Clinical Outcomes Using Coronary CT Angiography and FFR_{CT} Guided Management of Stable Chest Pain Patients

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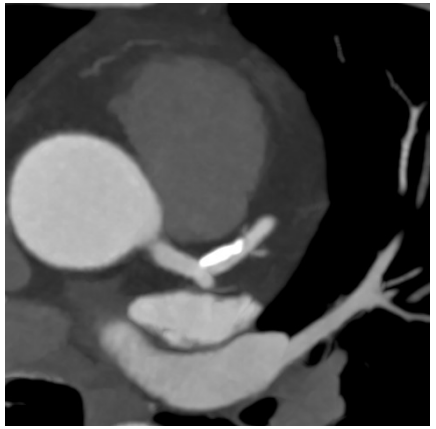
Background

- **Coronary CT Angiography:**



  - Can accurately exclude the presence of CAD[1]
  - Prognostic implications[2]
  - Cannot determine the physiologic significance of lesions[3]

Non-invasive strategies are needed to identify those patients with CAD who may benefit from cardiac catherization and those who do not require further testing

[1]Abdulla J et al, EHJ 2007; [2]Nielsen LH et al, EHJ 2017; [2]Xie JX et al, *i*JACC 2018; [3]Meijboom WB et al, JACC 2008; [3]Norgaard BL et al, JACC 2014

Background

- **CTA derived fractional flow reserve (FFR_{CT}):**

  - High and improved diagnostic performance compared to CTA[1]
  - Have shown promise in guiding downstream management of patients with CAD[2]
  - One-year outcomes of FFR_{CT} guided care in a clinical trial setting was favorable[2]

Longer term clinical outcome data in patients undergoing CTA testing with FFR_{CT} guidance in day-to-day practice is sparse

[1]Koo BK et al, JACC 2011; [1]Min JK et al, JAMA 2012; [1]Norgaard BL et al, JACC 2014; [2]Douglas PS et al, JACC 2016

Overall purpose of the study

- To assess the safety and clinical outcomes of utilizing a diagnostic strategy of first-line coronary CTA with selective FFR_{CT} testing in real world symptomatic patients with suspected stable CAD

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Study design

- Single-center, observational all-comer study of symptomatic patients undergoing non-emergent coronary CTA for suspected CAD with selective FFR_{CT} testing between May 2014 and December 2016

- Data sources
  - The Western Denmark Cardiac Computed Tomography Registry[1]
    - Patient demographics, CTA results
  - The Danish National Patient Registry[2]
    - Discharge diagnoses, test and procedures for all in and outpatient encounters
  - The Danish Civil Registration system[3]
    - Data on mortality

[1]Nielsen LH et al, Clin Epidemiol 2014; [2]Schmidt M et al, Clin Epidemiol 2015; [3]Schmidt M et al, Eur J Epidemiol 2014

Patients

- All Aarhus University Hospital patients with new onset chest pain and suspected CAD who had non-emergent coronary CTA performed from May 2014 to December 2016
  - Coronary CTA is the first-line test in such patients
  - CTA acquisition was performed according to societal guidelines[1]
    - Exclusion from CTA: Contrast allergy, pregnancy, scenarios where a diagnostic image quality cannot be expected (combination of e.g. obesity, arrhytmia, and severe calcification)

[1]Abbara S et al, JCCT 2016

Post-test management, *Coronary CTA*

	Test outcome	Post-test management recommendations
Coronary CTA		
Diagnostic conclusive	High-risk anatomy	ICA
	Intermediate-risk anatomy	FFR_{CT}
	Low-risk anatomy	No further testing
Diagnostic inconclusive	-	MPI, or ICA

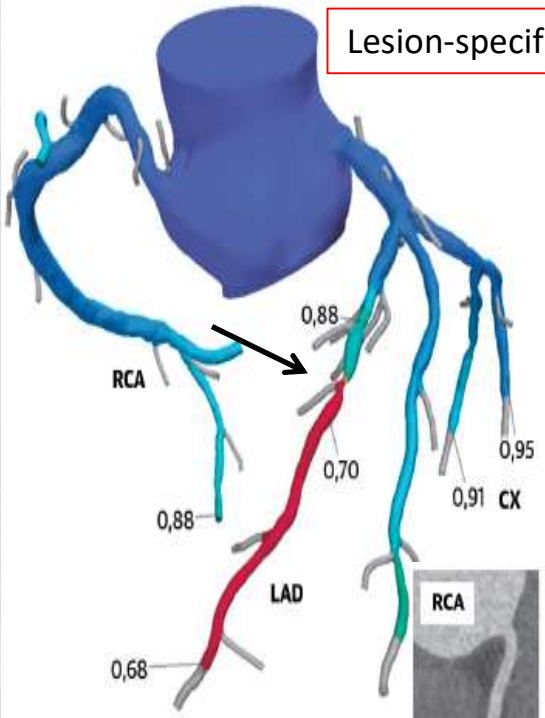
Optimal medical treatmet was recommended in all patients with CAD
ICA =invasive coronary angiography, MPI =myocardial perfusion imaging

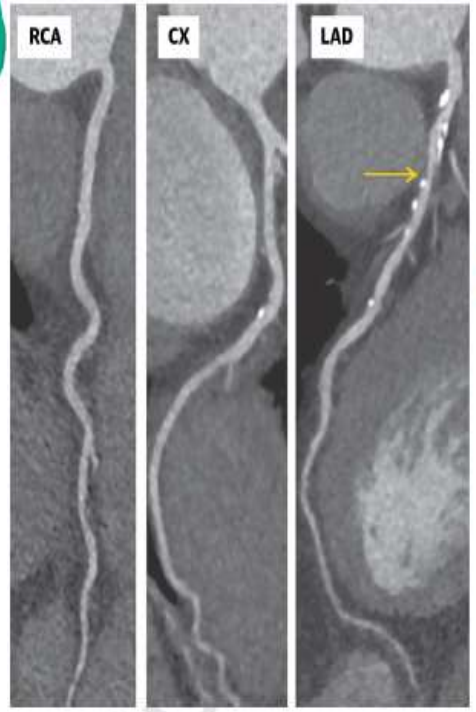
Post-test management, *FFR$_{CT}$*

	Test outcome	Post-test management recommendations
FFR$_{CT}$		
Diagnostic conclusive	**Negative**, all values >0.80	OMT, no additional testing
	Positive, one or more values ≤0.80	
	-Lesion-specific ischemia	OMT or ICA
	-Distal vessel positivity	OMT
Diagnostic inconclusive	-	MPI, or ICA

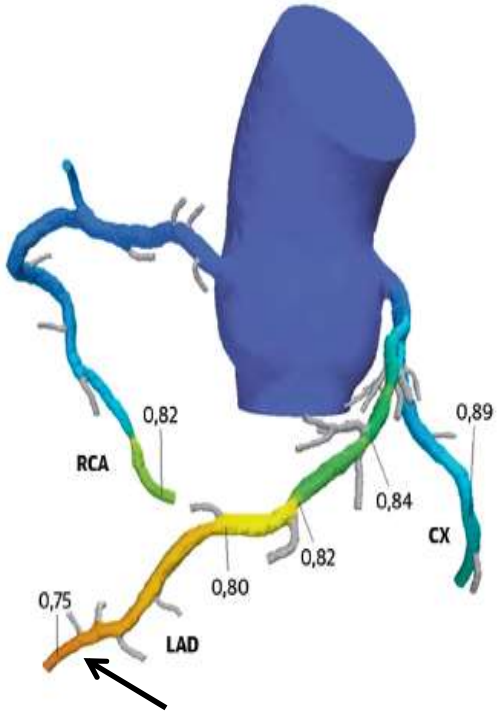
ICA =invasive coronary angiography, MPI =myocardial perfusion imaging, OMT =optimal medical treatment

Lesion-specific ischemia





Distal vessel FFR_{CT} positivity



Endpoint, Follow-up, and Study aims

- **Endpoint**: Composite of all-cause death, non-fatal myocardial infarction, hospitalization for unstable angina, and unplanned revascularization

- **Follow-up**: Median 24 (interquartile range, 16-32; range, 8-41) months. No patients were lost to follow-up

● **Primary aim**: The cumulative incidence of the combined endpoint in patients with FFR_{CT} >0.80, and no additional testing compared to patients with no or minimal (stenosis severity <30%) CAD

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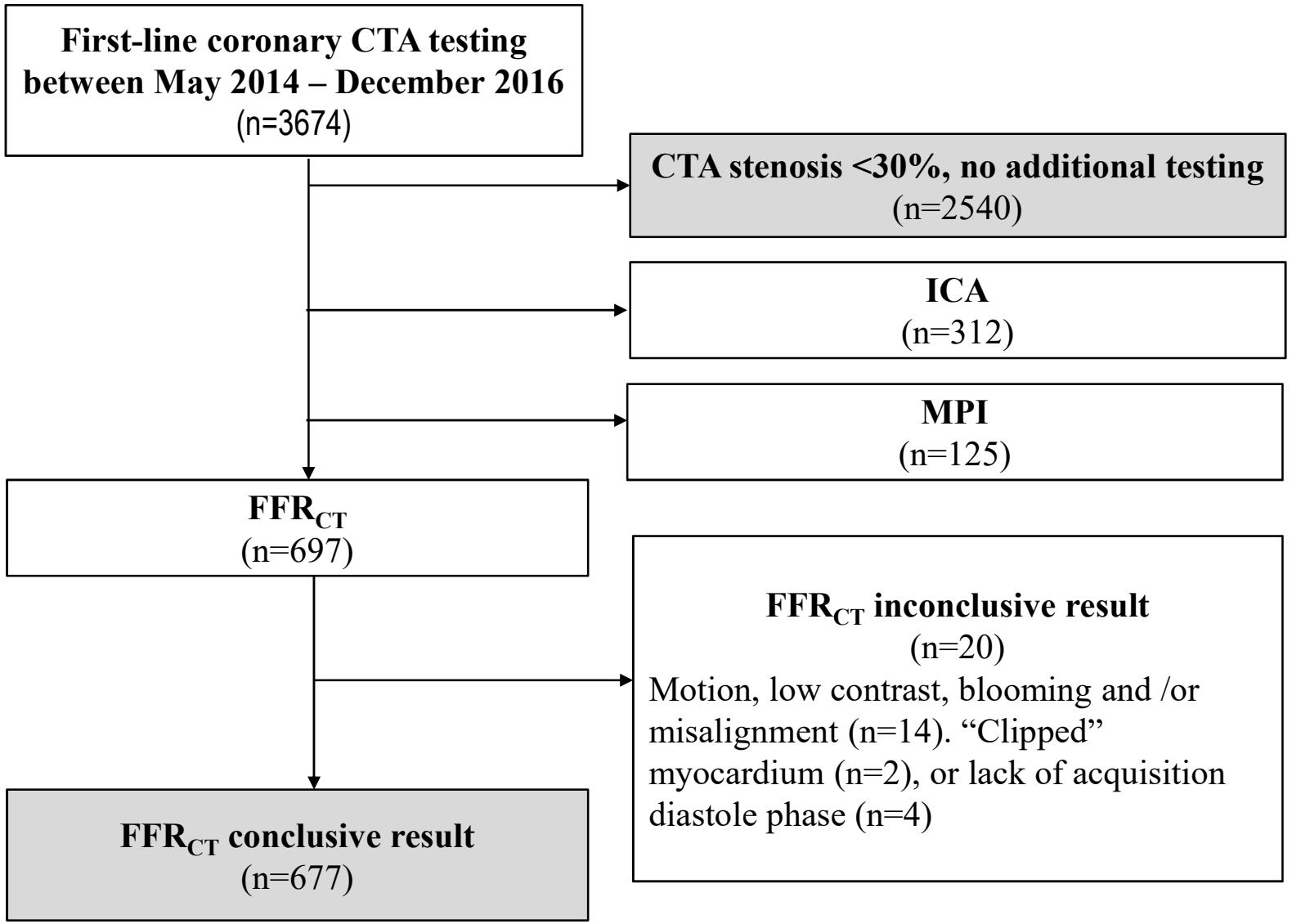
● **Secondary aim**: The cumulative incidence of the combined endpoint in patients with FFR_{CT} ≤0.80 (OMT or ICA), compared to patients with CTA stenosis <30%

Results: Patients Flow-chart



Results: Baseline characteristics

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	CTA stenosis <30%	CTA stenosis ≥30%		P-value (FFR_{CT} >0.80 versus FFR_{CT} ≤0.80 group)
	OMT (n =2540)	FFR_{CT} >0.80, OMT (n=410)	FFR_{CT} ≤0.80, OMT or ICA (n=267)	
Age, yrs, mean	56	60	62	0.006
Male, %	43	55	65	0.02
Diabetes mellitus,%	6	9	14	0.16
Hypertension,%	30	40	50	0.005
Updated D-F score, mean %	31	43	47	0.01

DF = Diamond-Forrester

Results: Anatomical characteristics

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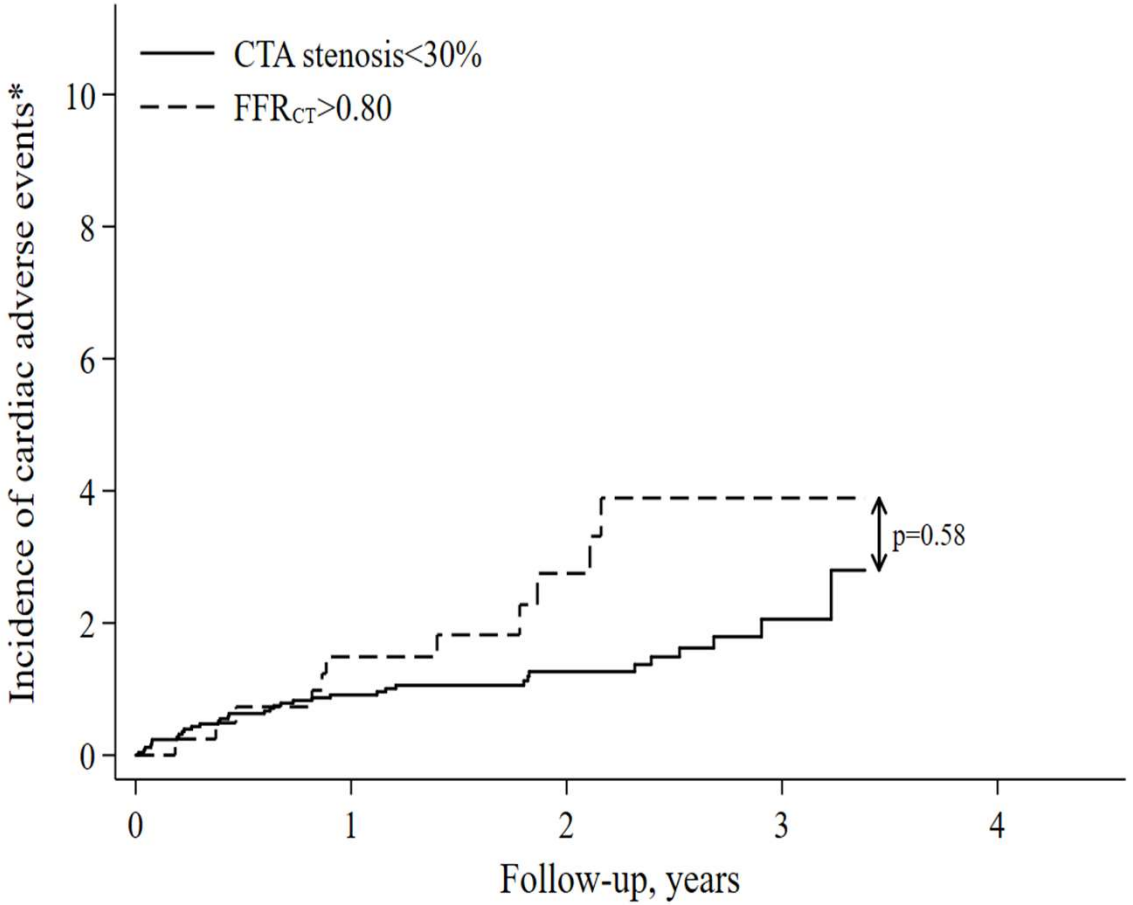
	FFR_{CT} >0.80, OMT (n=410)	FFR_{CT} ≤0.80, OMT or ICA (n=267)	P-value
Maximum CTA stenosis			
30-49%	25%	9%	<0.001
50-69%	65%	59%	0.10
≥70%	10%	32%	<0.001
Vessels with stenosis ≥50%			<0.001
1	63%	56%	
2	10%	27%	
3	1%	7%	
Mean Agatston score	164	456	<0.001

Results: Clinical outcomes

*All-cause death,
non-fatal myocardial MI,
hospitalization for unstable angina,
unplanned revascularization



Number at risk				
CTA stenosis<30%	2540	2187	1226	285
FFR$_{CT}$>0.80	410	366	187	49

Results: Clinical outcomes

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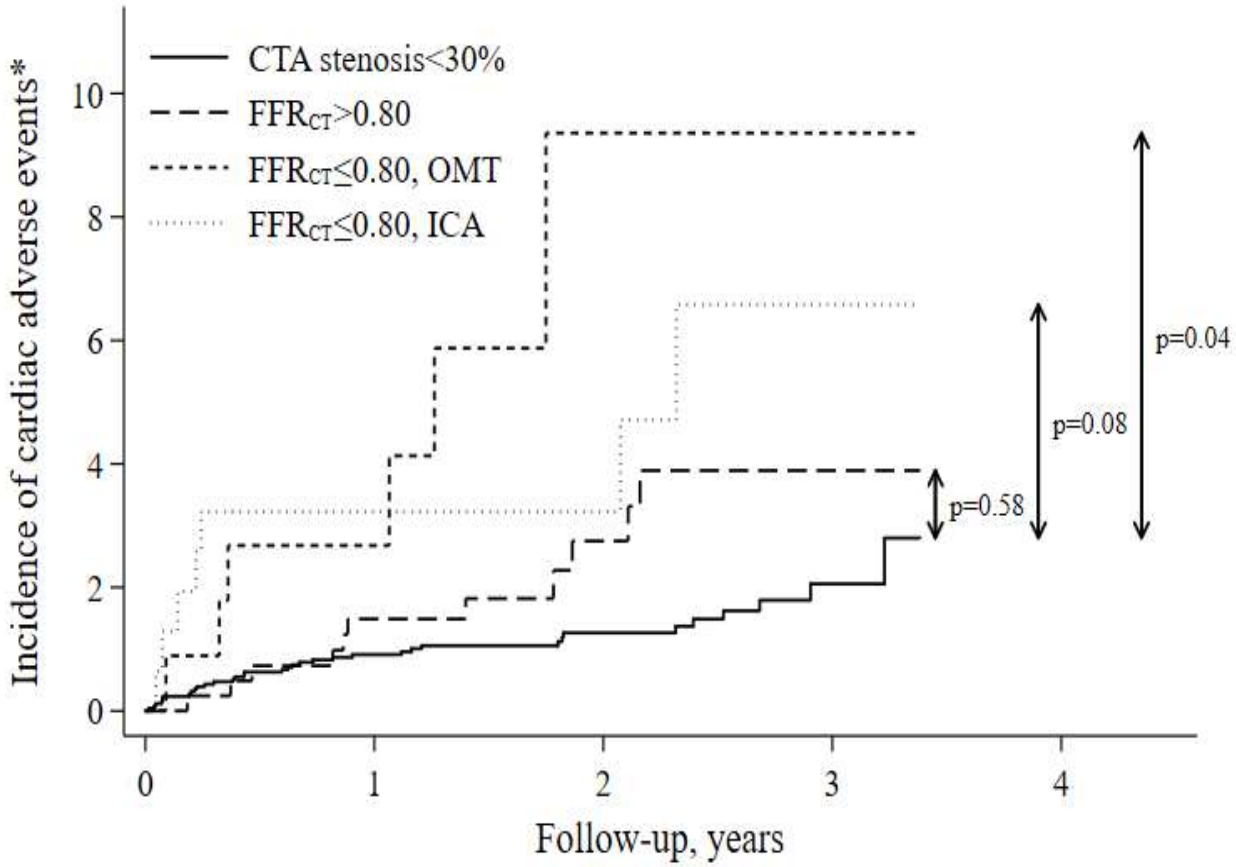

Number at risk				
CTA stenosis<30%	2540	2187	1226	285
FFR_{CT}>0.80	410	366	187	49
FFR_{CT}≤0.80, OMT	112	75	20	3
FFR_{CT}≤0.80, ICA	155	132	71	19

Results: Clinical outcomes

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	CTA stenosis <30%	CTA stenosis ≥30%			P-value
	OMT (n=2540)	FFR_{CT} >0.80, OMT (n=410)	FFR_{CT} ≤0.80, OMT (n=112)	FFR_{CT} ≤0.80, ICA (n=155)	
Composite end-point	2.8 (1.4-4.9)	3.9 (2.0-6.9)	9.4 (3.0-20.0)	6.6. (2.5-13.4)	0.07
All-cause death	2.3 (1.0-4.4)	1.4	1.5	2.8	0.97
Non-fatal MI	0.3 (0.1-0.6)	0.3	8.0 (2.2-18.6)	1.3	<0.001
Hospitalization for UA	0.1	1.7	0.9	2.5	0.01
Unplanned revascularization	0.4 (0.2-0.8)	1.0	8.8 (2.2-18.6)	0	<0.01

Results: Clinical outcomes

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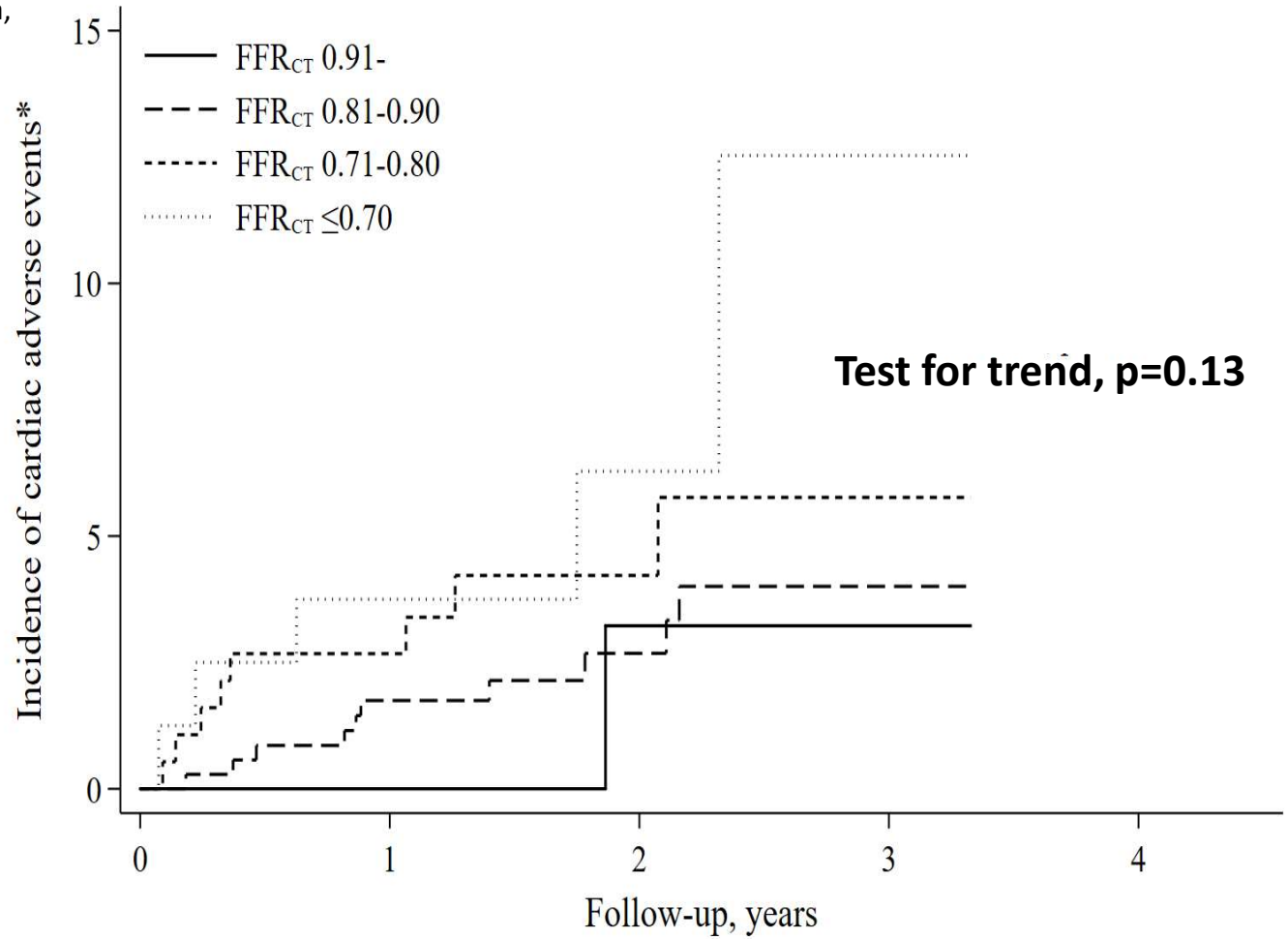

Test for trend, p=0.13

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Summary

- In a real-world setting of symptomatic patients without known CAD, the presence of intermediate range CTA stenosis and FFR_{CT} >0.80 was associated with favorable clinical outcomes similar to patients with no or minimal evidence of CAD

- Risk of an unfavorable outcome was increased (driven by a higher incidence of non-fatal MI) in patients with FFR_{CT} ≤0.80, who were not referred to ICA

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Conclusion

- In a real-world clinical practice, a diagnostic strategy of first-line coronary CTA in symptomatic patients suspected of CAD, and FFR_{CT} testing in those with intermediate range lesions is effective in differentiating patients who do not require further diagnostic testing or intervention (FFR_{CT} >0.80) from higher risk patients (FFR_{CT} ≤0.80) in whom further testing with ICA and possibly intervention may be needed

Thank you!