Performing Computed Tomography Instead of Invasive Coronary Angiography

Sex Effects in Patients With Suspected CAD

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Around 50% of women die of cardiovascular diseases. Diagnostic accuracy in detecting significant coronary artery disease (CAD) differs between men and women, underlining the need for further investigation of sex-specific differences (1). In this subanalysis of the prospective CAD-Man (Coronary Artery Disease Management) trial, we evaluated if women, compared with men, benefit from undergoing computed tomography angiography (CT) instead of invasive coronary angiography (ICA) in terms of procedural complications. Events in the follow- up period were defined in the study protocol (2). The CAD-Man trial showed that CT is a safe and accurate gatekeeper to ICA. Initial CT instead of ICA reduced minor complications and the length of hospitalization, while increasing the diagnostic yield of ICA.

Patients with suspected CAD based on atypical chest pain and a clinical indication for ICA were randomly assigned to CT or ICA (2). Major procedural complications (death, stroke, myocardial infarction, and other complications prolonging hospitalization by at least 24 h) and minor procedural complications (e.g., groin hematoma, groin pain, infection, allergy, thrombosis, and arteriovenous fistula), defined as occurring within 48 h of the last related procedure, were compared between men and women.

The sex analysis was a planned secondary analysis (2). The chi-square test was used to evaluate minor and major procedural complications. Additionally, a post hoc power calculation was performed. The calculations were performed by nQuery release 7 (Statistical Solutions Ltd., Boston, Massachusetts). Assuming the observed overall complication rate of 7.3% and the sample size of the study, differences in complication rates of 8% (i.e., 3.3% vs. 11.3%) or larger could have been detected (power 80%, type I error = 0.05; 2-sided).

Procedural complications occurred less often in women in the CT group compared with the ICA group (CT: 1.1% vs. ICA: 11.5%). Procedural complications were similar in men in both groups (CT: 7.6% vs. ICA: 9.5%). Major procedural complications were uncommon in the CT and ICA group in both sexes (**Table 1**). Minor procedural complications occurred less often in women in the CT group compared with the ICA group (**Table 1**). The interaction sex study arm regarding procedural complication was $p = 0.072$.

The number of any events at long-term follow-up at 3.3 years was similar in women and men in both groups (**Table 1**).

This study is limited by its single-center design and the small total number of adverse events. Although earlier studies revealed differences between women and men regarding the prevalence and symptoms of CAD, ours is the first study analyzing sex differences in terms of outcomes of diagnostic procedures (CT and ICA). This study shows that women with atypical chest pain and a clinical indication for coronary evaluation may benefit from a strategy based on CT instead of ICA, specifically due to a reduction in minor procedural complications.

Possible reasons for these results are:

1. Having a lower pretest probability of disease than men and a lower rate of complex diseases women are expected to benefit less from initial ICA.
2. Women with obstructive CAD have more comorbidities, present with atypical symptoms, and tend

TABLE 1 Any Procedural Complications and Events at Long-Term Follow-Up at 3.3 Years

	Women (n = 166)				Men (n = 163)			
	CT (n = 88)	ICA (n = 78)	p Value	Power	CT (n = 79)	ICA (n = 84)	p Value	Power
Procedural complications	1 (1.1)	9 (11.5)	0.005*	79.6	6 (7.6)	8 (10.5)	0.66	15.7
Major procedural complications	0	0			1 (1.3)	0	0.298	19.1
Myocardial infarction	0	0			1 (1.3)	0	0.298	19.1
Death	0	0			0	0		
Minor procedural complications	1 (1.1)	9 (11.5)	0.005*	79.6	5 (6.3)	8 (10.5)	0.450	15.7
Hematoma at puncture site	0	8 (10.3)	0.002	86.0	1 (1.3)	7 (8.2)	0.038	53.2
Bradycardia	1 (1.1)	0	0.345	13.9	1 (1.3)	0	0.298	19.1
Angina without infarction	0	0			1 (1.3)	0	0.298	19.1
Allergoid reaction to contrast agent	0	0			1 (1.3)	0	0.298	19.1
Stent migration	0	0			0	1 (1.2)	0.334	15.0
Hypotension requiring treatment	0	1 (1.3)	0.287	20.0				
Number of any event at long-term follow-up at 3.3 years	2 (2.3)	2 (2.5)	1		5 (6.3)	5 (5.9)	0.905	5.7
Myocardial infarction	0	0			1 (1.3)	0	0.298	19.1
Cardiac death	0	1 (1.3)	0.287	20.0	0	0		
Stroke	0	1 (1.3)	0.287	20.0	0	0		
Unstable angina pectoris	0	0			1 (1.3)	0	0.298	19.1
Re-revascularization or first revascularization	2 (2.3)	1 (1.3)	0.632	7.3	4 (5.1)	4 (5.9)	1	

Values are n (%). *Significant after Bonferroni correction with factor 2 for testing of 2 subgroups.
CT = computed tomography; ICA = invasive coronary angiography.

to develop plaque erosion (3). Thus, they are expected to have higher risks for procedural complications during ICA with poorer outcome (4).

3. Women more often have microvascular disease rather than obstructive luminal stenosis of the large epicardial vessels (5), and thus, benefit more from risk factor modification than from coronary revascularization. In addition, CT allows more detailed risk stratification, which may improve outcomes, especially in women.

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