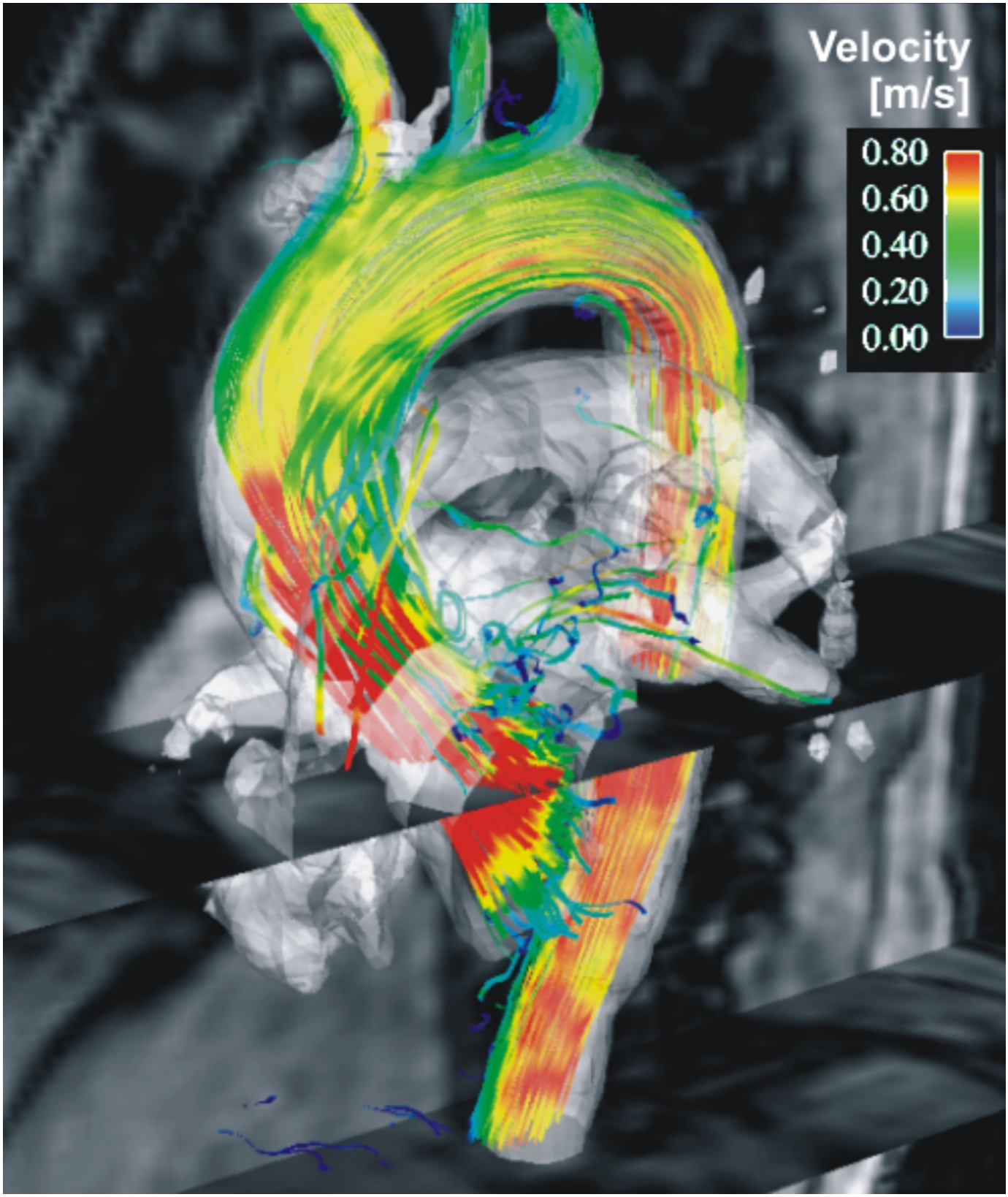
Healthcare industry BW

Life-saving look at the blood flow

Experienced medical physicists are able to detect everything without needing an operating table or a scalpel to construct a detailed picture of a patient's cardiovascular system. Dr. Michael Markl is one of these experts, who nevertheless require top technological equipment, i.e. magnetic resonance imaging (MRI), to gain comprehensive insights into the vascular system.

Markl runs the cardiovascular priority of the Medical Physics group at the Department of Diagnostic Radiology at Freiburg University Hospital. Under the scientific supervision of Prof. Dr. Jürgen Hennig, the group is developing MRI technologies for new medical applications. The representation of the brain and research into brain functions using functional magnetic resonance imaging (fMRI) are among the specialties of the 60 scientists working here. Other specialist areas include the further development of whole body imaging and the optimisation of "molecular imaging" on animals. The Freiburg medical physicists also deal with the resolution of theoretical problems associated with MRI and the development of new software packages for the analysis of complex data sets.

Images with huge diagnostic importance



Normal blood flow in the aorta. MRI also reveals pathological changes and enables the early prognosis of cardiovascular diseases.
© Work group M. Markl

"In many cases, new application possibilities arise from the technology that we have altered and further developed," explains Markl. For example, a great deal of basic research has already been carried out into 4D-MRI or 7D-MRI which enables the three-dimensional representation of the aortic blood flow. "Such images have never before been seen," said Markl. The physicians, instead of barely being able to see individual layers of a vessel, can now also see how the flood flows through the aorta enabling them to discover conspicuities such as turbulences. Such images are of

great diagnostic value because physicians are now able to see how changes in the blood flow affect the entire vascular system and which diseases arise from such changes.For example, this MRI method is used on patients with innate aortic aneurysms. "We know that the blood flow in the aorta affects the development of aneurysms, i.e. when they are likely to burst and become a life-threatening situation," explains Markl. The larger such a bulge becomes, the more likely the aorta is to burst, causing the patient to bleed to death. That is why cardiac surgeons recommend that patients undergo surgery to have the aneurysm removed once it has reached a certain size.

Looking for excellent perspectives

However, in many cases risk can only be postponed for a short time. "Despite the removal of the aneurysm, new bulges will occur, sometimes at the same location and sometimes at completely different ones," said the medical physicist. Markl and his colleagues are conducting long-term observations to find out how blood flow alterations affect the patients' prognosis. "We hope to find out which treatment generates good blood flow and hence a potentially positive outcome for patients who have undergone an operation," said Markl who, together with his colleagues, has analysed the blood flow of 250 patients and volunteers. However, the researchers are unable to draw final conclusions from the data collected so far. In addition, Markl's team of scientists hopes to identify patients who benefit from beta-blockers that are usually prescribed to lower the blood pressure. Statistical analyses show that about 80 per cent of patients treated benefit from this therapy. The remaining 20 per cent do not benefit from beta-blockers. "We are hoping that MRI will provide us with insights into how the blood flow changes when beta-blockers are administered and which patients actually benefit from this type of treatment," said Markl.

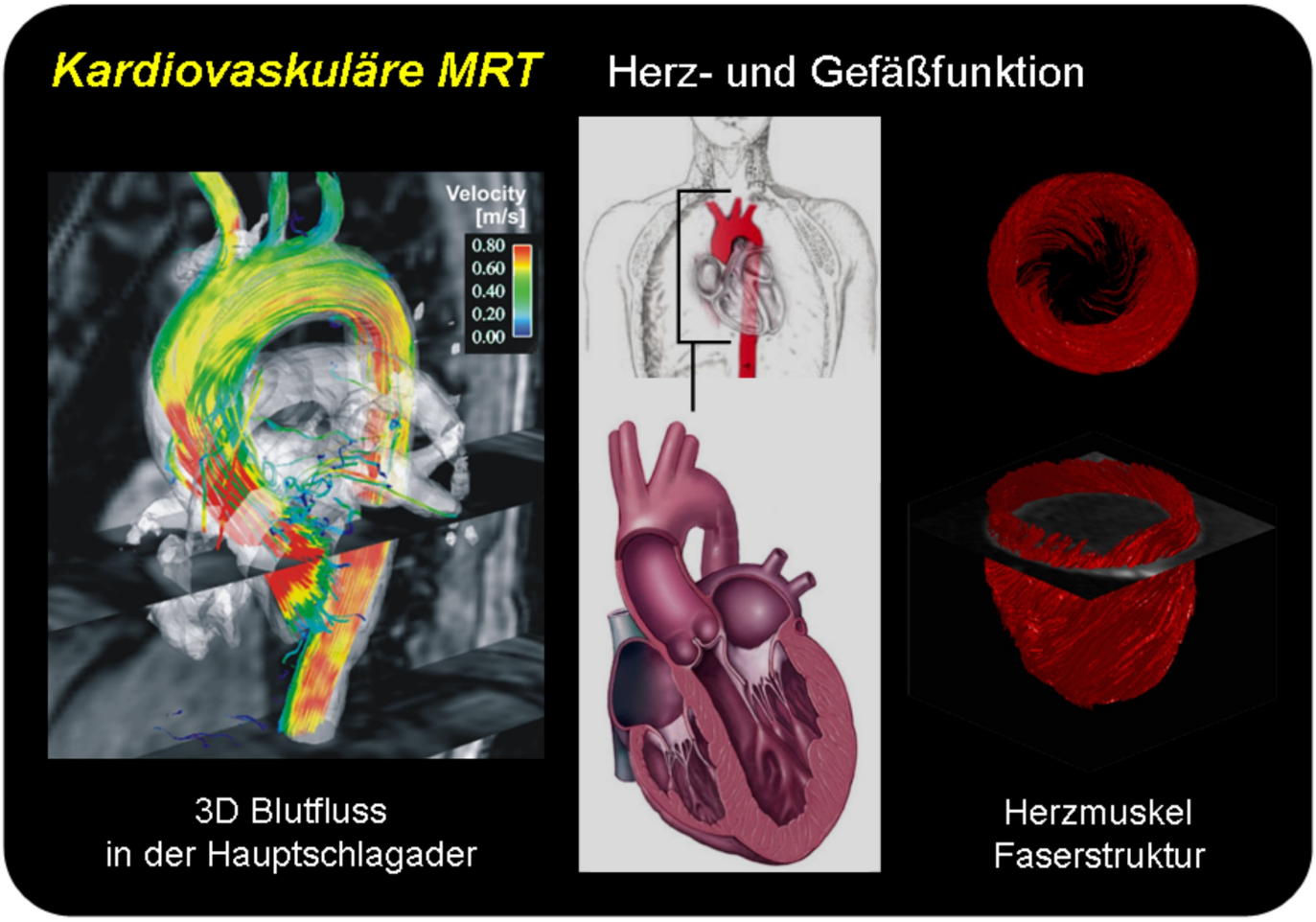
Using MRI to look behind the statistics

The medical physicist is interested in another statistical value. If an aortic aneurysm reaches a size of 4.5 centimetres and continues to grow, then a surgeon will generally decide to operate. However, nobody can really tell whether surgery was really necessary. Physicians are also unable to say with certainty that patients with smaller aneurysms are not at risk of a rupture. Markl also hopes to be able to solve this problem with MRI. His team is looking for specific biomarkers that provide information on the situation in the blood vessel and enable a reliable prognosis to be made. Preclinical studies have shown that wall shear stress is a very sensitive marker of vascular wall alterations," said Markl. A low value seems to be a clear indication of damaged cells. As wall shear stress can be calculated from the measured blood flow velocity, the vascular surgeons might soon have a reliable criterion at hand that will provide them with information about the state of the vascular wall. The only thing they would need is an MR image that could be used to assess wall shear stress. This would then enable them to tell whether the aneurysm is at risk of bursting or not.

Gradually approaching the solution together

"As is usually the case with our research, we will also work with other scientists in this project. We are in charge of developing the methods but the analysis of data must be carried out in close cooperation with clinicians," highlights Markl. The medical physicists intend to work with radiologists and use the MRI devices to also look at other vessels, not just the aorta. They hope to use MRI for assessing the state of the carotid artery and the arteries in the head and upper thighs. "We will jointly approach these vessels and slowly but surely we will come up with new findings,"

promises Markl.



MRI is suited to finding answers to a broad range of cardiovascular questions.
© Michael Markl

Press release

02-Jul-2008

mehr Info