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Examination of the interaction of alterations of blood flow in the heart and great vessels with changes of the blood vessels and heart muscle using cardiovascular magnetic resonance imaging: an observational study

Submission date	**Recruitment status**	[X] Prospectively registered
19/10/2020	No longer recruiting	[ ] Protocol
Registration date	**Overall study status**	[ ] Statistical analysis plan
26/11/2020	Completed	[ ] Results
Last Edited	**Condition category**	[ ] Individual participant data
26/11/2020	Circulatory System	[ ] Record updated in last year

Plain English summary of protocol

Background and study aims
The aim of this study is to examine the interaction of alterations of blood flow to the heart and great vessels in patients with thickening of the left heart muscle due to various causes.

Who can participate?
Patients with aortic valve pathologies, aneurysms of the aorta, hypertropic cardiomyopathy, or mitral valve diseases

What does the study involve?
The study involves cardiovascular magnetic resonance imaging (MRI) examinations with contrast agent. This examination will be repeated after 1, 3 and 5 years

What are the possible benefits and risks of participating?
The patients and their doctors will receive information about all the results that are collected during the examination. The risks for participants are vascular, skin and nerve lesions through the peripheral venous indwelling cannula as well as possible contrast medium allergy.

Where is the study run from?
Charité - Universitätsmedizin Berlin (Germany)

When is the study starting and how long is it expected to run for?
April 2020 to December 2025

Who is funding the study?
Funding is currently being applied for

Who is the main contact?
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Contact information

Type(s)
Scientific

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Additional identifiers

Protocol serial number
EA1/185/20

Study information

Scientific Title
Characterization of the interaction of intra- and extracardiac hemodynamics with myocardial and vascular remodelling using cardiovascular magnetic resonance imaging: a prospective observational study (Charakterisierung der Interaktion von intra- und extrakardialer Hämodynamik mit dem myokardialen und vaskulären Remodelling mittels kardiovaskulärer Magnetresonanztomographie: eine prospektive Observationsstudie)

Acronym
MRCorVasc

Study objectives
1. There are no relevant differences in the quantitatively detectable three-dimensional, time-resolved cardiovascular MRI measurement methods of hemodynamics (forward flow) between the imaging of the thoracic aorta on the one hand and the detection of the entire heart and the large intrathoracic vessels on the other hand, which exceed the already existing intra-individual variability between the individual heartbeats.
2. Changes in hemodynamics lead to remodelling of the heart and vessels and vice versa as well as to outcome differences (e.g. left ventricular hypertrophy, increase in diameter of the thoracic and abdominal aorta, differences in timing of surgical and interventional procedures) over the course of the disease.

3. A characterization of hemodynamics by imaging the entire heart allows a more differentiated consideration of the effects on myocardial remodelling and quantitative tissue parameters than the isolated consideration of hemodynamics by imaging the thoracic aorta alone.
4. There are no relevant differences from other quantitatively measurable parameters of hemodynamics, which are recorded by three-dimensional time-resolved cardiovascular MRI measurement methods (e.g. backward flow, regurgitation fraction, wall shear forces, deviations of blood flow from the center of the vessel (so-called normalized flow displacement), kinetic energy (KE), measurements of energy loss in turbulent flows (so-called turbulent kinetic energy (TKE), pulse wave velocity, pressure gradients, Jet Shear Layer Detection, Viscous Energy Loss Rate (VELR) and Pressure Drop) between imaging of the thoracic aorta as a sequence on the one hand and the detection of the entire heart and the large intrathoracic vessels on the other hand, which go beyond the already existing intraindividual variability between the individual heartbeats.
5. There are no relevant differences between non-accelerated and accelerated sequences for two-dimensional recording of hemodynamics in the thoracic aorta, both in real-time and in segmented measurement.
6. There are no relevant differences between time-resolved three-dimensional accelerated sequences on the one hand and two-dimensional sequences on the other.
7. By means of novel techniques for two-dimensional acquisition of hemodynamics, which combine different codes of maximum velocities in one measurement, it is possible to correctly characterize combined high-grade aortic valve diseases.

Ethics approval required
Old ethics approval format

Ethics approval(s)
Approved 18/09/2020, Research Ethics Committee of the Charité - Universitätsmedizin Berlin (Charitéplatz 1, 10117 Berlin, Germany; +49 (0)30 450 517222; ethikkommission@charite.de), ref: EA1/185/20

Primary study design
Observational

Study design
Prospective observational longitudinal study

Study type(s)
Diagnostic

Health condition(s) or problem(s) studied
Interaction of myocardial damage and intra- and extracardial hemodynamics in patients with left ventricular hypertrophy of various causes, as well as the investigation of underlying valvular defects and their influence on changes in the major vessels

Interventions
Two-dimensional and three-dimensional time-resolved sequences of flow using cardiovascular magnetic resonance imaging are used, which represent the aorta individually as well as the entire heart with inflowing and outflowing vessels. Furthermore, sequences of ventricular function, myocardial tissue characterization and the representation of the vascular anatomy are used.

The following images are taken:
1. Overview images for anatomy representation (approx. 5 min)
2. bSSFP cine images for functional analysis (approx. 5 min) with determination of left and right ventricular function (in %) and mass (in g and indicated on the body surface) as well as ventricular and atrial volumes (in ml and indicated on the body surface) and dimensions (in mm and indicated on the body surface)
3. 2D and 4D flow measurements (approx. 20 min) with determination of basic and advanced parameters of hemodynamics (forward, backward flow (in ml/cycle), regurgitation fraction (in %), maximum and average velocities (in m/s), Wall shear forces as a measure of the tangential force acting on the vessel wall (in Pa), normalized flow displacement as a measure of the deviation of the flow from the vessel center in terms of eccentricity (in mm), KE and TKE as a quantitative measure of flow turbulence (in J/m3 or J/ml), VELR as a measure of frictional loss between the flow layers (in J/m3 or J/ml), pulse wave velocity as an indicator of vessel stiffness, pressure gradients as the driving force of the flow (in mmHg), jet shear layer detection to illustrate the influence of constrictions on the blood flow (without unit of measurement) and pressure drop in the sense of a pressure loss as an additional quantitative measure of a constriction in the cardiovascular system (in mmHg)
4. T1, T2 and T2* measurements for tissue characterization to detect fibrosis, edema and extracellular volume (approx. 15 min) with determination of T1, T2 and T2* times (in ms)
5. Myocardial fat imaging
6. Contrast-free angiography for vessel imaging (approx. 10 min) with determination of the diameters of the vessels and their wall thicknesses (in mm)
7. Unique imaging of myocardial scars and fibroses using Lade Gadolinium Enhancement after administration of contrast medium during baseline examination

The researchers also plan to re-examine the patients after an interval of 1, 3 and 5 years. Furthermore, a questionnaire will be sent out every 6 months. In addition, as part of the study clarification, participants are asked to contact the study physicians at any time in the event of corresponding symptoms, in the event of a deterioration of the findings, which are recorded in the course of external and other diagnostic procedures, as well as prior to elective surgery and interventions that affect the pathology to be investigated, in the course of which the study was included. If necessary, a repeat study examination will then be performed outside the above-mentioned time intervals. This will serve to document the findings in the context of the long-term observation planned in this study. The results of all examinations and data on the efficiency of the examinations are recorded for each examination. During the MRI examination, blood pressure and pulse are continuously monitored and documented.

Intervention Type
Device

Phase
Not Applicable

Primary outcome(s)
Forward flow assessed by cardiovascular magnetic resonance imaging at baseline, 1, 3, and 5 years

Key secondary outcome(s)
Measured by three-dimensional, time-resolved cardiovascular MRI at baseline, 1, 3, and 5 years:
1. Backward flow
2. Regurgitation fraction

3. Wall shear forces
4. Deviations of blood flow from the center of the vessel (so-called normalized flow displacement)
5. Kinetic energy (KE)
6. Measurements of energy loss in turbulent flows (so-called turbulent kinetic energy (TKE))
7. Pulse wave velocity
8. Pressure gradients
9. Jet shear layer detection
10. Viscous energy loss rate (VELR)
11. Pressure drop

Completion date
31/12/2025

Eligibility

Key inclusion criteria
1. One of the following pathologies: aortic valve stenosis (moderate or severe), aortic valve insufficiency (moderate or severe), mitral valve insufficiency (moderate or severe), hypertrophic cardiomyopathy (with or without obstruction), dilation or aneurysm of the thoracic aorta or abdominal aorta
2. Written informed consent to participate in the study
3. Existing health insurance, so that in case of incidental findings, these can be clarified
4. Study subjects agree to the communication of incidental findings
5. Aged over 17 years

Participant type(s)
Patient

Healthy volunteers allowed
No

Age group
Adult

Lower age limit
17 Years

Sex
All

Key exclusion criteria
1. Agoraphobia
2. Contraindication for an MRI
3. Contraindication for an MRI contrast agent
4. Pregnancy, lactation
5. Severe renal insufficiency

Date of first enrolment
01/01/2021

Date of final enrolment
31/12/2025

Locations

Countries of recruitment
Germany

Study participating centre
Charité – Universitätsmedizin Berlin
Working group on cardiovascular magnetic resonance imaging
Campus Buch
Experimental and Clinical Research Center, eine gemeinsame Einrichtung von Charité und MDC
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Sponsor information

Organisation
Charité

ROR
https://ror.org/001w7jn25

Funder(s)

Funder type
Other

Funder Name
Pending

Results and Publications

Individual participant data (IPD) sharing plan
The datasets generated during and/or analysed during the current study are/will be available upon request from Univ.-Prof. Jeanette Schulz-Menger (jeanette.schulz-menger@charite.de).

IPD sharing plan summary

Available on request