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# SEGMENTATION AND CHARACTERIZATION OF THE AORTA AND SUPRA-AORTIC TRUNKS FOR NEURORADIOLOGY PROCEDURE PLANNING

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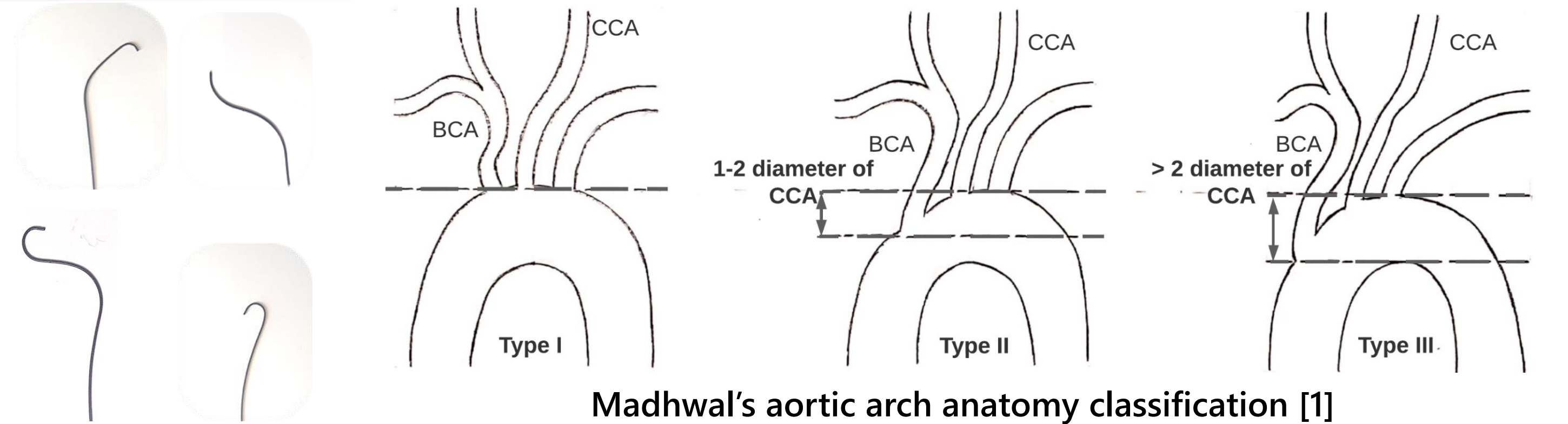
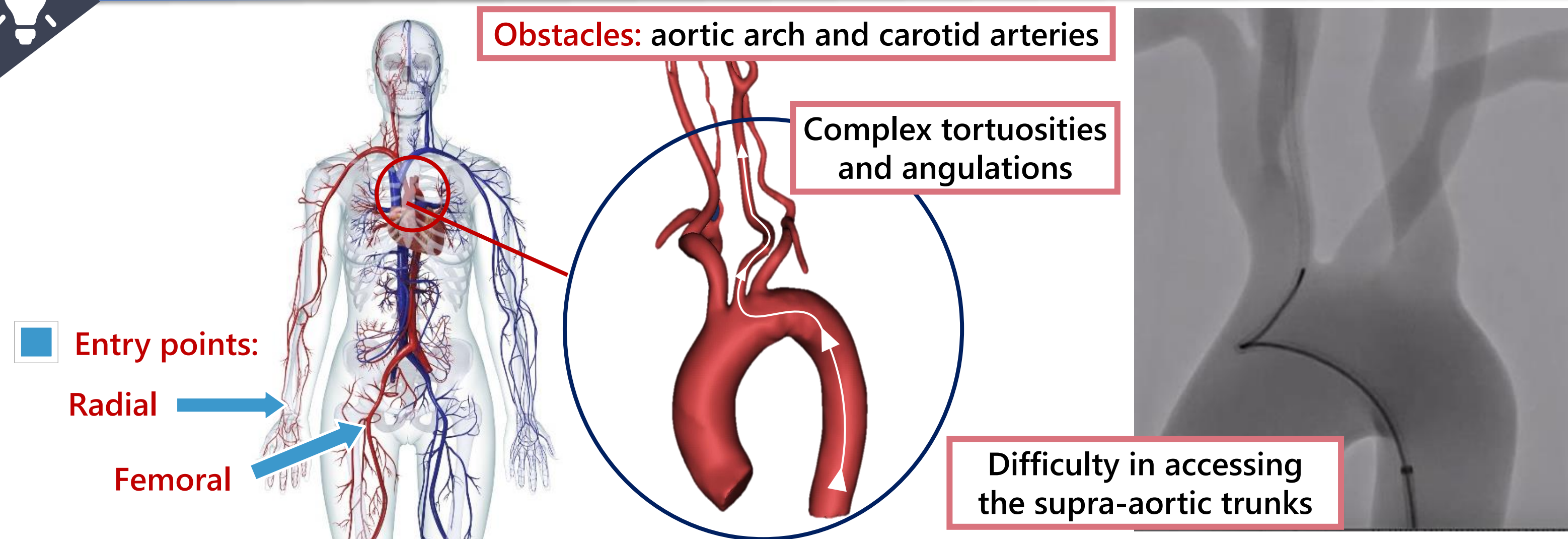
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## 1. Clinical background

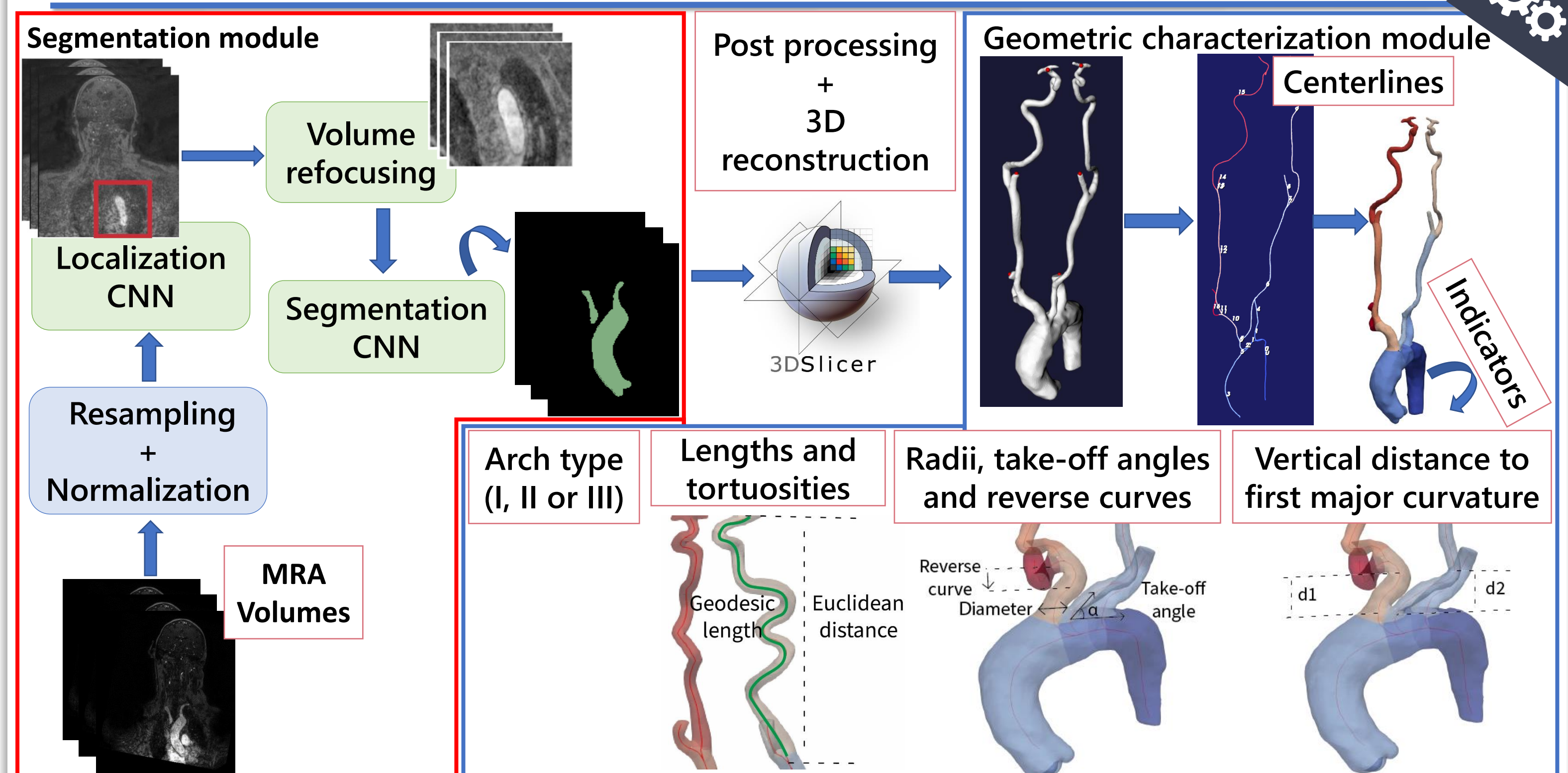


The type of aortic arch provides information on the complexity of navigation to the pathological area and helps to better plan procedures and choose the appropriate catheter.

## 2. Technical background

Task	Studies
SEGMENTATION	<ul style="list-style-type: none"> <li>Studies are oriented towards the use of CTA volumes.</li> <li>U-Net variants are the most used architectures.</li> <li>Approaches like multi-view 2D CNNs [2] and multi-stage pipelines were used [3].</li> <li>Segmentation is often pathology oriented e.g. segmentation of type B aortic dissection [3].</li> </ul>
CHARACTERIZATION	<ul style="list-style-type: none"> <li>Generic frameworks with sets of functions for geometric quantification of anatomical features and vessel characterization [4, 5]. These frameworks are suitable for engineers for research but not relevant for clinicians to use in a medical setting.</li> </ul>

## 4. Segmentation and characterization pipeline

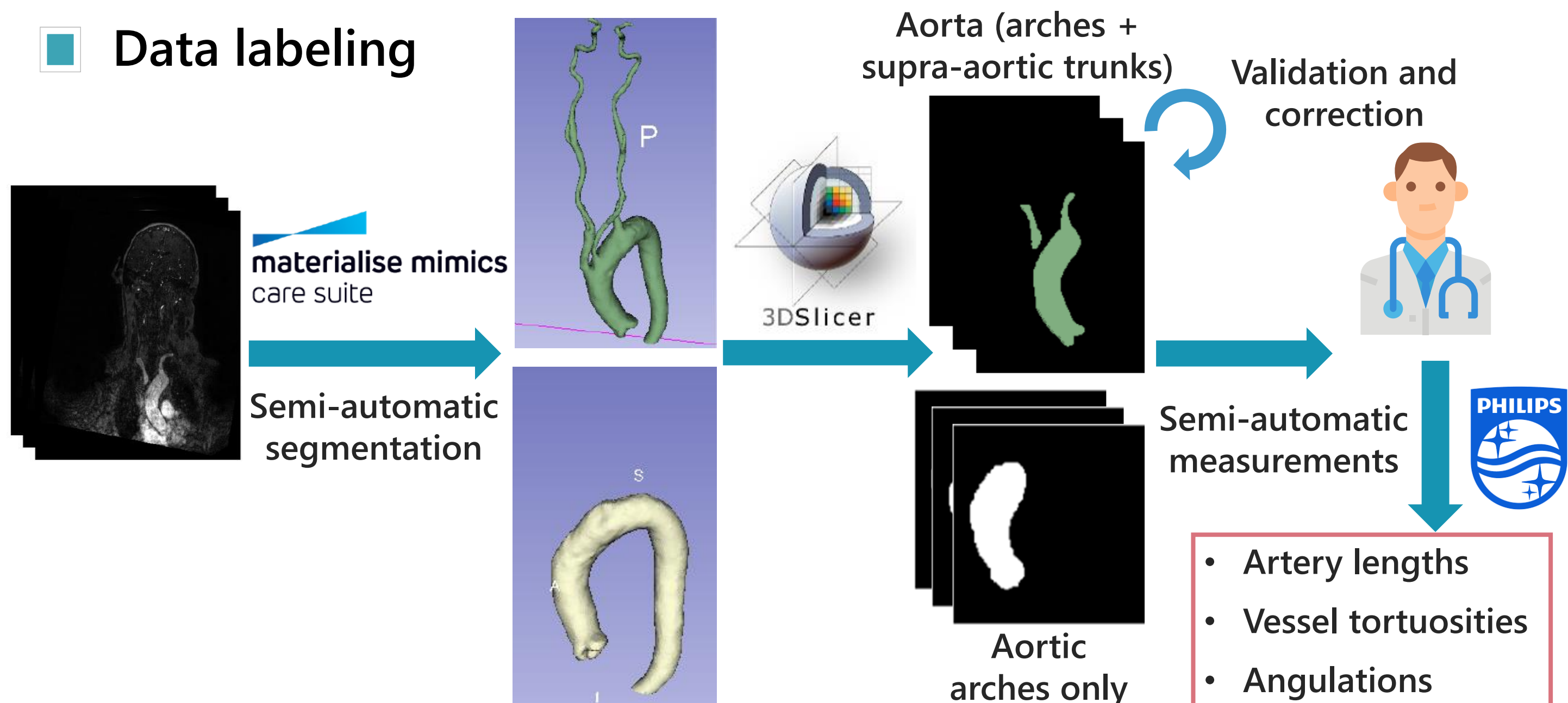


## 3. Data

22 patients underwent 3T MR exams of aortic arch, supra-aortic branches and intracranial vessels on Philips imaging system (Ingenuia 3T, Best, The Netherlands).

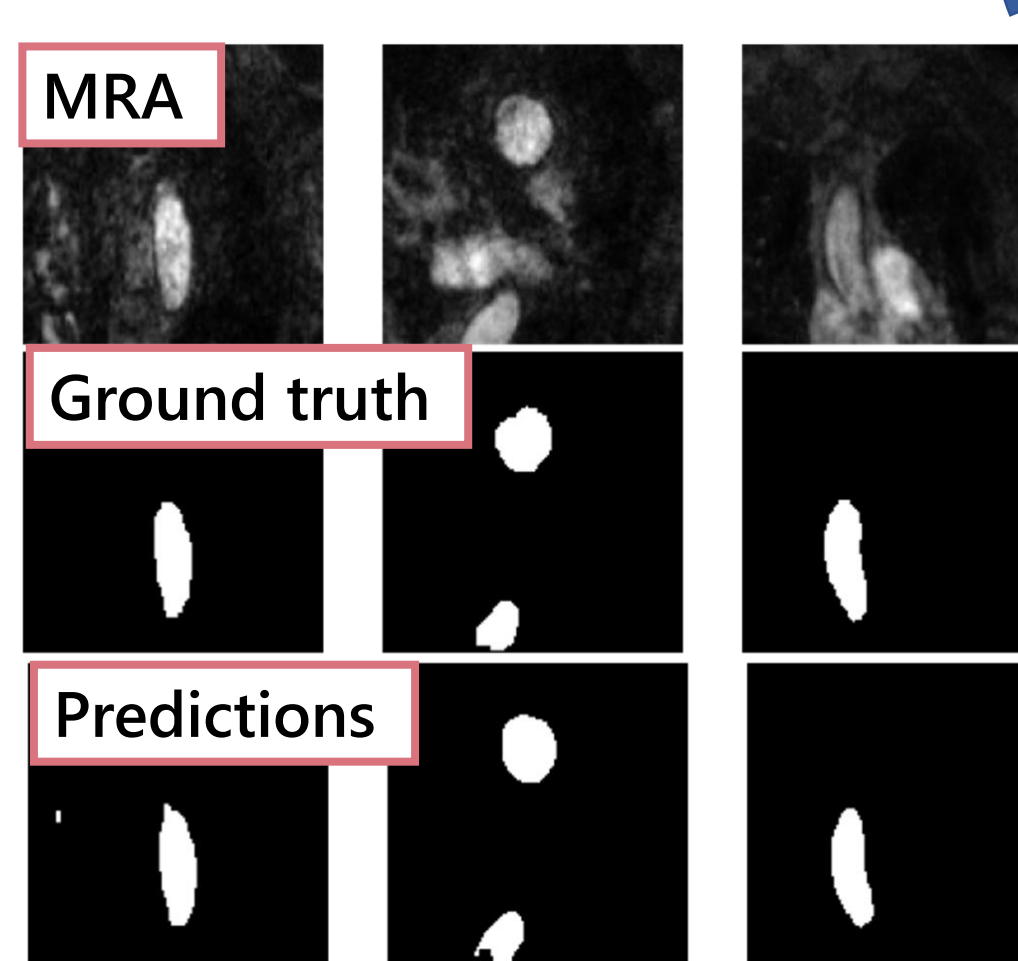
Acquisition parameters: coronal plane covering: 250 slices; active TR/TE = 5.5/2.2 ms; flip angle = 27°; number of excitations = 1; acquisition bandwidth = 476.7 Hz; FOV = 380 x 321; voxel size = 0.5 x 0.5 x 1.0 mm; imaging time = 69 sec; Bolus track injection technique.

### Data labeling

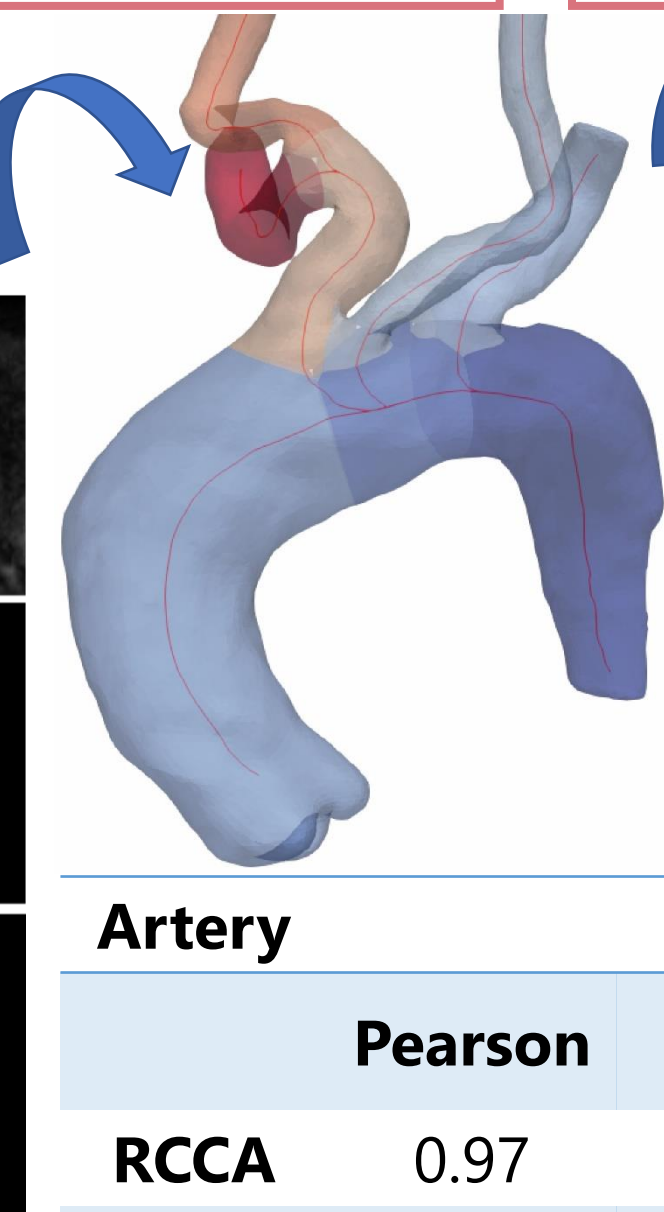


## 5. Results

- Dice score = 88.07%
- Precision = 84.10%
- Recall = 93.80%



3D reconstruction Geometric characterization

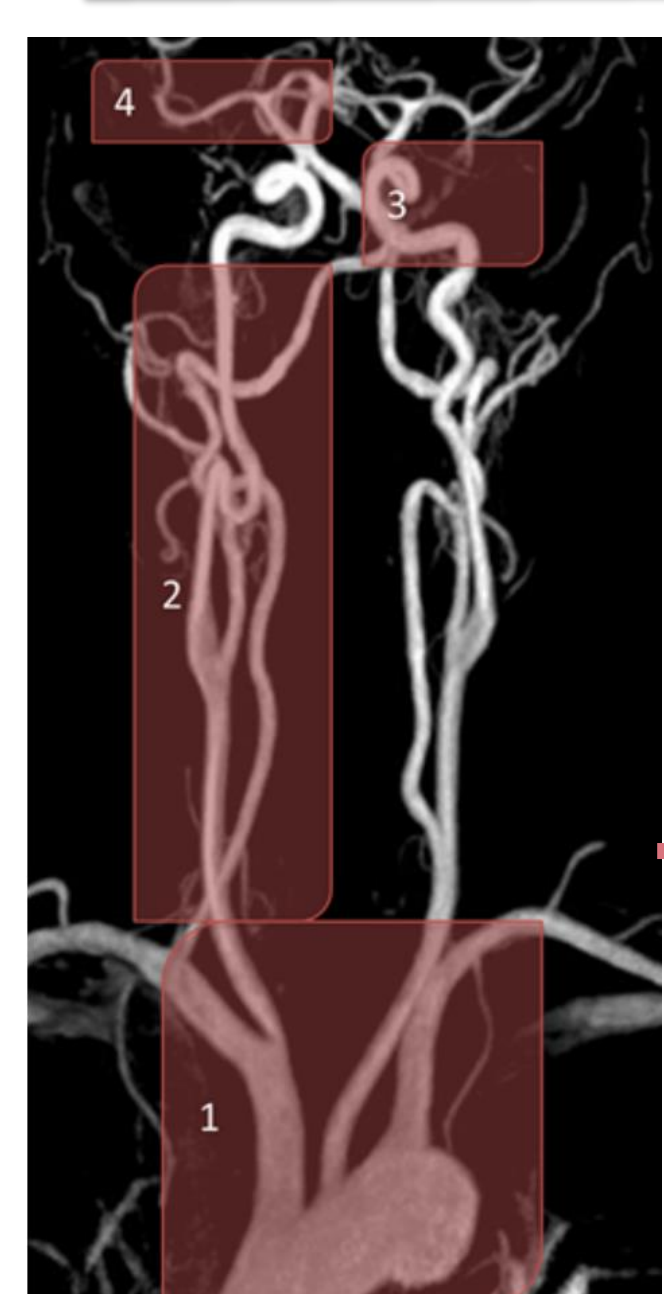


Arch type	Precision	Recall	F1-score
Type I	1.00	1.00	1.00
Type II	0.80	1.00	0.89
Type III	1.00	0.92	0.96

Reverse curves:  
 > RCCA: Pearson correlation = 0.88  
 > LCCA: Pearson correlation = 0.96

Artery	Length			Tortuosity		
	Pearson	RMSE	MAPE	Pearson	RMSE	MAPE
RCCA	0.97	5.97	1.75	0.93	0.06	3.32
LCCA	0.92	6.80	1.74	0.95	0.04	2.30

## 6. Conclusion and perspectives



- Complete analysis pipeline, from MRA images to high-level features: arch type, tortuosities, reverse curves, take-off angles and access difficulty after engaging an artery.
- Quantitative and qualitative validation by comparison to the medical reference (manual measurements and segmentations).

Clinical validation of our features on a diversified dataset in terms of demographic, pathological and imaging data of different modalities.

1) and 2) Aortic arch and supra-aortic branches, 3) and 4) intracranial vessels. Vascular structures of different anatomical characteristics: vessels become more tortuous, and their diameter decreases as they ascend to the brain.

3D extension of our CNN pipeline to better capture vessels of different diameters.

## References

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