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Coronary Artery Disease and Nonalcoholic Fatty Liver Disease: Clinical Correlation Using CT Coronary Calcium Scans

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Clinical Correlation between CAD and NAFLD Using CT Coronary Calcium Scans

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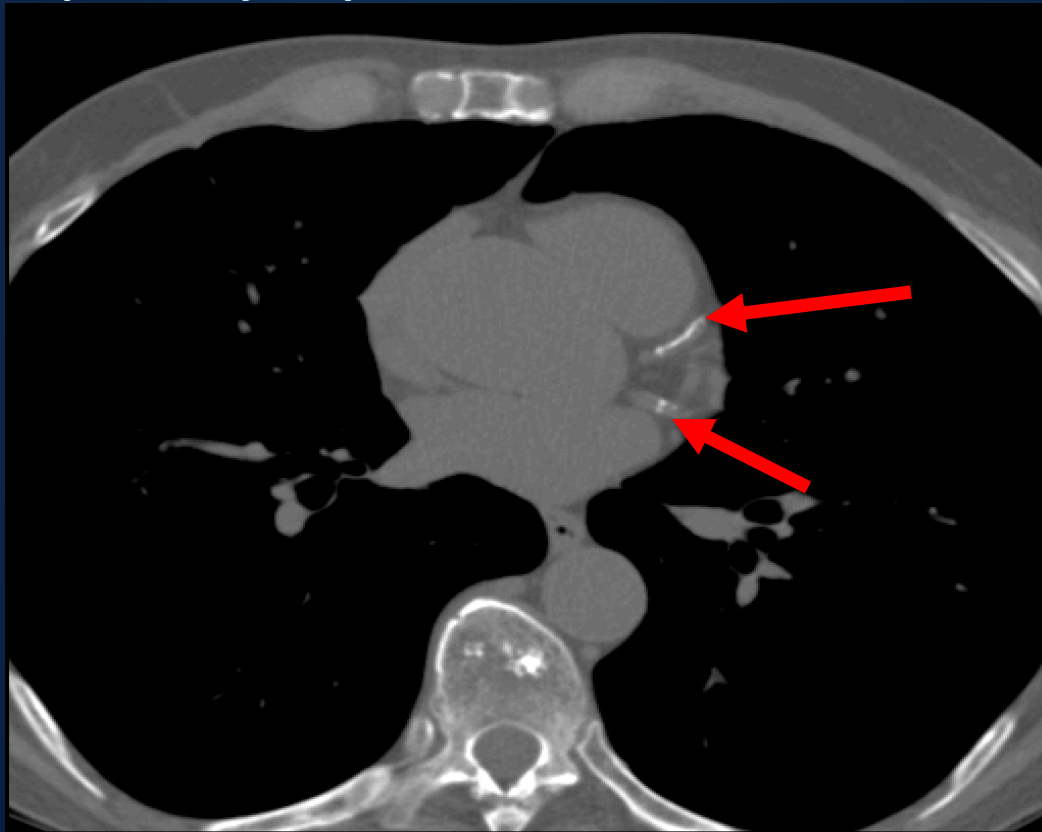
(*) indicates primary project advisor

(**) indicates another student who is declaring the same project as primary for SI

- Coronary Artery Disease (CAD) and Non-alcoholic fatty liver disease (NAFLD) are increasing in prevalence!¹
- Both CAD and NAFLD have known associations with diabetes mellitus type 2, dyslipidemia, hypertension, and abdominal obesity.²
- Finding methods of early detection of CAD/NAFLD are important!

1. Pandyarajan V, Gish RG, Alkhouri N, et al. Screening for Nonalcoholic Fatty Liver Disease in the Primary Care Clinic. *Gastroenterol Hepatol (N Y)*. 2019;15(7):357-365.
2. Targher G, Arcaro G. Non-alcoholic fatty liver disease and increased risk of cardiovascular disease. *Atherosclerosis*. 2007;191(2):235-240.

- CT Coronary Artery Calcium Scans are used to monitor pre-symptomatic CAD!¹



1. Cainzos-Achirica M, Di Carlo PA, Handy CE, et al. Coronary Artery Calcium Score: the "Mammogram" of the Heart?. *Curr Cardiol Rep.* 2018;20(9):70

Objectives & Hypothesis

- Aim/Research Question
 - Can we determine whether there is an increased risk of NAFLD in a population with asymptomatic CAD?
- Hypothesis
 - If patients have asymptomatic CAD, then they will have increased risk of NAFLD based on their common risk factor profile

Approach & Results

- Retrospective cross-sectional analysis of 134 patient charts from 4/2017 to 1/2020
 - The patients came from a community healthcare setting (low pre-test probability)
- Patients needed a positive CT CAC score and liver imaging within 3 years of the CAC study.
- Exclusion Criteria:
 - Alcohol consumption: W > 7/wk, M > 14/wk
 - Drugs: Glucocorticoids, Chemotherapy, Amiodarone, NRTI
 - Chronic Viral Hepatitis: Types B, C, and D.

Approach & Results

- Variables Obtained:
 - Sex, TG, Total Cholesterol, HDL, LDL, BMI, HbA1c, BP, AST, ALT, ALP, Total Bilirubin
 - FIB-4 and BARD Scores
- Statistics
 - Chi-squared Analysis for each variable to CAD Severity and Hepatic Steatosis.
 - Multivariate analysis for variables that had $p < 0.05$, Hepatic Steatosis, and CAD severity

Approach & Results

- Results

- 15.7% of patients who underwent CT CAC had findings of hepatic steatosis on abdominal imaging
- CAD severity was not associated with presence of hepatic steatosis (p = 0.36, OR 1.96 (95% CI 0.74-5.23))

Results & Analysis

Table 1. Analysis of CAC CT Positive Patients

	Total Patients	% of Patients with Abnormal Lab Values	CAD Severity p-value	OR (95% CI)
CAD Severity				
Sex	Men: 88; Female: 46	n/a	0.13	0.56 (0.27-1.16)
Triglycerides	114	(>160): 14.0	0.64	0.88 (0.30-2.55)
Total Cholesterol	115	(>200): 40.0	0.054	0.39 (0.18-0.86)
HDL	115	(<35): 4.3; (>80): 15.7	0.15	1.74 (0.28-10.80)
LDL	115	(>130): 28.7	0.28	0.57 (0.25-1.31)
BMI	133	(25-29.9): 40.6; (>30): 32.3	0.64	1.06 (0.51-2.21)
Hemoglobin A1c	134	(5.7-6.4): 20.1; (>6.5): 8.2	0.91	0.96 (0.28-3.33)
Hypertension	134	(>120/>80): 53.7	0.72	1.46 (0.74-2.90)
AST	121	(>48): 3.3	0.02	3.50 (0.35-34.64)
ALT	121	(>55): 5.0	0.88	0.55 (0.10-3.10)
Alkaline Phosphatase	121	(<40): 6.6	0.71	0.88 (0.21-3.71)
Total Bilirubin	121	(>1.2): 3.3	0.18	1.13 (0.15-8.27)
Hepatic Steatosis				
Sex	Men: 88; Female: 46	n/a	0.92	0.95 (0.35-2.54)
Triglycerides	114	(>160): 14.0	0.03	3.60 (1.05-12.29)
Total Cholesterol	115	(>200): 40.0	0.42	0.63 (0.20-1.96)
HDL	115	(<35): 4.3; (>80): 15.7	0.42	0.60 (0.06-6.17)
LDL	115	(>130): 28.7	0.35	0.54 (0.14-2.03)
BMI	133	(25-29.9): 40.6; (>30): 32.3	0.02	4.26 (0.94-19.31)
Hemoglobin A1c	134	(5.7-6.4): 20.1; (>6.5): 8.2	0.00044	8.64 (2.35-31.83)
Hypertension	134	(>120/>80): 53.7	0.75	1.19 (0.41-3.43)
AST	121	(>48): 3.3	0.65	1.70 (0.17-17.25)
ALT	121	(>55): 5.0	1	1.00 (0.11-9.05)
Alkaline Phosphatase	121	(<40): 6.6	0.19	0.88 (0.17-4.46)
Total Bilirubin	121	(>1.2): 3.3	0.36	1.18 (0.12-11.20)
CAD Severity and Hepatic Steatosis				
Triglycerides	114	(>160): 14.0	0.15	0.58 (0.05-6.47)
BMI > 25.0	133	(25-29.9): 40.6; (>30): 32.3	0.47	0.63 (0.06-7.05)
BMI > 30.0	133	(>30): 32.3	0.02	6.77 (1.40-32.66)
Hemoglobin A1c >6.5	134	(>6.5): 8.2	0.01	9.60 (0.56-165.5)
AST	121	(>48): 3.3	0.07	0.97 (0.01-5.80)

Table 2. FIB-4 and BARD Scores

FIB-4 Score (n = 102)						
Number of Patients with Score < 1.45	Number of Patients with Score 1.45-3.25	Number of Patients with Score > 3.25	CAD Severity p-value	Hepatic Steatosis p-value	CAD Severity and Hepatic Steatosis p-value	
1 (0.98%)	30 (29.4%)	71 (69.6%)	0.23 (OR 1.53 (95% CI 0.65-3.63))	<0.001 (OR 6.29 (95% CI 0.05-0.52))	< 0.01 (OR 5.66 (95% CI 1.71-18.75))	
BARD Score (n = 119)						
Number of Patients with BARD Score 0 and 1	Number of Patients with BARD Score 2	Number of Patients with BARD Score 3	Number of Patients with BARD Score 4	CAD Severity p-value	Hepatic Steatosis p-value	CAD Severity and Hepatic Steatosis p-value
22 (18.5%)	53 (44.5%)	40 (33.6%)	4 (3.4%)	0.58 (OR 1.04 (95% CI 0.50-2.20))	0.01 (OR 2.16 (95% CI 0.80-5.81))	0.01 (OR 2.38 (95% CI 0.21-27.48))



Discussion & Conclusion

- There was no association between CAD severity and presence of hepatic steatosis.
- Obesity and diabetes were significant contributors to the presence of CAD and hepatic steatosis
 - This supports the postulate that insulin resistance promotes fatty acid accumulation and accelerates atherosclerosis¹.
- Diet, exercise, and weight loss should be emphasized lifestyle modifications².
- Limitations: No liver biopsy or Fibroscan data to confirm liver fibrosis. Study population had in general less diabetes, high TG, and obesity than general population³.

1. Jaruvongvanich V, Wirunsawanya K, Sanguankeo A, Upala S. Nonalcoholic fatty liver disease is associated with coronary artery calcification: A systematic review and meta-analysis. *Dig Liver Dis.* 2016;48(12):1410-1417.
2. Chalasani N, Younossi Z, Lavine JE, et al. The Diagnosis and Management of Nonalcoholic Fatty Liver Disease: Practice Guideline From the American Association for the Study of Liver Diseases. *Hepatology.* 2019;67(1):328-357
3. Younossi ZM, Koenig AB, Abdelatif D, et al. Global epidemiology of nonalcoholic fatty liver disease-Meta-analytic assessment of prevalence, incidence, and outcomes. *Hepatology.* 2016;64(1):73-84



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Future Directions

- Exploring the effects of weight loss and diabetes control on NAFLD and CAD together prospectively.

Acknowledgements

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