separation was seen between the low and high S3 groups, measuring left ventricular (LV) ejection fraction, LV volume, left atrial volume, and diastolic filling (E and A waves).

NONTRANSVENOUS ICD

Long-term results of nontransvenous ICDs show a very high shock efficacy, reliable detection and discrimination, complication-free rate/low mortality beyond the first year, and no endovascular infection or electrode failure, said Andrew Grace, PhD, University of Cambridge–Papworth Hospital, Cambridge, United Kingdom. These results were observed in a broad patient range and improved with operator experience.

According to Prof Grace, leads are the "weakest link" of defibrillators, causing venous obstruction, thrombosis, infection, and inappropriate shocks in $> 20\%$ of patients. Simpler systems with subcutaneous electrodes can avoid lead issues.

A totally subcutaneous ICD had a complication-free rate of 99% and an acute ventricular fibrillation conversion rate $> 90\%$ at 180 days [Weiss R et al. *Circulation.* 2013]. Pooled 2-year results of the IDE study and EFFORTLESS registry showed that spontaneous shock efficacy of the subcutaneous ICD was 90.1% for first shock and 98.2% within 5 available shocks for an episode [Burke MC et al. *J Am Coll Cardiol.* 2015]. The most recently implanted quartile of patients had a lower rate of inappropriate shocks at 6 months (Q1: 6.9%, Q4: 4.5%), although this did not reach statistical significance. The incidence of inappropriate shocks with dual-zone programming was lower than single zone ($P = .001$). The complication-free rate was 90.6% through follow-up, with neither systemic blood infections nor electrode failures, noted Prof Grace.

LEADLESS PACING

Leadless right ventricular cardiac pacing is safe and feasible with proof of principle for subacute retrieval, said Petr Neuzil, MD, PhD, Na Homolce Hospital, Prague, Czech Republic. Benefits of a transcatheter leadless approach include reduced invasiveness and improved efficiency and outcomes. In the LEADLESS study [Knops RE et al. *J Am Coll Cardiol.* 2015], a feasibility study of leadless cardiac pacing, procedure times included a mean introducer time of 28 minutes (range, 11 to 74 minutes), a catheter in/out time of 16 minutes (range, 3 to 57 minutes), and a mean of 0.5 catheter repositionings (range, 0 to 3). Mean time from procedure to hospital discharge was 1 day (range, 1 to 4 days).

Early performance of the Micra leadless transcatheter pacing system was evaluated in 140 patients with class I or II indication for ventricular inhibited pacing [Ritter P et al. HRS 2015 (abstr AB06-06)]. Freedom from major complications at 6 months was >83%, and >80% of patients demonstrated low and stable pacing thresholds, said Prof Neuzil.

Eliminating the coronary sinus lead improves therapy for all CHF patients, said Prof Neuzil, and is compatible with all manufacturers' devices. Leadless pacing complements the subcutaneous ICD platform, allowing for delivery of anti-tachycardia pacing, pacing medications, bradycardia pacing support, and enhanced intracardiac sensing.

CRT ADVANCES FOR NONRESPONDERS

Philippe Ritter, MD, Hôpital du Haut-Lévêque, Bordeaux-Pessac, France, discussed improving outcomes in nonresponders to CRT. Electrocardiographic mapping can improve CRT efficacy through evaluation of electrical synchrony. Nonspecific intraventricular conduction delay reveals intermediary results between narrow and left bundle branch block. When no LV electrical dysynchrony is observed, however, CRT is not useful.

Advances in echocardiographic imaging provide preimplant assessment of ventricular dysynchrony and an accurate estimate of the amount and location of scar zones, allowing for intra-implant guidance of LV and right ventricular lead position. Comorbidity with kidney disease is associated with higher mortality even when short-term response is good. Follow-up of complicated patients at a multidisciplinary CRT clinic vs conventional follow-up resulted in greater event-free survival (P=.0015) [Altman RK et al. *Eur Heart J.* 2012].

Some actions to improve outcomes include avoidance of apical sites, a preference for the latest activated segments, avoidance of scar zones, and use of cardiac magnetic resonance imaging to optimize lead position.