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Novel technologies to diagnose and manage cardiovascular disease

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EDITORIAL

Novel technologies to diagnose and manage cardiovascular disease

Novel technologies (Cardiac Biomarkers, Genomic and Personalised Medicine, Implantable Devices and Therapies, Artificial Intelligence (AI), Telemedicine and Remote Monitoring) for diagnosing and managing cardiovascular disease (CVD) have emerged with advancements in medical technology. These innovative tools and approaches aim to improve the accuracy, efficiency, and effectiveness of CVD diagnosis and treatment [1]. AI algorithms can analyse large datasets, including medical images, genetic data, and patient records, to identify patterns and predict CVD risk more accurately. Machine learning models can assist in diagnosing conditions such as arrhythmias, heart failure, and coronary artery disease.

Medical doctors can utilise ChatGPT for accessing up-to-date medical information, assisting in clinical decision-making, and improving patient education. It can provide support in continuing medical education through materials and interactive modules. ChatGPT also aids in research by providing literature reviews, summarising articles, and generating research hypotheses, thereby streamlining the research process [2–4]. Teperikidis et al. conducted an extensive PubMed search for systematic reviews and meta-analyses. Two reviewers assessed study eligibility, extracted data, and evaluated methodological quality. The study focused on adults using proton pump inhibitors (PPIs) for at least three months, with outcomes categorised as major adverse cardiac events (MACE). Control groups included placebo or active comparators, with no time restrictions but limited to English reports. Simultaneously, another group used ChatGPT for the same process, comparing results. Seven reviews involving 46 randomised trials and 33 observational studies were included, indicating a potential link between PPI use and increased MACE risk. Further research is needed to understand this relationship's nuances and implications for patient care. ChatGPT proved effective in executing review tasks, showing promise for future evidence synthesis [5].

Innovations in implantable devices, such as pacemakers, defibrillators, and left ventricular assist devices, offer advanced therapeutic options for managing arrhythmias, heart failure, and other cardiac conditions. Cardiac resynchronisation therapy (CRT) may benefit chronic heart failure patients with existing cardiac implantable electrical devices [6–8]. In the Mannheim CRT Registry (MARACANA), a retrospective analysis of CRT implantations from 2013 to 2021 ($n = 459$), including 136 upgrade procedures, revealed significant improvements in heart failure symptoms and left ventricular function over the long-term (59.3 ± 5 months) [9]. Similarly, a separate study aimed to compare clinical and procedural outcomes between patients undergoing de novo CRT implantation and those undergoing CRT upgrades. Success rates for the procedure were high in both groups, with significant improvements observed in left ventricular ejection fraction (LVEF), severity of mitral regurgitation, and New York Heart Association (NYHA) functional classification. While procedural complications were slightly higher in the upgrade group, there was no significant difference in postoperative outcomes between the two groups [10]. Overall, upgrading to CRT appears to be a safe and effective procedure for improving functional status and left ventricular function.

Pittie et al. rigorously tested the AFIAS Tn-I Plus assay, ensuring it met CLSI guidelines for sensitivity, precision, and accuracy. Results showed consistent performance within specified limits for detection and quantification of troponin levels. Reference values for healthy individuals were established, aiding in diagnostic assessments. The assay demonstrated high diagnostic sensitivity and specificity, surpassing 95% in both measures. Comparison with an established assay from Abbott revealed no significant differences in diagnosing acute myocardial infarction. Overall, the evaluation concludes that the AFIAS Tn-I Plus assay is reliable and suitable for routine clinical use, offering comparable performance to established assays [11].

Compared to surgical aortic valve replacement (SAVR), transcatheter aortic valve implantation (TAVI) often leads to conduction disturbances, notably new-onset left bundle-branch block (LBBB) and high-degree atrioventricular block necessitating permanent pacemaker implantation, which continue to be prevalent complications [12–15]. The present survey evaluated experienced operators' approaches to conduction system disorders in

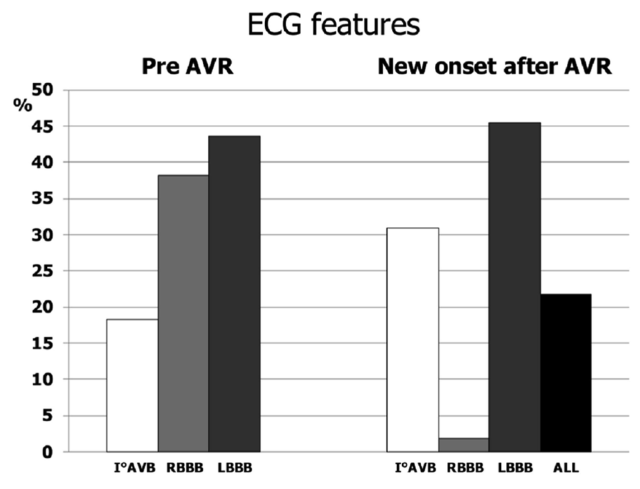

Figure 1. ECG worst prognostic factor for pacemaker implantation according to survey respondents. (A) before aortic valve replacement (AVR); (B) new onset after AVR (From reference [16]).

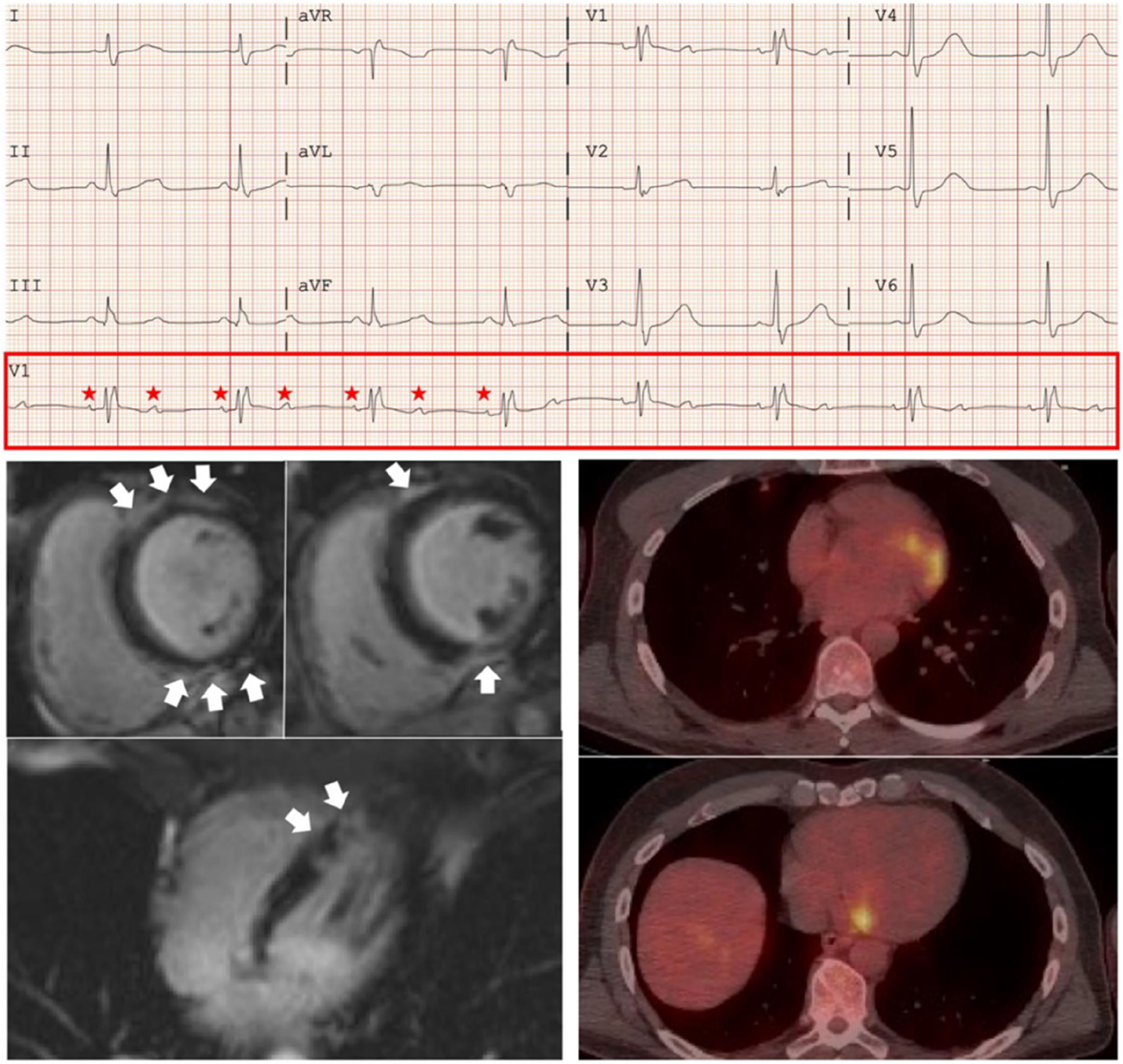

Figure 2. Patient with conduction disorders in Cardiac Sarcoidosis. ECG showing second degree atrioventricular block 2/1. Cardiac magnetic resonance imaging showing patchy mid-wall and subepicardial late gadolinium enhancement (LGE) involving the infero-basal, infero-septal-apical and antero-basal segments of the left ventricle compatible with myocardial fibrosis. Positron emission tomography (PET) showed infero-basal and antero-basal myocardial 18 F-Fluorodoxyglucose uptake (From reference [33]).

patients undergoing SAVR or TAVI. It comprised 24 questions covering respondents' profiles, centre characteristics, and management of conduction disease in various scenarios. Fifty-five physicians from 55 Italian arrhythmia centres participated, revealing rare prophylactic pacemaker implantation and differing wait times for definitive pacemaker implantation after aortic valve replacement procedures. Bundle branch blocks, especially pre-existing LBBB, were deemed significant prognostic factors for pacemaker implantation after TAVI. The survey highlighted a reduction in waiting time for pacemaker implantation post-aortic valve replacement, with anticipated differences between SAVR and TAVI, and showed heterogeneity in pacemaker selection for patients with new-onset LBBB and without severe left ventricular systolic dysfunction (Figure 1) [16].

Leadless pacemakers represent a revolutionary advancement in cardiac pacing technology, offering a minimally invasive alternative to traditional pacemakers by directly pacing the heart without the need for leads or a surgical pocket [17,18].

Diagnosis and treatment of cardiovascular manifestations of COVID-19 require a comprehensive approach due to the virus's propensity to affect the cardiovascular system. Clinicians employ various diagnostic tools, including imaging studies and biomarker analysis, to identify cardiac involvement, including myocarditis, arrhythmias such as atrial fibrillation, and thromboembolic events. Treatment strategies often involve a combination of supportive care, antiviral therapy, and management of cardiovascular complications and thromboembolism. Close monitoring and multidisciplinary collaboration are essential to optimise outcomes in patients with COVID-19-related cardiovascular issues [19–22].

Genetic testing and genomic profiling help identify individuals at increased risk of developing certain cardiovascular conditions, allowing for personalised risk assessment and targeted interventions. Pharmacogenomic testing can guide the selection of medications and dosage adjustments based on genetic variations, improving treatment outcomes, and reducing adverse drug reactions. The present study aimed to explore the potential link between tinnitus and CVD risk, as well as all-cause mortality. Using data from the UK Biobank, a prospective cohort study was conducted, with tinnitus assessed *via* questionnaire. Results from 140,146 participants revealed that tinnitus was associated with a higher incidence rate of cardiovascular events, particularly myocardial infarction (MI), and all-cause mortality. However, no significant association was found between tinnitus and stroke or mortality from CVD. Subgroup analysis indicated significant associations in certain groups, including females and those without hearing difficulty, depression, or anxiety. These findings support the notion of a relationship between tinnitus and increased CVD risk and mortality [23].

The management of CVD seeks to alleviate symptoms, improve quality of life, and prevent cardiovascular events. This involves a multifaceted approach incorporating medical therapy, such as sodium/glucose cotransporter-2 inhibitors (SGLT2i) for diabetic and non-diabetic patients [24,25], as well as treatment of hypercholesterolaemia [26,27] and correction of blood pressure [28]. Lifestyle adjustments, including dietary changes and exercise, are also essential components. In their study, Abdel-Hady showed that chromium supplementation could mitigate hypoxia-induced cardiovascular dysfunction by enhancing antioxidant capacity, offering potential therapeutic benefits [29].

Acute exposure to extreme altitude increases arterial stiffness through various physiological mechanisms, posing a cardiovascular risk. This pilot study aimed to explore how temporary exposure to moderate altitude, such as during recreational activities or air travel, affects vascular tone. Eight healthy individuals underwent pulse wave analysis at baseline (521 m) and after 24 h at moderate altitude (2650 m). Results showed significant increases in heart rate, central and peripheral pulse pressure, and pulse wave amplitudes, indicating mild changes in vascular tone. While the effects observed were mild, they underscore the importance of adaptation capacity, particularly in individuals with health conditions or ageing, even at moderate altitudes [30].

Coronary atherosclerotic heart disease (CAD) is characterised by inflammation and atherosclerosis. This study investigates the role of the long non-coding RNA PVT1 (PVT1) in human coronary artery endothelial cells (HCAECs). Overexpression of PVT1 enhances cell viability and migration while reducing apoptosis in HCAECs, whereas miR-532-3p has opposite effects. PVT1 regulates miR-532-3p expression, which in turn modulates MAPK1 levels. These findings suggest that targeting PVT1 may hold promise as a therapeutic strategy for CAD [31].

Heart failure (HF) affects over 26 million people globally, with prevalence exceeding 10% in those over 80 years old. Despite treatment advancements, HF patients often face poor quality of life and high morbidity and mortality rates. Periodontal disease (PD), an inflammatory condition, is linked to various cardiovascular diseases. Leelaviwat et al. conducted a meta-analysis of three cohort studies involving 17,807 patients, revealing a 58% increased risk of HF in individuals with PD. This suggests a significant association between PD and HF risk. Improving oral health could potentially reduce HF risk, although larger studies are needed to confirm this [32].

In this issue of Acta Cardiologica, alongside the original article mentioned, several focus images have also been featured (Figure 2) [33,34].

Disclosure statement

No potential conflict of interest was reported by the author(s).

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