AI-based Assessment of Abdominal Aortic Aneurysms

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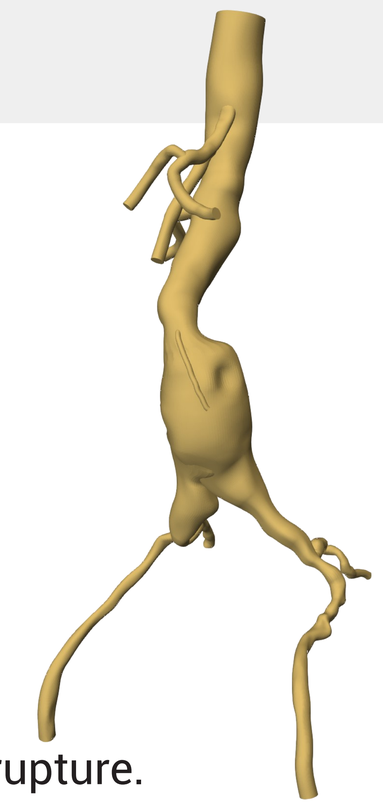
Introduction

- Abdominal aortic aneurysms (AAAs) are irreversible dilatations of the aorta.
- AAAs are often asymptomatic, but their **rupture** has **high mortality** rates.
- Rupture can be prevented by elective **surgery;** patients are eligible based on **maximal diameter** or **growth rate**[1].
- However, AAAs might rupture before reaching this diameter or remain stable after exceeding it.

There is a need to include more **patient-specific biomarkers** related to AAA growth and rupture into clinical decision making.



We aim to develop a fully automatic geometric deep learning pipeline predicting AAA growth and rupture.
We automatically acquire relevant shape and hemodynamics parameters directly from image data.

Envisioned Pipeline

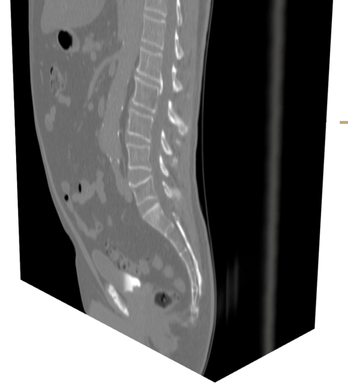
☑ (Partly) accomplished ☐ Collaboration opportunity

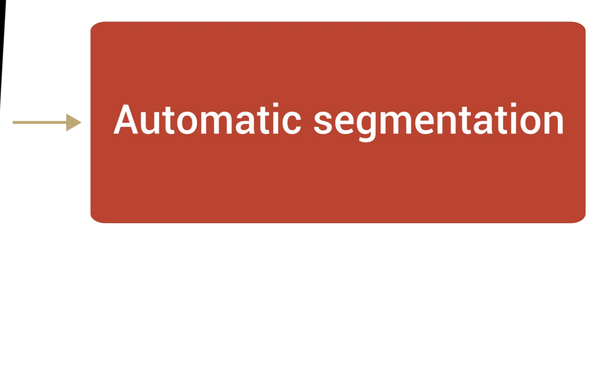
1. Segmentation

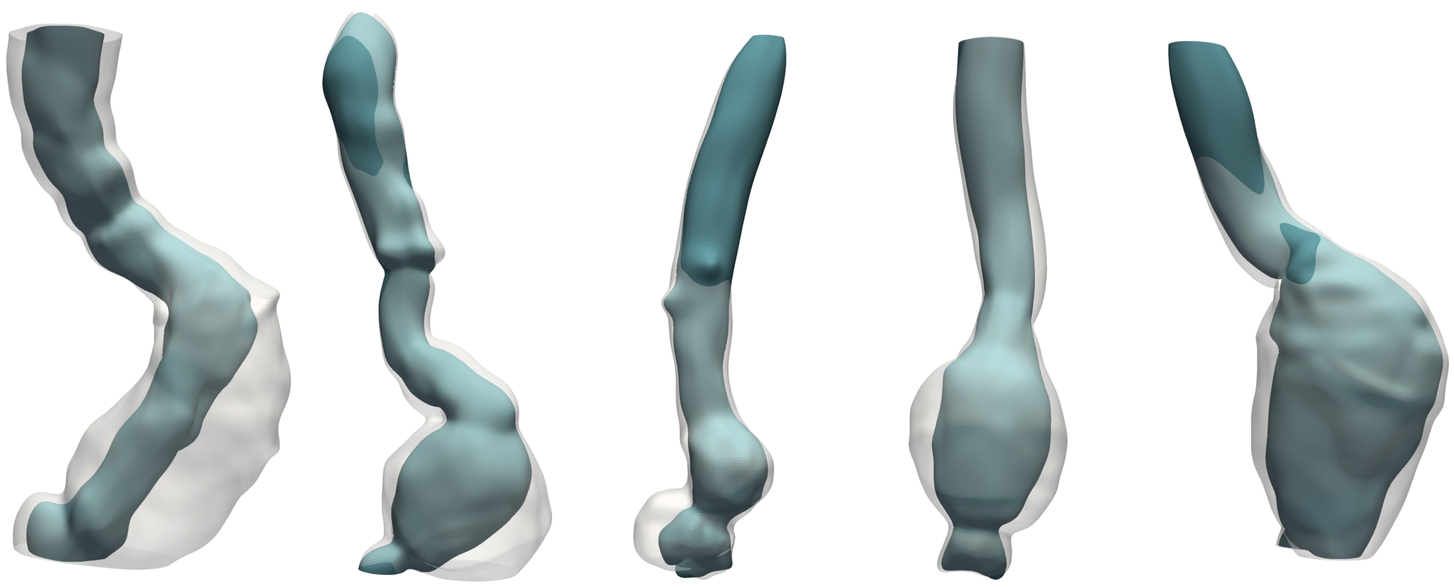
Use (longitudinal) 3D image data acquired at surveillance:
- ☑ (Contrast) CT
- ☐ (4D flow) MRI
- ☐ 3D Ultrasound

Segment AAA **lumen** and **thrombus** using automatic prior-based deep learning method[2].

Reconstruct a **watertight, personalized 3D** AAA model[3].







☑ In-house dataset of 129 annotated pre-operative AAAs

2. Shape analysis

Geometry based, therefore **modality invariant.**

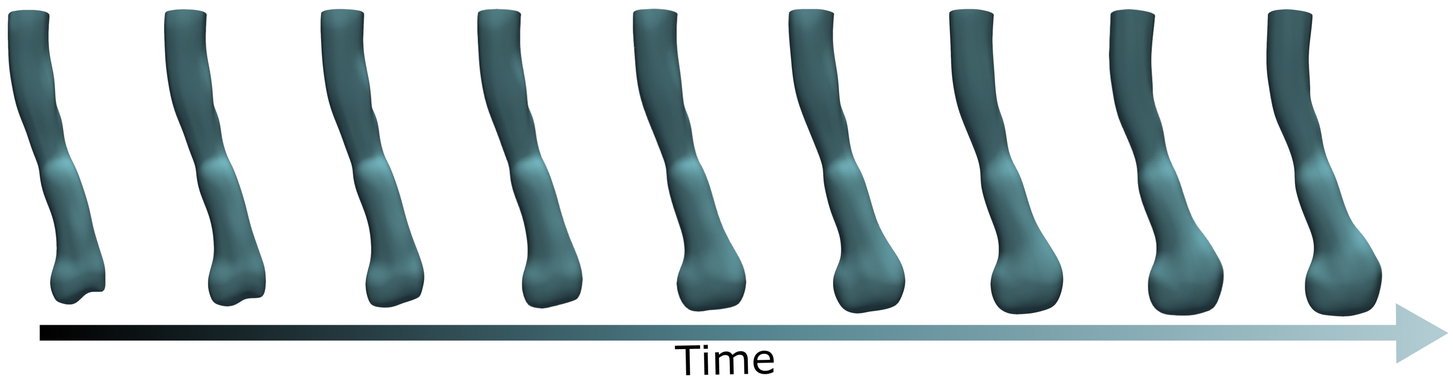
- ☐ Extract local and global **morphological features**, e.g. volume, curvature, diameter profile, etc.
- ☐ Extract **implicit features** from latent representation.

3. Hemodynamics

- ☑ Rapidly estimate hemodynamics with a **graph neural network** based on vessel geometry[4].

4. Growth prediction

- ☐ Combine morphological, hemodynamic and implicit parameters
- ☐ Predict local deformation fields of AAA
- ☑ Continuous modeling of AAA growth



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