Predicting myocardial infarction risk using abdominal CT-derived biomarkers

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Background

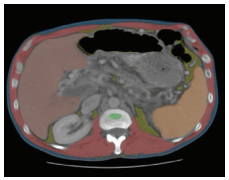
- Within cardiovascular disease (**CVD**), myocardial infarction (**MI**), commonly known as heart attacks, is one of the major global causes of death.
- Early detection of **MI** risk can lead to timely interventions, reducing the incidence and severity of **MI** on aging populations.

Goal: Examine the utility of abdominal computed tomography (**CT**) derived fully-automated biomarkers in predicting **MI** risk through survival analysis.

CT biomarkers*: muscle density, visceral adipose area, mean visceral adipose density, abdominal aortic plaque (Agatston score).

*measurements from third lumbar vertebra (L3), biomarkers are generated through automated AI segmentation

CT machine
Source: Cleveland Clinic



Sample L3 CT scan

Methods

Data set: 136,109 patients from **OSCAR** cohort, extracting automated biomarkers to leverage value-added CT scans

- **Control** (no **CVD**): 85,862
- **Study** (had **CT** done at/before **MI** diagnosis): 9,782
- **Excluded** (had **CT** done after **MI** diagnosis, other **CVD** diagnoses (e.g., heart failure, stroke)): 40,465

Data preparation: removed non-physiological values and tool failures, split data 80:20 train test (train: 76,515, test: 19,129), unit scaling (Cox proportional-hazards models)

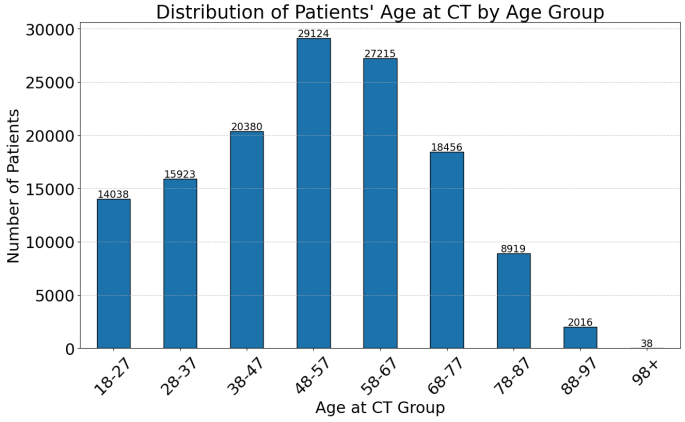
Survival analysis:

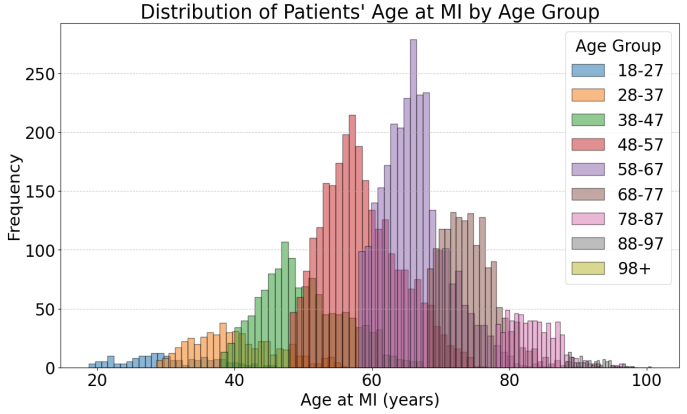
- Kaplan-Meier curves
- Cox proportional-hazards models

Descriptive Statistics

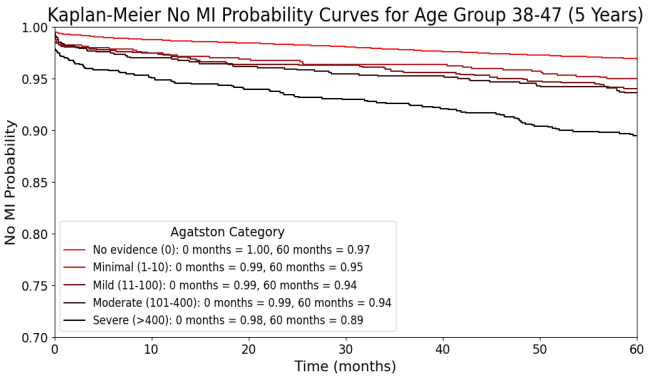
	Control group (No CVD)	Study group (MI at/after CT)
Age at CT (years)	47.5 ± 16.4	58.5 ± 13.4
Age at MI (years)	N/A	62.6 ± 12.6
Time difference MI to CT (months)	N/A	49.2 ± 57.1
Muscle density (Hounsfield Unit)	34.8 ± 15.7	27.6 ± 15.9
Visceral adipose area (cm^2)	140.7 ± 117.1	193.2 ± 130.1
Mean visceral adipose density (Hounsfield Unit)	-89.2 ± 9.8	-90.6 ± 9.9
Abdominal aortic plaque (Agatston score)	501.4 ± 1829.6	1359.3 ± 3155.5

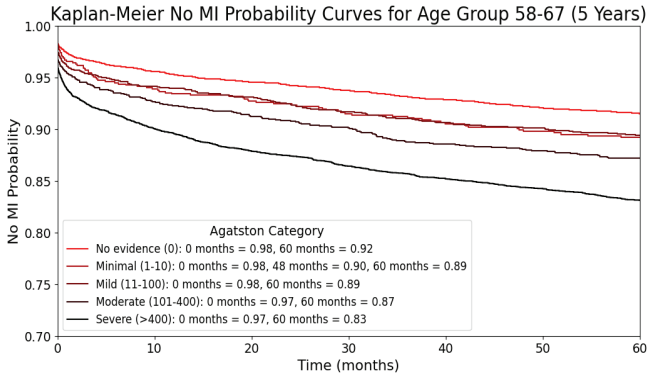
Distributions





Kaplan-Meier Curves





Cox Proportional-Hazards Models

	5-year MI risk coefficient (β)	p-value
Age at CT	0.04	0.04*
Muscle density	-0.02	< 0.005***
Visceral adipose area	0.05	< 0.005***
Mean visceral adipose density	0.14	< 0.005***
Abdominal plaque	0.05	< 0.005***

Concordance Index: Train Set = 0.750, **Test Set** = 0.749

* =p < 0.05, **= p < 0.01, ***= p < 0.001

Conclusions and Future Directions

Kaplan-Meier analysis shows differences in survival probabilities by age group, indicating that older age groups may have a higher risk of MI over time.

Cox proportional-hazards model shows that for example higher visceral adipose density (fat more dangerous to health) and higher plaque burden being associated with increased risk.

Early identification and intervention in younger age groups could significantly reduce long-term CVD risk.

Future research will include:

- Cox proportional-hazards models including demographic and clinical variables
- Relative risk for different age groups
- Machine learning to enhance predictive modeling and risk stratification

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data science HUB