Artificial intelligence for pre- and post-EVAR CT analysis: segmentation landmark annotation, and endoleak detection

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Background

Abdominal aortic aneurysms (AAA) are treated with **endovascular aortic repair** (EVAR), but require **continuous imaging monitoring** for complications such as **AAA growth or endoleaks** (EL) [1]

Purpose

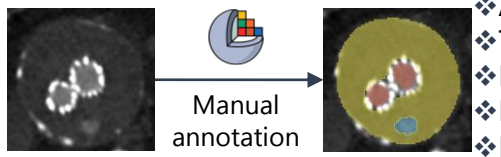
To develop **artificial intelligence** (AI) models that annotate **anatomical structures** in pre- and post-EVAR computed tomography images (PreCT and PostCT) and **detect EL** and **AAA diameter progression**

Study cohort

Center 1 (C1)
UH Vall d'Hebron, Barcelona
136 patients — 295 CT — 135 PreCT, 160 PostCT

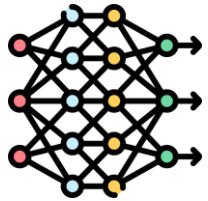
Center 2 (C2)
ULS São José, Lisbon
237 patients — 838 CT — 237 PreCT, 601 PostCT

Methodology



- Aortic lumen
- Thrombus / excluded aorta
- Landmarks
- EL
- Maximum diameter

All images from **C1** + **30 PreCT and 40 PostCT** from **C2**
Interobserver analysis: 20 PreCT + 20 PostCT by 2 observers



Trained **4 different AI models** with nnU-Net [2]

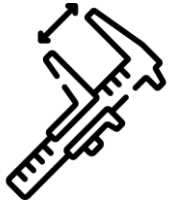
- PreCT segmentation + 6 landmarks
- PostCT segmentation+EL+9 landmarks

Training→ C1 (5-fold-cross-validation)
Testing→ 30 PreCTA+40 PostCTA **C2**

EL detection

EL presence by AI vs clinical report (all PostCT)





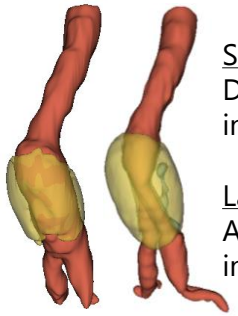
AAA diameter and progression

- Extracted from aortic segmentation in all CT
- AAA diameter progression
  - PreCT to first PostCT
  - PreCT to all postCT

Results

	IC	EC	p
N	136	237	-
Age (y, IQR)	75 [10]	74 [10]	0.99
Male (N,%)	129 (96)	228 (96)	0.99
HTA (N,%)	**98 (78)**	**209 (89)**	**0.02***
Dyslipidemia (N,%)	84 (67)	173 (74)	0.22
AAA diam. (mm, IQR)	60 [10]	59 [15]	0.10
EL (N,%)	57 (42)	93 (39)	0.69

p-value: Mann-Whitney / Chi-squared test

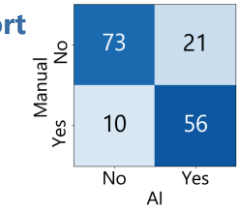


Segmentation
Dice score > 0.9, similar in **C1** and **C2**

Landmarks
AI errors similar to interobserver variability

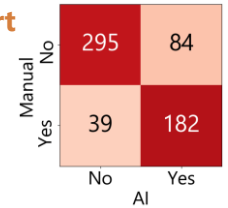
EL detection in C1 cohort

Sensitivity = 0.85
Specificity = 0.78
Accuracy = 0.81
AUC = 0.87

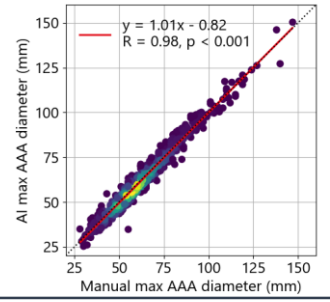


EL detection in C2 cohort

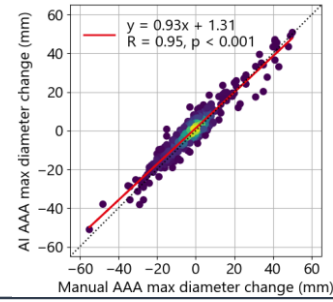
Sensitivity = 0.82
Specificity = 0.78
Accuracy = 0.80
AUC = 0.85



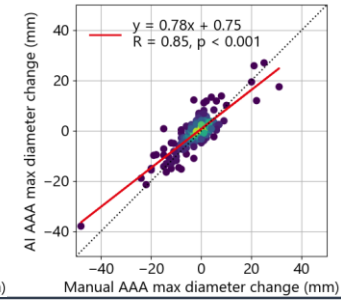
AI vs manual diameter



PreCT to first PostCT



PreCT to all PostCT



Conclusion

AI enables automatic **aortic segmentation**, **EL detection**, and **AAA diameter and progression assessment** on CT images, enabling quicker and more consistent evaluations that can **enhance risk stratification** in EVAR patients

References: [1] Wanheinen et al. *Eur J Vasc Endovasc Surg* (2024); [2] Isensee et al. *Nat. Methods.* (2020). Funding: Red de Investigación Vascular - Sociedad Española de Angiología y Cirugía Vascular. Generalitat de Catalunya (AGAUR-2021SGR758; AGAUR-2023FI100322). Instituto de Salud Carlos III (CP24/00121, co-funded by EU). Spanish Ministry of Science, Innovation and Universities (FORT23/00034)