Effective Health Care Program

Heart and Blood Vessel Conditions
Heart Disease

Noninvasive Technologies for Diagnosing Coronary Artery Disease in Women: Comparative Effectiveness

Research Focus for Clinicians

In response to a request from the public regarding the accuracy and harms of noninvasive technologies for diagnosing coronary artery disease (CAD) in adult women with symptoms suggestive of CAD, a systematic review of comparative studies was undertaken to evaluate the evidence. The review included 1 randomized clinical trial, 79 prospective observational studies, and 24 retrospective observational studies published from August 1975 through September 12, 2011. The full report, listing all studies, is available at www.effectivehealthcare.ahrq.gov/diagnosecad.cfm. This summary is provided to inform clinicians and to assist in decisionmaking along with consideration of a patient's values and preferences. However, reviews of evidence should not be construed to represent clinical recommendations or guidelines.

Background

The diagnosis of CAD in women is challenging. Women with chest pain demonstrate a lower prevalence of obstructive epicardial CAD. Symptoms of CAD in women are less predictive and more often atypical when compared with those of men. The American Heart Association (AHA) reports that women at risk of CAD are less often referred for an appropriate diagnostic test than men. Coronary angiography, the gold standard for diagnosing CAD, is indicated in patients with chest pain and a high likelihood of CAD; however, it is associated with risks that make noninvasive modalities attractive for women in whom angiography is not indicated.

In 2005, the AHA developed a consensus statement on the role of noninvasive technologies (NITs) in diagnosing CAD in women. The statement recommended noninvasive tests for women with atypical chest pain and a low risk of CAD who might require evidence that their symptoms are not cardiac in origin and for symptomatic women with intermediate pretest probability of CAD.

The NITs used to diagnose CAD may be categorized as "functional" or "anatomic" tests. Functional NITs include:

- Exercise/pharmacologic stress electrocardiography (ECG)
- Exercise/pharmacologic stress echocardiography (ECHO) with or without a contrast agent
- Exercise/pharmacologic stress radionuclide myocardial perfusion imaging, including single photon emission computed tomography (SPECT)
- Exercise/pharmacologic stress cardiac magnetic resonance imaging (CMR)

Anatomic NITs include:

- Coronary computed tomography angiography (CTA)
- Cardiac magnetic resonance imaging (CMR)*

Although the 2005 AHA consensus statement was a thorough synopsis of the literature and included expert recommendations for the diagnostic evaluation of symptomatic women, it did not include a comparative effectiveness review of the accuracy of the various NITs. A better understanding of the accuracy of the many different NITs for CAD may help in clinical decisionmaking.

Conclusions

Overall, within a given modality, the summary sensitivities and specificities were similar for all studies when compared with good-quality studies alone. When considering only the good-quality studies, the diagnostic accuracy of detecting CAD in women presenting with anginal chest pain but with no known CAD appeared to be better (in descending order) for coronary CTA, SPECT, ECHO, CMR, and ECG. However, the confidence intervals were wide, especially for CTA and CMR. Analysis for statistical differences between the diagnostic accuracies of NITs in women revealed that the sensitivities of ECHO and SPECT were significantly higher than that of ECG. Statistical analysis also revealed that the specificities of CMR and ECHO were significantly higher than that of ECG (when considering only good-quality studies). From comparator trials, there is limited or insufficient evidence on the predictors of the diagnostic accuracy of NITs; on the role of NITs in improving risk stratification, decisionmaking, and clinical outcomes; and on potential harms associated with NITs.

*Cardiac magnetic resonance imaging can be used as an anatomic or a functional modality.

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Clinical Bottom Line: Accuracy of Noninvasive Technologies for Diagnosing CAD in Symptomatic Women With No Known CAD

Modality	Quality of Studies	Number of Studies	Number of Patients Total	Number of Patients Women	Summary Sensitivity (95% CI)	Summary Specificity (95% CI)	Strength of Evidence
ECG	All	29	8,825	3,392	0.62 (0.55–0.68)	0.68 (0.63–0.73)	●●●
	Good	10	3,821	1,410	0.70 (0.58–0.79)	0.62 (0.53–0.69)	
ECHO	All	14	2,538	1,286	0.79 (0.74–0.83)	0.83 (0.74–0.89)	●●●
	Good	5	1,227	561	0.79 (0.69–0.87)	0.85 (0.68–0.94)	
SPECT	All	14	1,340	1,000	0.81 (0.76–0.86)	0.78 (0.69–0.84)	●●●
	Good	4	484	394	0.83 (0.52–0.95)	0.72 (0.37–0.92)	
CMR	All	5	580	501	0.72 (0.55–0.85)	0.84 (0.69–0.93)	●○○
	Good	5	580	501	0.72 (0.55–0.85)	0.84 (0.69–0.93)	
Coronary CTA	All	5	1,298	474	0.93 (0.69–0.99)	0.77 (0.54–0.91)	●○○
	Good	3	312	124	0.85 (0.26–0.99)	0.73 (0.17–0.97)	

Analysis for a statistical difference between the accuracies of NITs for diagnosing CAD in women with no known CAD revealed that:

- The sensitivities of ECHO and SPECT were significantly higher than that of ECG ($p < 0.001$).
- In the subset of good-quality studies, the specificities of CMR and ECHO were significantly higher than that of ECG ($p = 0.006$).

95% CI = 95-percent confidence interval; CMR = cardiac magnetic resonance imaging; CTA = computed tomography angiography; ECG = electrocardiography; ECHO = exercise/stress echocardiography; SPECT = single photon emission computed tomography

Strength of Evidence Scale

- High: ●●● High confidence that the evidence reflects the true effect. Further research is very unlikely to change our confidence in the estimate of effect.
- Moderate: ●●○ Moderate confidence that the evidence reflects the true effect. Further research may change our confidence in the estimate of effect and may change the estimate.
- Low: ●○○ Low confidence that the evidence reflects the true effect. Further research is likely to change the confidence in the estimate of effect and is likely to change the estimate.
- Insufficient: ○○○ Evidence either is unavailable or does not permit a conclusion.

Additional Findings

- Within a given modality, the summary sensitivities and specificities were similar for both types of populations (unknown CAD and mixed known and unknown CAD).
- The diagnostic accuracy of the NITs appeared to be consistent over time.
- Evidence from comparative studies was insufficient to permit meaningful conclusions about predictors of diagnostic accuracy and about the potential adverse effects of different NITs (such as those associated with the radiation exposure that can occur with SPECT or CTA) used to diagnose CAD in women.

Gaps in Knowledge and Future Research Needs

- Clinicians order a particular diagnostic procedure based on a patient's pretest probability of CAD, testing thresholds, physical condition, functional capacity, test availability, and clinician preference. It is hoped that future randomized controlled trials will provide more information on how the choice of a diagnostic modality and diagnostic test results might impact CAD prognosis, treatment, clinical outcomes, and costs.
- Women were poorly represented in studies including both sexes. To assess the influence of sex differences on the diagnostic accuracy of the NITs, a sufficient sample size is required.
- Few studies assessed the impact of factors such as weight, functional status, race/ethnicity, sex, age, microvascular disease, menopausal status, and heart size on the diagnostic accuracy of the various NITs.
- No studies were identified that discussed the order in which different NITs were used to evaluate CAD. Multiple testings or layered-testing strategies are areas where significant research is needed.
- The accuracy of the NITs reviewed may also be location or operator dependent, and the results of studies conducted at highly specialized centers may not uniformly apply to those seen in routine practice. Future research should include studies that are conducted in routine practice settings.

What To Discuss With Your Patients

- Their risk for developing CAD and factors that might increase their risk such as smoking, obesity, and a sedentary lifestyle
- The importance of early detection and management of CAD
- The relative accuracy of the NITs available for diagnosing CAD
- The physical status, health conditions, or medication use that might preclude the use of a certain procedure for diagnosing CAD
- The relative safety of the NITs available for diagnosing CAD, particularly the risk of radiation exposure for younger women
- Coexisting conditions such as diabetes and the metabolic syndrome that have an impact on the risk of CAD
- The possible consequences of an abnormal test result

Ordering Information

For electronic copies of this clinician research summary and the full systematic review, visit www.effectivehealthcare.ahrq.gov/diagnosecad.cfm. To order free print copies, call the AHRQ Publications Clearinghouse at 800-358-9295.

Source

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