BIOMARKERS

Troponin I in CVD risk prediction

In the acute setting, high-sensitivity troponin I and T (hs-TnI and hs-TnT) assays enable the early risk stratification of patients with suspected acute coronary syndrome. Given that these assays can detect much lower concentrations of troponins in plasma than conventional assays, they might have a role in the risk stratification of individuals without known cardiovascular disease (CVD). A new study published in *Circulation* now reports that hs-TnI is strongly associated with global CVD and all-cause mortality in people without prior coronary heart disease or heart failure.

In total, 8,121 individuals aged 54–74 years without clinical CVD from the ARIC cohort were included in the analysis, and followed up for approximately 15 years. Elevated levels of hs-TnI (≥3.8 ng/l) in plasma were associated with higher incidence of coronary heart disease, ischaemic stroke, atherosclerotic CVD, hospitalization for heart failure and all-cause mortality than low levels of hs-TnI (≥1.3 ng/l), independent of traditional risk factors. HsTnI was more strongly associated with global CVD in white individuals than in black individuals.

Although both hs-TnI and hs-TnT are used to diagnose acute myocardial infarction, only a weak correlation was observed between the two tests in this study. Individuals who showed elevations in both hs-TnI and hs-TnT had increased risk of CVD events and all-cause death compared with those with elevated hs-TnI or hs-TnT alone, suggesting that the two biomarkers are complementary for predicting risk.

"This study, in addition to others, provides a strong scientific basis to use hs-TnI to identify individuals who are at high risk of myocardial infarction, stroke and heart failure to target with more intensive lifestyle modification and risk factor control," comments Christie Ballantyne, the senior author of the study. Additional studies are needed in other populations to determine any differences related to sex, race or age in the predictive capacity of hs-TnI and hs-TnT assays.

Karina Huynh

ORIGINAL ARTICLE Jia, X. et al. High-sensitivity troponin I and incident coronary events, stroke, heart failure hospitalization, and mortality in the ARIC study. *Circulation* (2019)

IMAGING

Improved visualization of fetal heart abnormalities with 3D MRI

The use of motion-corrected 3D MRI can improve the visualization of congenital abnormalities in fetal hearts compared with either uncorrected 2D MRI or 2D echocardiography. This novel approach "offers the potential for a safe, reliable and highly complementary form of imaging of the fetal cardiovascular system", conclude the researchers from London, UK.

Pregnant women are assessed using 2D echocardiography when a congenital cardiac abnormality is suspected, but if further diagnostic information is needed, the options for reliable secondary imaging are limited. Use of fetal MRI is well-established for other organs (such as the brain), but is susceptible to movement of the fetus, especially for 3D imaging. Therefore, the investigators aimed to test the use of MRI with novel, motion-corrected, 3D image-registration software in the diagnosis of congenital heart disease.

The study included 85 women carrying a fetus with known or suspected congenital heart disease on the basis of 2D echocardiography who attended the fetal cardiology unit at Evelina London Children's Hospital, UK. Gestational age at the time of MRI was 24–36 weeks. MRI data were obtained as overlapping stacks of 2D images and processed using a bespoke, open-source reconstruction algorithm to generate a super-resolution 3D volume of the fetal thorax.

Vascular measurements obtained using 3D MRI showed good overall agreement with 2D echocardiography. Visualization of fetal vascular structures was more effective with 3D MRI (97%) than with 2D MRI (53%). Moreover, for 90% of the structures visualized, the diagnostic quality of the images was better with 3D MRI (or the same as with 2D MRI for the remaining 10%). The detailed 3D images obtained could be highly informative for counselling, planning surgery and coordinating postnatal care.

Gregory B. Lim

ORIGINAL ARTICLE Lloyd, D. F. A. et al. Three-dimensional visualisation of the fetal heart using prenatal MRI with motion-corrected slice-volume registration: a prospective, single-centre cohort study. *Lancet* https://doi.org/10.1016/S0140-6736(18)32490-5 (2019)

DEVICE THERAPY

Pacemaker powered by cardiac motion

Researchers have developed a nanogenerator that can harvest biomechanical energy from the motion of the heart and thereby power an implanted pacemaker. "Millions of patients have implanted pacemakers, which were first used in the 1950s," explain Zhou Li and Zhong Lin Wang, senior authors on the paper published in *Nature Communications*. "Their batteries are still bulky and typically must be replaced every 5–12 years." The investigators aim to design a pacemaker that can be implanted for the lifetime of a patient.

The researchers developed an implantable pacemaker comprising a power management unit, a pacemaker unit and a novel implantable triboelectric nanogenerator (iTENG), containing two triboelectric layers. The iTENG was placed between the heart and the pericardium of a pig; cardiac motion caused periodic contact and separation of the two triboelectric layers, generating electrical energy, which could be stored in the capacitor of the power management unit.

The researchers demonstrated that after continuously harvesting energy from cardiac motion for approximately 200 min, electrical pulses (0.5 ms, 130 bpm) could be generated by the pacemaker and transmitted to the myocardium for cardiac pacing. In a pig with sinus arrhythmia induced by sinus node hypothermia, the iTENG-based pacemaker successfully converted the sinus arrhythmia to a pacing rhythm. The pig remained in sinus rhythm when, after about 1 min of pacing, the power supply voltage dropped and the pacemaker stopped working.

The researchers describe this new pacemaker as being symbiotic, because it converts biomechanical energy from the beating heart to electricity for powering the pacing module. When sinus rhythm is restored by these pulses, the recovered heart provides more energy for the pacemaker. Of note, the flexible iTENG technology can also be used to power other implantable devices (such as neural and muscle stimulators) as well as wearable electronic medical devices.

Gregory B. Lim

ORIGINAL ARTICLE Ouyang, H. et al. Symbiotic cardiac pacemaker. *Nat. Commun.* **10**, 1821 (2019)
FURTHER READING Cingolani, E. et al. Next-generation pacemakers: from small devices to biological pacemakers. *Nat. Rev. Cardiol.* **15**, 139–150 (2018)