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Early Pancreatic Cancer Detection

Tumors of the pancreas seldom cause symptoms in their early stages. This means that in many cases, they are not diagnosed until late, when the chances of successful treatment are poor. A new non-invasive diagnostic method designed by Fraunhofer researchers is set to make it possible to detect this aggressive form of cancer early on with high accuracy, significantly improving the prognosis for treatment.

Pancreatic carcinoma, a type of malignant tumor of the pancreas with a high mortality rate, accounts for two to three percent of all malignant cancers. This kind of cancer is generally not diagnosed until an advanced stage, partly because the symptoms are nonspecific. The tumors have a tendency to metastasize aggressively, which makes this type of cancer so dangerous. To date, there has been no screening method available to detect pancreatic cancer early on, as is done with breast and colon cancer, for example. This means there is great need for a method of early diagnosis that can reliably detect not only pancreatic cancer but other tumors of the gastrointestinal tract as non-invasively as possible and with high accuracy. This is where the research done by the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB comes in: The In-vitro Diagnostics department, headed by Kai Sohn, has established an innovative method for early detection of pancreatic cancer in cooperation with the Universitätsklinikum Erlangen university medical center and a company called GeneData. The new method is based on complex next-generation sequencing (NGS) technology, a high-throughput approach to sequencing nucleic acids that makes it possible to sequence and analyze millions of DNA fragments simultaneously. The project received funding from the German Federal Ministry of Research, Technology and Space.

Analyzing cell-free tumor DNA from the blood of cancer patients

The new molecular diagnostic method is based on analysis of cell-free tumor DNA from patients' blood, a method known in the field as differential methylation analysis. A blood sample is taken and centrifuged to separate the plasma from cellular components of the blood. After that, the cell-free DNA is isolated from the blood plasma and tested for certain pathological changes. Tumor DNA often differs from healthy DNA in biochemical modifications known as methylation in certain locations in the DNA, which Sohn and his team identify by means of high-throughput sequencing.

"After taking a blood sample, we analyze a suitable class of biomarkers. The cell-free DNA released by cells as they die off, which circulates in the soluble components of the blood, is proving to be very promising in this regard. Even degenerated cells release DNA that circulates throughout the body. This means it is not necessary to perform a biopsy of the pancreas. Instead, blood can be taken from a site like the crook of the elbow to find tumor DNA," Sohn explains. He adds that the new early detection screening is gentler on patients than other methods, as it is non-invasive.

Method allows doctors to differentiate between different tumors of the gastrointestinal tract

As part of a clinical study conducted in collaboration with Georg Weber, a professor at the Universitätsklinikum Erlangen, patients who either had pancreatic cancer at various stages or a condition called non-malignant pancreatitis were recruited for a proof-of-concept study. Blood samples from these patients were analyzed for clinical validation purposes. "We demonstrated that our method allows researchers not only to tell healthy patients apart from those with tumors but also to distinguish among different gastrointestinal tract tumors," Sohn says, highlighting the advantages of the innovative method. It will allow physicians to determine whether a certain DNA signature is specific to a disease. In the process, the cell-free DNA isolated from the plasma is screened for relevant methylation patterns. "The differentiation is successful because the methylation pattern in the genome of the pancreas differs from that of an immune cell, for example. The methylation also indicates a cell's physiological condition," Sohn explains.

The new method also makes it possible to distinguish a malignant tumor of the pancreas from a benign inflammation of the pancreas known as pancreatitis. The symptoms are very similar at first, but the treatment is completely different. In the study, the researchers were even able to classify non-malignant early stages based on specific methylation patterns in some cases.

As the next step, Sohn and his team are now working to analyze patient samples from different medical centers as part of a

multicenter study with the ultimate goal of making this method a routine part of clinical practice.

Publications:

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Further information

- Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung
- Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB