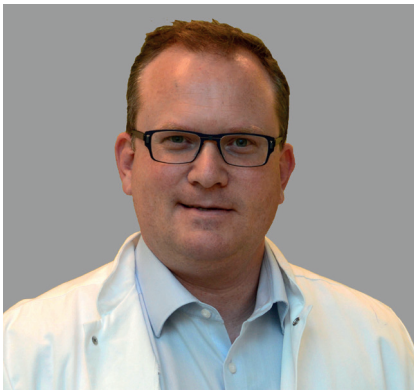


CUSTOMER REPORT

Expert knowledge and intelligent software: the perfect team for tiny hearts



UKRUB UNIVERSITÄTSKLINIKUM DER
RUHR-UNIVERSITÄT BOCHUM



PD Dr. Kai Thorsten Laser

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Dedicated clinicians and innovation-happy healthcare-IT companies share an important mission: to drive medical progress. The cooperation between the Pediatric Heart Center and Center for Congenital Heart Defects at the Heart and Diabetes Center NRW, Bad Oeynhausen and TOMTEC illustrates the immense added value that can be generated for everyday medical practice when know-how and dedication are pooled. TOMTEC's 3D analytic tools provided the foundation for the development of an ultrasound method to measure volume and evaluate the heart chambers in children with congenital heart defects. A true milestone in pediatric cardiology.

Echocardiography has been going through major changes over the last few years: ultra-modern transducers and IT solutions have significantly improved 2D image quality while static and dynamic views offer entirely new insights into the heart. Particularly in pediatric cardiology these improvements are highly welcome since ultrasound is and remains the diagnostic technology of choice for tiny hearts: no radiation, quick and flexible exams.

"Excellent 2D image quality is the precondition for exact visualization of the anatomy – and thus for the evaluation of heart defects. However, the mere visualization of the heart has diagnostic limitations. In order to be able to evaluate complex cardiac defects we also need to quantify ventricles and assess function," says PD Dr. Kai Thorsten Laser, Deputy Director of the Pediatric Heart Center and Center for Congenital Heart Defects.

"The software enabled me to measure volumes with comparable precision to the gold standard CMR. However, since we did not have any reference values for ultrasound measurements we conducted a multi-center study together with facilities in Munich and Bonn to determine these reference values for the evaluation of children's hearts."

PD Dr. Kai Thorsten Laser

INSTITUTION

- The Herz- und Diabeteszentrum NRW (HDZ NRW) is a University Hospital of the Ruhr-Universität Bochum/ Germany and an international leader in the treatment of cardiac, vascular and metabolic diseases.
- With 35,000 cardiac and diabetic patients per annum, 14,000 of them inpatients, the HDZ NRW is one of the largest state-of-the-art clinical centers of its kind in Europe.

Until recently MRI was the only modality to reliably allow such functional analyses – but the technology is rather unsuitable for children since examination times of approximately 45 minutes require sedation or anesthesia. Consequently, the data pool with regard to MRI quantification is poor and there are no reliable reference values for ventricular volumes in the different age brackets.

Precise, valid and reproducible: functional 3D ultrasound analysis

PD Dr. Laser has for some time been exploring the possibilities with the develop a 3D analysis tool based on the TOMTEC software package to determine left and right ventricular volumes. “The software enabled me to measure volumes with comparable precision to the gold standard CMR. But we did not have any reference values for ultrasound measurements. Thus we conducted a multi-center study together with facilities in Bonn and Munich to evaluate children’s hearts.”

In a first step the cardiologist and his team determined the overall suitability of the TOMTEC software package for measurement purposes: all pediatric patients who underwent diagnostic MRI also underwent a subsequent ultrasound exam. The results were assessed, blinded and compared to the MRI results.

“The differences in the volume measurement results generated with ultrasound and MRI were minimal. 3D ultrasound yielded precise and valid results. And the results could be nicely reproduced and transferred to complex congenital heart defects with the interpretation workflow we had developed,” explains Kai Thorsten Laser.

In a next step the team examined 360 healthy young hearts and used the results to establish reference values for different body sizes. “Currently the data pool for 3D ultrasound datasets is much larger than the one for MRI exams,” the pediatric cardiologist adds.

Good software generates diagnostic benefits

The software package PD Dr. Laser’s team used played a crucial role in the successful development of reference values that significantly facilitate the assessment of heart defects in pediatric patients. “In order to generate reproducible and valid results we have to stick to a certain workflow. This entails for the volume measurements of the right ventricle to control and possibly adapt the contours between blood and myocardium in many 2D sections taken from the 3D-dataset which improves the quantification results. Granted, today automatic contouration and evaluation work well. Nevertheless, when dealing with highly individual and complex issues such as pediatric heart defects they reach their limits. But together with TOMTEC we were able to overcome these obstacles. The TOMTEC team responded to our ideas and updated the software. Now we can view the entire data set and adapt contours as needed, even in the right ventricular outflow tract.”

KEY FOCUS AND MODULES IN USE

- While the team at the Pediatric Heart Center and Center for Congenital Heart Defects (ZAH) treats pediatric and adult patients of any age with congenital or acquired heart defects, many of our patients are infants, children and adolescents.
- With 350 operations, more than 450 cardiac catheter exams and interventions, more than 300 cardio MRI scans and more than 200 pathologic fetal echocardiographies in our fetal cardiology department our 40-bed clinic is one of the leading institutions in Germany to treat congenital heart defects.
- Some key figures: 1100 inpatients per year, 6000 outpatients per year, 3000 exams in the ZAH echo lab per year.

IMAGE-COM¹
 2D CPA¹
 4D LV-ANALYSIS¹
 4D CARDIO-VIEW^{1,2}
 4D RV-FUNCTION¹
 MV-ASSESSMENT¹

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PD Dr. Kai Thorsten Laser

At PD Dr. Laser’s Heart Center 3D echo is a standard component in the diagnostic work-up of left and right ventricular congenital heart defects, for example in patients with tetralogy of Fallot, a severe right ventricular defect. Children suffering from this condition have to be regularly examined after a first corrective operation since the pulmonary valve tends to leak. Volume measurements as well as calculation of ejection fraction play a major role in these exams. In the left ventricle, for example, enlarged chambers present in valvular heart disease can be reliably evaluated with ultrasound in order to determine valve dysfunction.

From North Rhine-Westphalia into the world

3D imaging, however, is not being used extensively since not many office-based cardiologists have access to the technology. Moreover the method, including workflows, requires careful training as PD Dr. Laser explains: “Now it will be our task to spread the method throughout the healthcare system, for example in workshops we will conduct jointly with TOMTEC. In these training sessions we have to explain why we think it is worthwhile to invest more time in the evaluation of 3D echos: it takes 5 to 10 minutes which is longer than the evaluation of 2D data. When you take into consideration that an MRI exam itself takes 45 minutes plus 20 minutes for the evaluation ultrasound offers a clear advantage in terms of time. Most importantly however: the children are spared the stress of sedation. This is major progress in diagnostics.”

PAPERS

Validation and Reference Values for Three-Dimensional Echocardiographic Right Ventricular Volumetry in Children: A Multi-center Study.

Laser KT, Karabiyik A, Körperich H, Horst JP, Barth P, Kececioglu D, Burchert W, DallaPozza R, Herberg U.

J Am Soc Echocardiogr. 2018 Sep;31(9):1050-1063. doi: 10.1016/j.echo.2018.03.010. Epub 2018 Jun 19.

Real-Time Three-Dimensional Echocardiography of the Left Ventricle-Pediatric Percentiles and Head-to-Head Comparison of Different Contour-Finding Algorithms: A Multicenter Study.

Krell K, Laser KT, Dalla-Pozza R, Winkler C, Hildebrandt U, Kececioglu D, Breuer J, Herberg U.

J Am Soc Echocardiogr. 2018 Jun;31(6):702-711.e13. doi: 10.1016/j.echo.2018.01.018. Epub 2018 Mar 28.

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