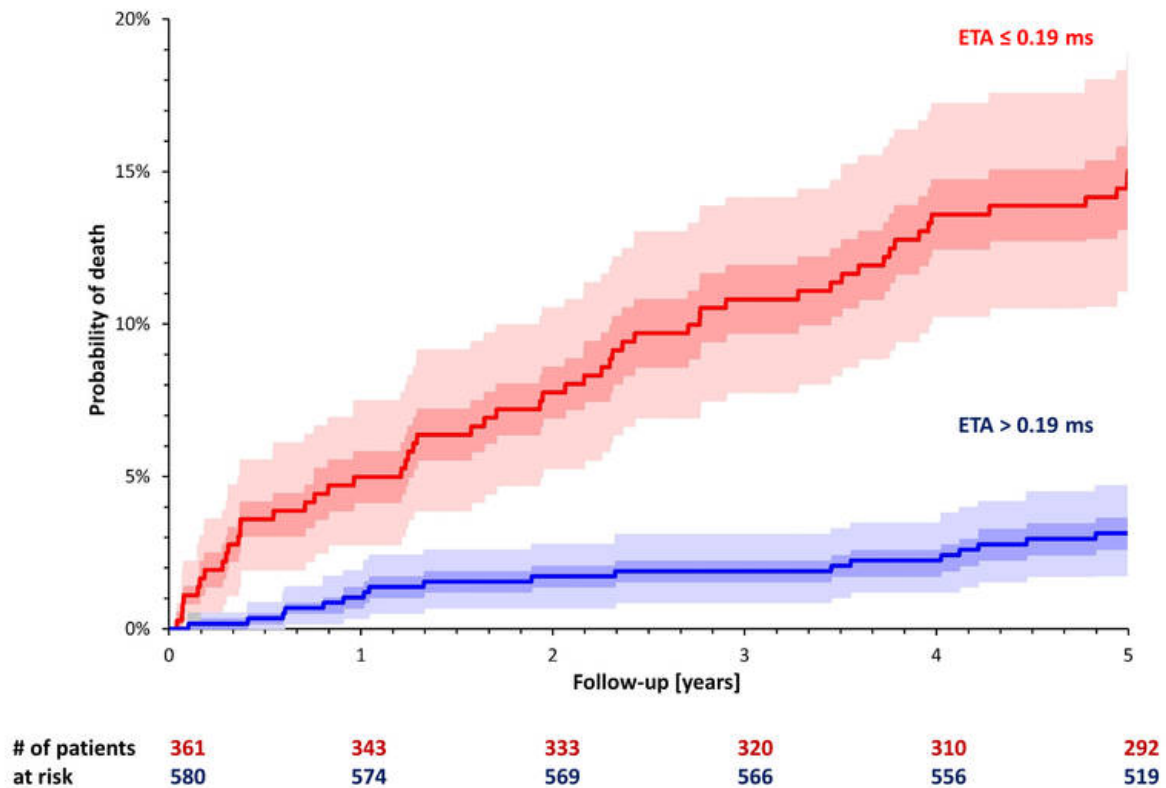


New procedure uses the heart rate to estimate the life expectancy of infarct patients

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After five years, persons with only minor arrhythmia (red graph) were five times more at risk of dying than people with higher breathing-related fluctuations.
Credit: JACC

The heart rate may be an indicator of a person's life expectancy. A research team at the Technical University of Munich (TUM) has to this end analyzed an effect which at first seems paradoxical: Minor irregularities in the heartbeat are indicative of a healthy body. A clinical study confirmed a strong correlation between this phenomenon and the survival prospects of heart attack patients. The new methods of measurement may soon be applied in medical practice.

A healthy person's heart will beat slightly faster upon inhalation and slow down again upon exhalation. The reason for this is that inhaling dampens an effect that will normally regulate the [heart rate](#) down to the at rest rate of approximately 60 beats per minute. This phenomenon is called respiratory sinus arrhythmia, which may be translated as a "breathing-induced irregularity in the sinus node, the bundle of nerve fibers controlling the heart beat".

The phenomenon has been known since the 19th century. A body weakened by a [heart attack](#) will show a clearly smaller difference between heart rates during the exhaling and inhaling cycles. Therefore, several attempts at using arrhythmia characteristics to draw conclusions about the life expectancy of patients were made in the past. Thus far, however, the data taken on its own yielded no conclusions as to the [life expectancy](#) of a patient. This, however, is precisely what the scientists working with Prof. Georg Schmidt, head of the Biosignal Processing team at the University Hospital Klinikum rechts der Isar, have now achieved.

Breathing cycle and heart rate: The decisive moment

Whilst in the majority of earlier studies the full breathing cycle was correlated to the heart rate, the TUM team now focused on exhaling and specifically on the moment when the heart rate would normally be reduced again. "With our approach, you might say we are surgically

selecting the moment when the decisive events take place," says Georg Schmidt. In the analysis of the heart rate data, an algorithm Schmidt and his team proposed in an article published in the *Lancet* in 2006 has proven useful. The method renders the respiratory sinus arrhythmia measurable by - to put it simply - extracting other sources of heart rhythm variation from the data collected over a certain period. The algorithm calculates an average from the data, which may then be graphed.

"Our method produces a far more specific picture of the functional condition of the body," says Dr. Daniel Sinnecker, primary author of the study. "There is no other method as yet to isolate the vagal function as specifically as this." The vagal function, i.e. the activity of the vagus nerve, is responsible, among other, for reducing the heart rate of healthy persons as described above. Although the vagus nerve affects many other bodily processes, its activity is not directly measurable.

More than 900 patients examined

Within the framework of the study, published in the *Journal of the American College of Cardiology*, breathing cycles and heart beat rhythms of close on 950 heart attack patients were measured shortly after a heart attack. The data was analyzed to find respiratory sinus arrhythmia. The test persons were re-examined every six months over a five-year period. The result: Heart attack patients with less pronounced arrhythmia had a higher risk of dying within the period of observation. Examined persons with only minor arrhythmia were five times more at risk of dying over the five-year period than people with higher breathing-related fluctuations.

Two further clinical studies are currently under way with TUM participation, examining the respiratory sinus arrhythmia in different groups of persons. One of the studies (EU-Cert-ICD) examines different

treatment strategies in people with pacemakers, whilst the other (INVADE) monitors elderly people with and without heart disease. Schmidt and his team are confident that the results of these studies will confirm that their method, taken on its own, will be a reliable indicator of risk.

Everyday application imminent

The developers are confident that the new method may soon be widely deployed. "We are quite close to everyday application since, by and large, the development of the method is complete," says Georg Schmidt. The technical hurdles are few: Since it is no longer necessary these days to measure breathing rate in addition to heart beat, a modern ECG unit would basically suffice. "Even the general practitioner could therefore within ten minutes record sinus arrhythmic activity."

The method may be fruitfully applied in more than 80 percent of the cases, says Schmidt. Irrespective whether the examined patients had recently suffered a heart attack, it could be used in combination with other indicators to assess the health risk. Hidden risks may in this way be detected in some persons and possibly mitigated with an implantable defibrillator, for instance. "In addition to that, the cost of treatments could be reduced by avoiding unnecessary procedures," says Georg Schmidt.

A next step might be to apply this method to examine the efficacy of different strategies for treatment. Should a patient's characteristics improve in the course of treatment, it is likely that the applied therapy was appropriate.

More information: Daniel Sinnecker et al. Expiration-Triggered Sinus Arrhythmia Predicts Outcome in Survivors of Acute Myocardial Infarction, *Journal of the American College of Cardiology* (2016). [DOI:](#)

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