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Klee Prize 2023: New measurement methods improve diagnostics and therapy for cardiac arrhythmias

- **VDE DGBMT and the Klee Family Foundation award Laura Anna Unger from the Karlsruhe Institute of Technology (KIT) with Klee Prize**
- **Improved evaluation of catheter signals as well as new measurement methods provide doctors with better maps of heart tissue as a basis for therapy**
- **Second and third place dealt with new possibilities for diagnostics in the fields of diabetes and clinical neurophysiology**

(Frankfurt a. M., 25.05.2023) Atrial fibrillation is the most common cardiac arrhythmia and, with a steadily increasing number of cases, poses a major challenge for patients and the healthcare system. However, the usual therapy – isolation of the pulmonary veins in the left atrium – currently does not lead to the desired result in 20 to 30 percent of patients. The reason: For lasting success, doctors need a map of the atrium that is as precise as possible in order to treat diseased tissue in a targeted manner. Dr.-Ing. Laura Anna Unger explains: "This is exactly the starting point for my dissertation, for which I wanted to work as closely as possible to everyday clinical practice. Together with the doctors at Städtisches Klinikum Karlsruhe and Universitätsklinikum Essen, I looked for ways to gain the maximum amount of information about the atrial tissue and thus create the basis for a precise therapy."

The path to measuring the heart

To achieve her goal, the young scientist started with the already common electrograms, which record the electrical signals of the heart in a minimally invasive way via one or more catheters. A catheter has up to 64 electrodes, and multiple catheters are usually used, meaning that around 20,000 measurement points have to be interpreted. "I've worked on algorithms that can read more from the measurements. To do that, abnormalities must be determined from the signals after filtering out sources of interference, such as signals from other heart chambers, catheter movement or an X-ray machine."

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Healthy tissue behaves differently from diseased tissue

Measurements are taken at different heart rhythms, as the tissue changes its properties with the heart rhythm. The result is a much better map of the atrium with indications of where diseased tissue is located. This image is complemented by a second, completely new measurement of local impedance (alternating current resistance). Here, Unger examines how heart tissue reacts to alternating electrical current, because healthy tissue behaves differently than diseased tissue. This information complements the electrogram and takes a step closer to the data quality of a biopsy, which cannot be performed on living humans. "We first tested this in a computer model and in the lab, and then proved in a clinical trial that we can localize pathologically altered regions."

In the meantime, this year's winner of the EUR 5,000 Klee Prize is employed at Städtisches Klinikum Karlsruhe and is continuing her research. Unger does not yet know whether the focus will remain on cardiological matters or whether other areas will follow, and whether later on a path will lead to industry or research. "But I will stay close to clinical work, because that is how my developments make the most sense."

Second and third place: Diagnostics of diabetes and peripheral nervous system disease

This year, Dr. Dominik Weidlich was awarded second place and prize money of EUR 2,000 for his work on developing a non-invasive measurement method for diagnosing diabetes and obesity. In contrast to the previously common method of determining cell size in adipose tissue using biopsies, which is not widely accepted, his approach is based on magnetic resonance imaging. By developing this methodology, including measurement error reduction, it was possible to correctly determine cell size in human adipose tissue samples.

Third place and prize money of EUR 1,000 was awarded to Dr.-Ing. Eric Elzenheimer. In his dissertation, he dealt with systemic diseases of the peripheral nerves (polyneuropathies), which occur in about 5.5 percent of people over the age of 50. Through innovative methods of digital signal processing, functionally impaired peripheral nerves can now be evaluated more precisely and located earlier. Differential diagnosis will be significantly improved. In addition, a solid basis is being created for a semi-automated disease classification in clinical neurophysiology.

The Klee Family Foundation and the German Society for Biomedical Engineering in the Association for Electrical, Electronic & Information Technologies (VDE) award the prize to scientists each year for practice-based developments in the field of medical technology.

About the German Society for Biomedical Engineering within VDE (VDE DGBMT)

The German Society for Biomedical Engineering within VDE (VDE DGBMT) is the largest scientific and technical society in the field of medical engineering in Germany. It was founded in Frankfurt am Main in 1961.

VDE DGBMT networks experts from all areas of technology applications in biology and medicine. With approximately 2,000 members and 23 expert committees, it covers the entire range of topics in biomedical engineering. In addition, it offers conferences and workshops for specialist audiences and is the sponsor of two international scientific journals: Biomedical Engineering and Current Directions in Biomedical Engineering published by Walter de Gruyter. The DGBMT also awards prizes for young scientists, for scientific excellence and innovation, and for patient safety in biomedical engineering. Last but not least, it represents German biomedical technologies in international committees.

For more information, visit www.vde.com/dgbmt

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