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Cardiovascular Disease in Women: An Update for Nurses

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Synopsis: Cardiovascular disease (CVD) is the leading cause of death in women but is often underrecognized and undertreated. Women are more likely to experience delay in treatment and worse outcomes even though they experience similar symptoms as men. Women are more likely to experience ischemia related to microvascular dysfunction which is not readily diagnosed by commonly used diagnostic tests. Nurses are ideally positioned to be patient advocates and use evidence-based guidelines to encourage primary prevention and ensure prompt treatment when CVD does occur in women. This paper provides an update on CVD in women for clinical nurses based on the latest research evidence.

Key words: women; cardiovascular disease; nursing; signs and symptoms; heart disease

Key Points

- Women have different risk factors for cardiovascular disease (CVD) than men and diagnostic tests have varying efficacy due to physiologic differences in women.
- Women are more likely to experience ischemia related to microvascular dysfunction with no obstructed coronary arteries.
- Chest pain is the most common symptom of acute coronary syndrome regardless of sex or gender, but women may not report chest pain because the experience is characterized as discomfort, heaviness, or pressure.
- Some women may see an OB/GYN provider for primary care, so it is important that OB/GYN providers provide primary prevention and monitoring for CVD.

Cardiovascular Disease in Women: An Update for Nurses

Introduction and Background

Cardiovascular disease (CVD) is the leading cause of death for women.[1] Even so, women have historically been under-represented in CVD clinical trials and research.[2,3] In clinical practice, women have often been undertreated and experienced worse outcomes than men with CVD.[2,3] Moreover, women's experiences of CVD are often labeled as "atypical," while men's experiences are more often called "typical"[4] which leads to delay in diagnostic testing and treatment.

Since the turn of the twenty-first century, increased focus has been placed on CVD in women. It is critical that nurses and other healthcare providers understand the experiences of women diagnosed with CVD. Women have different cardiovascular risk factors, and the accuracy of diagnostic tests differ based on sex. Registered nurses must recognize the unique needs of women with CVD and the symptom profile in women to provide high quality care and patient education. The goal of this paper is to review the latest information about CVD in women including risk factors, symptoms, diagnostic testing, and educational priorities.

We use the term women broadly throughout this article, incorporating aspects of sex and gender. We note, however, that sex and gender are different variables, [5] and both can independently affect CVD.[6-8] We also acknowledge that additional special considerations exist for transgender women, gender nonconforming and non-binary individuals who may be chromosomally female, intersex individuals, and many others.[9] In this paper, we have specifically focused on the experience of cisgender, chromosomally female individuals – that is,

women who were born female and identify as women. However, we encourage readers to seek out resources supporting the experience of all individuals, regardless of identity category.

Common Cardiovascular Problems in Women

At the root of most CVD is atherosclerosis, an inflammatory process involving the accumulation of lipids and white blood cells in the wall of the arteries. As atherosclerosis progresses, plaques form, ultimately leading to a narrowing of the blood vessel lumen; plaque rupture or erosion may lead to acute thrombosis, which causes cardiovascular events like acute coronary syndrome (unstable angina, non-ST-elevation myocardial infarction, ST-elevation myocardial infarction), stroke, and acute ischemic limb.[10] Thus, preventing atherosclerosis is a priority for prevention. While it is beyond the scope of this paper to detail the complex pathophysiology and epidemiology of every CVD experienced by women, below we have highlighted particularly salient issues pertinent to women for leading cardiovascular conditions, including coronary artery disease (CAD), stroke, and heart failure.

Coronary Artery Disease

At the most basic level, CAD occurs when atherosclerotic plaques progress and one or more coronary arteries become narrowed, reducing blood flow to the myocardium. If one of these atherosclerotic plaque ruptures or erodes, acute coronary syndrome (ACS) may occur.[10] However, it is increasingly recognized that microvascular dysfunction is common in women, present in as many as two in three women who undergo clinically-indicated coronary angiography.[11] Instead of major coronary arteries (e.g., left anterior descending, left circumflex) being stenosed, small, more distal arterioles may become narrowed or obstructed, causing ischemia with no obstructive coronary arteries, or INOCA.[11] Women may present with common

symptoms of CAD, undergo coronary angiography, and be told that their coronary vessels are "normal," even though they have unrecognized microvascular dysfunction.[11] Unfortunately, even though the larger coronary arteries in these women are not involved, they are still more likely to die from a cardiovascular problem within 10 years and have up to 10 times higher odds of hospital admission with heart failure with preserved ejection fraction.[11-13] Additionally, women are often more likely to develop long-term, chronic angina because of this microvascular dysfunction, and this form of angina may be more challenging to treat.[11] Thus, nurses' attention to the possibility of microvascular disease in women is essential.

Two additional related conditions affecting women more often than men include Takotsubo syndrome and spontaneous coronary artery dissection (SCAD).[14,15] Takotsubo syndrome is also called Takotsubo cardiomyopathy, apical ballooning syndrome, broken heart syndrome, and stress cardiomyopathy. While emotional triggers (e.g., death of a loved one, loss of job) have often been linked to Takotsubo syndrome, as many as one-third of patients cannot identify such a stressor.[15] Thus, nurses must recognize that Takotsubo syndrome is possible, even without an identifiable stressor. Table 1 highlights information about these two diagnoses. Given that both conditions have only recently received significant research attention, clinical evidence about both diagnoses continues to emerge.

Stroke

Stroke is slightly more common in women (lifetime risk 25.1%) than in men (lifetime risk 24.7%), and it is the fifth most common cause of death for women in the United States (U.S.).[16,17] However, Black women in the U.S. have higher mortality from and the highest overall prevalence of stroke (4.9%), compared to White, non-Hispanic women (2.5%), Hispanic women

(1.7%), and Asian women (1.0%).[1] Some reasons why Black women are at higher risk of stroke include a higher prevalence of risk factors, including chronic inflammation from psychosocial and environmental stressors, hypertension, smoking, diabetes, obesity, and sickle cell disease.[1,18]

Heart Failure

While both men and women can experience heart failure with reduced ejection fraction (HFrEF, ejection fraction ≤ 40%), heart failure with moderately reduced ejection fraction (ejection fraction 41% to 49%), and heart failure with preserved ejection fraction (HFpEF, ejection fraction ≥50%), women are almost three times more likely than men to be diagnosed with HFpEF.[19] Comorbidities such as long-standing hypertension, obesity, diabetes, chronic kidney disease, atrial fibrillation, and amyloidosis contribute to the development of HFpEF.[19] Other risk factors for heart failure may affect women more severely than men, including depression, anxiety, and psychosocial stress.[20]

In addition to HFpEF, peripartum cardiomyopathy (a cause of HFrEF) is also a consideration for pregnant women, occurring in 0.01 to 0.1% of pregnancies brought to delivery.[19] Peripartum cardiomyopathy tends to happen in the third trimester or early postpartum period, more often affecting Black women and those older than 30 years of age, along with women who experience hypertensive disorders of pregnancy and exhibit common cardiovascular risk factors.[19] Although the incidence is relatively low, it is still a consideration for nurses and other healthcare providers, especially those working in peripartum settings.

Risk Factors for CVD in Women

Several factors increase the risk of CVD, irrespective of sex and gender. Nurses are ideally positioned to educate women about these various risk factors and to implement evidence-based strategies to help women reduce their CVD risk. Box 1 highlights these important risk factors. Many of these risk factors have been documented and emphasized for decades. Still, they remain essential, given that the prevalence and incidence of many of these risk factors in the U.S. population have continued to grow or remain at higher-than-desirable levels.[1,3] For example, nearly 43% of women in the U.S. have hypertension, one of the most important risk factors for CVD development and progression, and hypertension remains uncontrolled in approximately two-thirds of these people.[1] Notably, hypertension is markedly more prevalent in Black women (57.6%) than in Asian women (42.1%), Hispanic women (40.8%), and White, non-Hispanic women (40.5%) in the U.S.[1] Nurses play an essential role in accurately measuring blood pressure, and many blood pressure measurements are taken improperly.[21] Table 2 highlights key recommendations for measuring blood pressure precisely and the consequence of imprecise measurement. Additionally, Hispanic and Black women in the U.S. have a higher prevalence of overweight and obesity (78%) than the national average of 68%.[3] Diabetes mellitus is experienced by about 14% of Hispanic women and 13% of Black women, compared to the national average of 9%.[3]

While these universal risk factors are always important and harm CVD health, women's CVD risk increases substantially during the post-menopausal period.[22] Menopause does not cause CVD, but hormones such as estrogens are present in higher quantities before menopause and may play a protective role before menopause.[23] Other changes that occur with the onset of

menopause, such as weight gain, a higher incidence of depression, sleep disturbances, and higher LDL and apolipoprotein B levels, also increase CVD risk.[23] Premature menopause – that is, menopause that occurs before age 40 – in particular increases a woman's long-term risk of CVD.[23]

Aside from the accelerated risk around the onset of menopause, women are also at an increased risk for CVD given several sex- and gender-related factors, as shown in Box 2. In the U.S., women have a nearly 13% chance of developing breast cancer in their lifetime, compared to 0.13% of men.[24] Treating breast cancer with chemotherapeutic agents and/or radiation may increase the lifetime risk of CVD, including CAD, heart failure, and arrhythmias.[25] The use of hormonal contraceptives, especially by women with other CVD risk factors, may also increase the risk of thrombosis, but the specific hormonal formulation of these products appears to affect the degree of overall CVD risk.[26] Women are also at increased risk of other autoimmune problems that increase CVD risk, including conditions like rheumatoid arthritis and systemic lupus erythematosus.[26] Systemic scleroderma, which may lead to inflammation and scarring across the cardiovascular system, is almost five times more common in women than men.[27]

Pregnancy-related complications also increase CVD risk. Gestational hypertension, preeclampsia, and eclampsia increase cardiovascular risk in women, especially in the presence of additional risk factors.[28] Women with preeclampsia during their first pregnancy are almost two times more likely to experience CVD than those who do not. Other pregnancy-related problems, such as gestational diabetes mellitus and preterm delivery, also increase CVD risk.[22]

In addition to biologically driven, sex-specific factors increasing cardiovascular risk, various gender-driven factors affect CVD and the gender construct stands as an independent

risk factor for CVD. For example, O'Neil et al.[7] pointed out that physical activity, which is protective and promotes health, has traditionally been encouraged for young boys, while young girls have historically been directed to participate in less physically demanding activities. To lose weight and maintain their body image, young women are more likely to smoke cigarettes; also, stress created by harassment and discrimination affects women's cardiovascular health more significantly than men.[7] Moreover, depression and other emotional stress, which may originate from issues related to gender, often influence women's cardiovascular health more significantly than men.[25]

Prevention of Cardiovascular Disease in Women

Prevention of CVD falls into different categories: primordial prevention, primary prevention, secondary prevention, and tertiary prevention. Each of these levels of prevention focuses on different time frames and has different goals, as outlined in Figure 1. Table 3 highlights examples of prevention at every level. Of note, authors define and classify levels of prevention in slightly different ways, but the overall message remains intact, regardless of specific definitions.

Primordial Prevention

Primordial prevention is perhaps the truest form of prevention, in that it involves interventions that prevent the development of *risk factors* of CVD, ultimately preventing CVD.[29] Primordial prevention involves individual- and population-level interventions that improve overall health and living conditions and reduce the incidence of CVD risk factors. The idea is that by eliminating risk factors for CVD in the population, especially through middle age, CVD

can largely be eliminated.[30] Improving parents' health today and eliminating CVD risk factors in this group may reduce the risk of CVD in the next generation.[31]

Primary Prevention

While primordial prevention focuses on preventing risk factors from ever developing, primary prevention focuses on the early identification and management of causal risk factors for CVD before a CVD event.[32] The use of risk assessment tools, such as the American Heart Association/American College of Cardiology Atherosclerotic Cardiovascular Disease (ASCVD) risk estimator, has been encouraged to assess an individual's 10-year and lifetime risk of CVD.[33] To achieve primordial and primary prevention, attention can be turned from cardiovascular *disease* to cardiovascular *health* (CVH) and the strategies that promote optimal cardiovascular wellness and reduce the development of atherosclerosis and CVD.[34] The eight critical components of CVH have come to be known by the American Heart Association as Life's Essential 8™, outlined in Box 3.

Secondary and Tertiary Prevention

Though primordial and primary prevention occur before CVD onset, secondary and tertiary prevention are employed once an individual has experienced a CVD event or has been diagnosed with CVD. Secondary prevention focuses on reducing the chance of another CVD event in an individual with known CVD. In contrast, tertiary prevention strategies aim to reduce the long-term complications and worsening of existing CVD, hopefully reducing mortality and improving quality of life.[35]

Prevention strategies are important across all populations of women. However, given their increased risk of CVD, attention to prevention is especially important in women with

pregnancy-related complications, such as hypertensive disorders, premature delivery, and low birth weight babies.[28] A systematic and meta-analysis of data from over one million women also suggests that breastfeeding may reduce women's long-term risk of CVD.[36] Additionally, work is needed to engage women of all backgrounds in secondary and tertiary prevention. For example, women are less likely than men to participate in cardiopulmonary rehabilitation after being diagnosed with acute cardiovascular conditions, even though they can derive benefits.[37] Psychosocial and referral issues likely contribute to the lack of participation by women, and nurses are positioned to find ways to facilitate access to these programs.[37]

Women's CVD Symptom Presentation

Symptoms play an important role in the CVD experience, alerting patients and health professionals to the presence of CVD, including time-sensitive problems like stroke and ACS. Moreover, symptom recognition and care seeking play an important role in secondary and tertiary prevention, given that when patients accurately recognize and attribute the symptoms they are experiencing to a cardiovascular condition, they seek care more rapidly.[38,39] Further, accurate assessment and triage of symptoms by nurses and other healthcare providers reduces delays in intervening for CVD.[10]

While early stroke identification is important, the symptoms of stroke in men and women are largely the same (Box 4). Given the prevalence of ACS and the lack of awareness of ACS symptoms in women, this section focuses specifically on symptoms of ACS in women. Cushman et al.[40] found that women's knowledge of common ACS symptoms declined significantly from 2009 to 2019, especially related to shortness of breath, tightness of the chest, pain that spreads to the shoulders/neck/arms, and fatigue. Knowledge of chest pain as an ACS

symptom also declined for some groups, including Black, Hispanic, and Asian women and those ages 25 to 44 years.[40] Regardless of racial or ethnic group, only 51.5% of women recognized chest pain as a symptom of ACS, while 27.9% recognized shortness of breath, 6.6% recognized fatigue, and 5.7% recognized tightness of the chest.[40] Additionally, patients sometimes delay seeking care for symptoms when their expectations about symptoms do not match their actual symptom experience.[41,42] For example, a woman may expect ACS symptoms will be overwhelming, excruciating, or debilitating in nature when, in fact, these symptoms range in their overall severity and may be only moderate or mild in severity and intensity and develop gradually. Women also report concerns about bothering others, having too many competing life responsibilities, embarrassment, and belief that symptoms were not serious as reasons for delaying care for symptoms consistent with ACS.[38,43]

Women experience both prodromal symptoms of ACS and acute symptoms of ACS, highlighted in Table 4. Women seek care for prodromal symptoms of ACS, affording clinicians an early opportunity to intervene, but these symptoms are not always recognized as cardiac in nature.[44, 45] When women tell health professionals about symptoms consistent with possible CAD or ACS, they have reported sometimes feeling that their symptoms were trivialized, not fully assessed, or were quickly attributed to other health conditions, such as weight or other comorbidities.[44,46]

Women and men differ in the overall frequency with which they experience *some* ACS symptoms, and women tend to experience a larger number of ACS symptoms . However, women and men experience ACS symptoms that are more similar than different, and even when the frequency of a particular symptom differs between men and women, the overall

magnitude of this difference is small.[4,47,48] A recent meta-analysis showed that men experience chest pain slightly more than women (79% vs. 74%); however, chest pain is still the most common acute ACS symptom, regardless of sex or gender.[47] Recent evidence suggests that men and women sometimes incorrectly associate several ACS symptoms with different genders.[43] In a study comparing the ACS symptoms associated with men and women by a nationwide sample, almost 80% of participants selected a chest symptom (e.g., discomfort, pain, pressure) as the most common ACS symptom for men, while less than 50% selected a chest symptom as the most common for women.[43] Further, women (46.9%) in this study were significantly more likely than men (17.3%) to endorse that men and women have either "fairly different" or "very different" ACS symptoms.[43]

Beyond patients' knowledge and attribution of symptoms, assessment of symptoms by nurses and other healthcare professionals is crucial. When asking patients about common CAD and ACS symptoms like chest pain, it is wise for nurses to ask patients if they are experiencing symptoms using a variety of descriptors, given a recognition that "chest pain" as a CAD and ACS symptom is an umbrella term for many sensations, [49] as shown in Box 5. It has been demonstrated that women sometimes deny having chest *pain* because they were experiencing a different sensation, such as chest heaviness or discomfort, potentially leading to a missed opportunity to identify CAD or impending ACS.[50] In addition to using a variety of descriptors to assess symptoms, it is essential to note that fatigue is an important possible CAD symptom, [51] endorsed by over 70% of women before ACS.[52] Indeed, fatigue is a common symptom of many different problems, so it may be challenging to determine whether fatigue is cardiac-related.

However, nurses should be aware that fatigue (especially unusual or overwhelming) is a common symptom of heart disease and ACS.

Diagnostic Testing for Low-risk Chest Pain in Women

Women with low-risk chest pain require diagnostic testing but typically do not require hospitalization or urgent cardiac testing. Low-risk chest pain is defined as symptoms suggestive of ACS, but with a <1% risk of major adverse cardiac event (MACE) within 30 days. To determine the likelihood of MACE, a detailed history and physical exam are needed along with basic diagnostic testing – 12 lead electrocardiogram (ECG) and troponin.[49]

Basic Diagnostic Testing

Unless a noncardiac cause is immediately apparent, all women experiencing chest symptoms should get a 12-lead ECG immediately. A normal 12-lead ECG does not rule out ACS but is an important diagnostic tool. If symptoms persist, serial ECGs may be indicated. If the history and physical exam suggest a noncardiac cause that can be diagnosed through a chest radiograph (e.g., pneumonia), then it is appropriate to obtain a chest radiograph and rule out other diagnoses. In addition to a 12-lead ECG and possibly a chest radiograph, troponin should be measured. High sensitivity cardiac troponin is the preferred biomarker; however, a basic troponin is also of diagnostic value if the facility does not have high-sensitivity lab troponin testing. Troponin is specific to myocardial injury, and addition of CK-MB is not of diagnostic value.[49] Women may experience smaller elevations in troponin compared to men, necessitating different criteria for the upper reference limit of this test.[53] Additionally, elevated troponin may not be detected for 2 to 4 hours after initial symptom onset and may take as long as 8-12 hours[54], so women who seek medical attention quickly may initially have a normal troponin. For

ongoing symptoms or in women presenting shortly after symptom onset, serial troponin measurements may be indicated.[53, 54] Follow up evaluation with the further diagnostic testing presented below is often warranted.

Further Diagnostic Testing

When considering diagnostic testing in women, it is important to note anatomical differences that may impact the sensitivity of the testing. Women are at higher risk for microvascular changes in distal vessels as opposed to large obstructive plaques in major coronary arteries making exercise stress tests less sensitive in women.[13] However, recent consensus statements support the use of exercise stress tests as a cost-effective strategy in low-risk women who have a normal resting ECG.[13,49] In women at higher risk, a stress echocardiogram improves diagnostic accuracy (e.g., dobutamine stress echocardiography). Compared to an exercise stress test, the stress echocardiogram has better sensitivity and specificity for detecting obstructive CAD.[13]

Both exercise stress tests and stress echocardiograms are *functional* tests of CAD. While the sensitivity with these modalities is adequate for most low-risk women, they are not as sensitive as tests that detect *anatomical* CAD (e.g., cardiac computed tomography angiography [CTA]). The cardiac CTA is a noninvasive test with high diagnostic accuracy. Women with a positive CTA are more likely to have a clinically significant event than those with a positive exercise stress test. Cardiac CTA allows evaluation of plaque characteristics including identification of coronary artery calcium (CAC) lesions. Cardiac CTA allows clinicians to provide treatment recommendations based on plaque characteristics and patient risk factors.[13] This personalized approach to treatment better meets the needs of individual patients. CAC testing

can also be a standalone test often called a heart scan. This specialized CT scan is used in low and intermediate risk individuals to detect plaques and may be recommended as a screening test if certain risk factors are present. A CAC score of 0 means that it is very unlikely the woman has obstructive plaques.

Many other valuable diagnostic tests including PET scans and nuclear myocardial perfusion stress tests are available; however, low-risk individuals rarely need costly workups. In low-risk women who can exercise, beginning with an exercise stress test is acceptable. If further evaluation is needed, additional testing can be ordered as appropriate. If symptoms persist, it is reasonable to assess coronary microvascular dysfunction which may be the cause of ischemia symptoms.[13] Recent guidelines consider the anatomical differences in women and men as recommendations are made for diagnostic testing. Table 5 outlines the differences in some common, outpatient diagnostic tests.

Patient and Family Education

Patient and family education are a cornerstone of nursing practice. Education about CVD prevention and cardiovascular health promotion should be provided to patients and their family members (and/or support persons).[55] Engaging family members and caregivers may increase the likelihood that positive behavior change will occur and create a synergistic effect in which a patient's close friends and family develop healthier habits themselves.[55] Additionally, it is recognized that many women receive primary care from their obstetrician-gynecologist (OB-GYN) or women's health nurse practitioner and thus may not have routine contact with any other provider.[26] As such, nurses and providers in OB-GYN practices must recognize the opportunity that they have to address cardiovascular risk and health with their patients.[26]

One evidence-based strategy for patient and family education is the development of SMART (specific, measurable, action-oriented, realistic, timely) goals. Working collaboratively with patients, nurses and other healthcare providers can develop goals that are achievable and measure the short-term success of the patient. An example of an exercise SMART goal is: Starting Monday, 9/26 for 1 month, I want to walk at least 30 minutes, 3 times each week. The SMART goal provides a specific, measurable time frame and the goal itself is action oriented. Too often education is centered around teaching patients what they should do without providing any goals or actions. Action-oriented goals can be discussed at a follow-up appointment to determine whether the goal needs to be revised. The Preventive Cardiovascular Nurses Association has a Heart Healthy Toolbox complete with information on SMART goals and many other patient education materials. [56]

Summary

Indeed, much progress has been made in understanding women's experiences of CVD. However, more work is needed to improve CVD outcomes in women. Continued emphasis on CVD prevention, especially through primordial and primary prevention, will be critical, as will better understanding the underlying pathophysiology and causes of problems like SCAD and Takatsubo syndrome. Eliminating knowledge deficits will continue to be a focus for nurses and patients alike. It is imperative that women recognize CVD symptoms and recognize that CVD is the leading cause of death for women. Prompt, evidence-based workup of patients with symptoms consistent with CAD and ACS remains essential.

Nurses are charged with taking the best available evidence and applying it to their real-world practice. Nurses are well positioned to listen carefully to women, regardless of

background – hearing their stories, concerns, and experiences and seeking to have open, transparent conversations that engage women in their own care. By improving knowledge deficits, through active engagement, and by implementing behavior change strategies, nurses can help improve the cardiovascular health of all women.

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Tables and Boxes

Table 1
Key features of spontaneous coronary artery dissection and Takotsubo syndrome

	Spontaneous Coronary Artery Dissection	Takotsubo Syndrome
Overall problem	• Dissection of coronary artery, followed by the development of a hematoma in the wall of the coronary artery or blockage of blood flow due to a disruption in the arterial wall	• Acute but transient development of left-ventricular dysfunction (reduced left ventricular ejection fraction), generally followed by improvement in ejection fraction
Prevalence in women vs. men	• At least three in four patients with SCAD are women • Often affects younger women (age 40 to 50) • Exact prevalence metrics are difficult to establish, given under-recognition/ underdiagnosis	• Affects women about five times more than men • Exact prevalence metrics are difficult to establish, given under-recognition/ underdiagnosis
Common precipitating events[a]	• Connective tissue disorders (e.g., Marfan syndrome, Ehlers-Danlos syndrome) • Emotional stressors • Fibromuscular dysplasia • Hormonal therapies (e.g., birth control, hormone replacement therapy) • Perimenopause • Physical stressors • Pregnancy	• Emotional stressors (e.g., loss of job, death of loved one) • Physical stressors, (e.g., acute illness)
Theories about etiology[b]	• Hemorrhage from within wall of vessel • Hormones, pregnancy, unknown arteriopathies, and inflammation, genetics may all play a role • Tear of the intimal layer of artery	• Surge of catecholamines may explain part of pathophysiology
Signs and Symptoms	• Chest pain/discomfort • Diaphoresis • Elevated cardiac troponin • Nausea and/or vomiting	• Chest pain/discomfort • ECG with ST-segment and t-wave abnormalities • Elevated cardiac troponin

	• Shortness of breath • ST-segment and t-wave abnormalities	• Left-ventricular wall motion abnormality on echocardiography (usually apical, basal, or focal) • Shortness of breath • Symptoms consistent with acute heart failure
Notes for nurses	• Both may mimic CAD/ACS, leading to misdiagnosis • Clinicians must keep both diagnoses in mind when patients present with consistent symptoms, especially when other precipitating events are present and/or when other common diagnoses are ruled out	

Abbreviations: ACS, acute coronary syndrome; CAD, coronary artery disease; ECG, electrocardiogram; SCAD, spontaneous coronary artery dissection
Data from Refs. [14,15]
[a] Both spontaneous coronary artery dissection and Takotsubo syndrome may occur in individuals without any obvious precipitating events.
[b]The true etiology/pathophysiologic basis for these diagnoses is not fully understood at this time.

Table 2
Clinics Care Points: Recommendations for accurate blood pressure measurement

Recommendation	Consequence of not following recommendation
Use correct size blood pressure cuff	Cuff too small for the arm may add 2 to 10 mm Hg
Apply blood pressure cuff to a bare arm, not over clothing	Taking blood pressure over clothing may add 5 to 50 mm Hg
Ensure the arm is supported and placed at heart level	An unsupported arm may add 10 mm Hg
Ensure the legs are not crossed and feet are flat on the floor	Crossing legs may add 2 to 8 mm Hg
Do not talk during measurement	A patient talking or actively listening to someone talk can add 10 mm Hg
Ensure the patient empties their bladder prior to measurement	A full bladder may add 10 mm Hg
The patient's back should be supported, as should their feet	Unsupported back/feet may add 6.5 mm Hg

Data from Refs. [57]

Table 3
Selected examples of cardiovascular disease prevention at each prevention level

Level of Prevention	Examples
Primordial[a]	• Advocating with policymakers and food companies to reduce the amount of sodium included in the nation's food supply • Advocating for policies that lead to the elimination of secondhand smoke in public places and to the elimination of tobacco use altogether • Developing exercise and healthy eating programs in schools • Enhancing maternal health to support fetal health • Expanding access to healthy food and clean water • Facilitating access to high quality health care at all stages of life, across all geographical areas (rural, suburban, urban) • Improving social determinants of cardiovascular health (education, health care access, socioeconomic status, environment, social support) • Maintaining a healthy weight, normal glucose, blood pressure, and cholesterol levels from birth • Promoting equity, diversity, and inclusion initiatives that in turn reduce discrimination, bias, and psychobiological stress • Providing access to health education and wellness programs by meeting individuals where they live and work (churches, workplaces, barber shops/hair salons, community facilities) • Supporting mental health of the population by interventions to reduce stigma, improve access to mental health care, and reduce stress
Primary[a,b]	• Encouraging participation in weight management programs to lose weight (if overweight or obese) • Facilitating the cessation of smoking and tobacco use at the individual level (education, behavioral interventions, medications) • Measuring blood pressure, glucose, and cholesterol to identify those with hypertension, prediabetes/diabetes, and dyslipidemia • Treating dyslipidemia with lifestyle change (reduced intake of *trans* and saturated fats, exercise) and pharmacotherapy (statins and PCSK9 inhibitors in qualifying patients) • Treating hypertension with lifestyle changes (weight loss, increased physical activity, reduced sodium intake, following DASH eating plan) and medication, as indicated • Using risk assessment tools to quantitatively assess an individual's risk of future CVD and to make decisions on strategies to mitigate that risk
Secondary	• Encouraging adherence to prescribed lifestyle interventions and risk factor control, after a CVD event/diagnosis • Following goal-directed medical therapy for a patient with heart failure, to reduce subsequent exacerbations and hospitalization

	• Encouraging participation in cardiopulmonary rehabilitation programs for patients after myocardial infarction or comprehensive stroke rehabilitation after stroke (with the goal of reducing recurrent CVD events) • Prescribing antiplatelet and/or anticoagulants in a patient with diagnosed CVD, to prevent additional events (e.g., stroke, ACS) • Using high-sensitivity troponin assays to identify patients with myocardial infarction or injury, in order to intervene in a timely manner and reduce damage to myocardium
Tertiary	• Implanting left-ventricular assist device in a patient with advanced cardiomyopathy/heart failure • Implanting permanent defibrillators or applying wearable defibrillators to patients with an ejection fraction < 35% at risk of sudden lethal arrhythmia like ventricular tachycardia • Encouraging participation in cardiopulmonary rehabilitation programs for patients with CVD or comprehensive stroke rehabilitation after stroke (with the goal of preventing further morbidity and mortality and improving quality of life) • Performing stent placement or coronary artery bypass surgery in appropriate patients with CAD to improve blood flow to the myocardium

Abbreviations: ACS, acute coronary syndrome; CAD, coronary artery disease; CVD, cardiovascular disease; DASH, dietary approaches to stop hypertension; PCSK9, proprotein convertase subtilisin/kexin type 9

Data from Refs. [3,18,19,26,28,29,32]

[a] Primordial and primary prevention interventions may also be beneficial as a means of secondary and tertiary prevention, as these primordial and primary prevention strategies target cardiovascular health promotion and risk factor reduction overall, which is beneficial for the cardiovascular system regardless of prevention level

[b] Hypertension and hyperlipidemia can be viewed as cardiovascular diseases as well as risk factors for other cardiovascular diseases/events, such as coronary artery disease and acute coronary syndrome; thus, interventions for hypertension and hyperlipidemia could be included in primary and/or secondary prevention.

Table 4
Common prodromal and acute symptoms of acute coronary syndrome experienced by women

Category of Symptom	Characteristics	Common Symptoms in Category
Prodromal ACS Symptoms	• Occur in the days, weeks, and months prior to ACS • May fluctuate in severity and frequency leading up to ACS • Serves as warning of impending ACS event • Rarely experience one prodromal symptom in isolation (generally experience a combination of symptoms)	• Unusual or overwhelming fatigue • Changes in sleep/trouble sleeping • Anxiety • Frequent indigestion • Racing heart or palpitations • Change in thinking/remembering or cognition • Discomfort in the chest • Tingling in the arms/hands
Acute ACS Symptoms	• Occur at time of ACS event • Range in severity and degree of distress they cause • Though patients often expect that acute symptoms like chest pain will be excruciating or debilitating, may be only mildly to moderately intense and minimally debilitating • Rarely experience one acute symptom in isolation (generally a combination of symptoms)	• Chest symptoms (e.g., pressure, tightness, discomfort, heaviness) • Shortness of breath • Diaphoresis • Nausea/vomiting • Arm, shoulder, and/or upper back pain • Dizziness/lightheadedness • Fatigue (unusual or new onset) • Neck and/or jaw pain • Palpitations • Indigestion

Abbreviations: ACS, acute coronary syndrome
Data from Refs. [47,48,58]

Table 5
Common imaging tests for the evaluation of chest symptoms

Test	Notes	Indications	Nursing Considerations
12-lead Electrocardiogram	-First line for all patients with chest symptoms -Records the electrical signals in the heart to detect ischemia -Not a routine screening test in adults who do not have suspected ischemic symptoms	-All patients with symptoms suggestive of heart disease including chest symptoms, dizziness, rapid pulse, and shortness of breath among others	-Make sure the patient remains still during the reading -May need to shave the chest if very hairy
Chest x-ray (CXR)	-Used to rule out other causes of chest symptoms	-Patients with complaints that may be related to the heart or lungs	-Assess for potential pregnancy
Exercise stress test	-First line option for low-risk patients with chest symptoms -Lower diagnostic accuracy in women	-Patients with complaints of chest pain who are physically able to exercise	-Patient must be able to exercise -Assess for musculoskeletal, pulmonary, or other conditions that may prevent patient from exercising at a high enough intensity to reach target heart rate
Stress echocardiogram	-Often used in patients when imaging is a recommended adjunct (e.g., intermediate risk women) -Better accuracy than an exercise stress test -Exercise or pharmacologic measures can be used to increase HR	-Intermediate risk women with complaints of chest symptoms -Low risk women who are unable to complete an exercise stress test for whom testing is deemed necessary	-Patient dependent factors may limit usefulness (e.g., morbid obesity) -Adequate pre-procedure education is necessary as the medication used to speed the heart may make the patient uncomfortable or experience a panic attack
Coronary Calcium or Heart Scan	-Specialized CT scan used in low to intermediate risk people	-Screening for heart disease risk -May be recommended if a woman has certain risk factors	-Education about what to expect during scan (e.g., potential use of medication to slow the heart; placement of electrodes on chest)

	-Detects and measures calcium containing plaques in coronary arteries -Women with more plaque are at higher risk for MACE		-Depending on score, patient education on modifiable risk factors
Computed Tomography Angiography (CTA)	-High diagnostic accuracy as it allows visualization of coronary arteries	-Not recommended as a first line screening test in low-risk women due to higher cost -Used to assess intermediate risk patients or patients whose stress test was inconclusive	-Check for iodine allergy -Educate patient on what to expect during the test (e.g., insertion of IV; injection of dye; feeling when dye is injected)
Nuclear myocardial perfusion testing/Nuclear stress test	-High diagnostic accuracy -Shows cardiac perfusion and areas of decreased perfusion -Exercise or pharmacologic measures can be used to increase HR	-Not a first line screening in low-risk patients due to cost	-Review medications as some may need to be stopped prior to the procedure (e.g., beta blockers) -Educate patient on what to expect and any preprocedural preparations (e.g., avoid caffeine; IV insertion; injection of dye)
Cardiac PET scan	-Best approach to diagnose cardiac microvascular dysfunction -Shows myocardial and coronary blood flow	-May be used in women with continued chest pain after obstruction is ruled out	-Patient education about what to expect and preprocedural preparation are necessary (e.g., NPO x4-6 hours)

Abbreviations: CT, computed tomography; MACE, major adverse cardiovascular event; NPO, nothing by mouth; PET, positron emission tomography
Data from Refs. [13,49]

Box 1
Selected important risk factors for cardiovascular disease development and progression

- Advancing age
- Chronic kidney disease
- Diabetes mellitus
- Diet high in saturated and *trans* fats
- Elevated LDL-C levels (general goal is LDL-C < 70 mg/dL in individuals with existing atherosclerotic disease, < 100 mg/dL in high-risk individual, and < 130 mg/dL in other populations)
- First-degree relative (e.g., biologic parent, biologic sibling) with history of premature atherosclerotic cardiovascular disease (age < 55 for males and < 65 for females)
- Hypertension
- Metabolic syndrome (elevated glucose, hypertension, large waist circumference, low levels of HDL, and elevated triglycerides)
- Overweight (BMI 25.0 to 29.9 kg/m^2) and obesity (BMI ≥ 30 kg/m^2)
- Sedentary lifestyle
- Sleep disorders (e.g., obstructive sleep apnea) and getting < 7 or > 10 hours of sleep per night
- South Asian ancestry (higher cardiovascular risk than other ethnicities)
- Tobacco use, including smoking, vaping, and using smokeless products
- Triglyceride level > 175 mg/dL on three or more occasions

Abbreviations: BMI, body mass index; LDL-C, low-density lipoprotein cholesterol; HDL, high-density lipoprotein cholesterol
Data from Refs. [1,32,59]

Box 2
Selected sex- and gender-related cardiovascular risk factors for women

- Pregnancy-related hypertension (gestational hypertension, preeclampsia, and eclampsia)
- Preterm delivery or delivery of child with low birth weight
- Polycystic ovarian syndrome (related to higher incidence of metabolic syndrome and diabetes mellitus)
- Menopause prior to age 40
- Certain hormonal contraceptives, especially when used by patients with additional cardiovascular risk factors
- Inflammation from autoimmune disorders, including systemic lupus erythematosus and rheumatoid arthritis. Sclerosis caused by the autoimmune condition scleroderma.
- Breast cancer treatment with chemotherapeutic agents, especially doxorubicin and epirubicin. Additional agents with cardiovascular risk potential include cisplatin, 5-fluorouracil, tamoxifen, letrozole, anastrozole, and paclitaxel.
- Breast cancer treatment with radiation, especially when the heart is in the path of radiation.
- Adverse life events, especially physical, sexual, and emotional abuse
- Smoking or drug use as a method of weight loss or weight maintenance

Data from Refs. [7,23,25,26,28]

Box 3
American Heart Association's Life's Essential 8™: Strategies for ideal cardiovascular health

- Do not use nicotine (including cigarettes and vaping products)
- Maintain a healthy weight (BMI < 25 kg/m^2 for ages 20 years and above; below the 85th percentile for ages 2 to 19 years)
- Engage in physical activity (≥ 150 minutes/week of moderate or greater intensity exercise for ages 20 years and above; ≥ 420 minutes/week of moderate or greater intensity exercise for ages 6 to 19 years)
- Consume a heart-healthy diet (following DASH-style and/or Mediterranean diet patterns)
- Reduce non-HDL cholesterol (< 130 mg/dL for ages 20 years and above; < 100 mg/dL for ages 9 to 19 years)
- Maintain a normal blood pressure (SBP < 120 mm Hg and DBP < 80 mm Hg for ages 13 years and above; blood pressure less than the 90th percentile for ages < 13 years)
- Maintain normal fasting plasma glucose levels and/or HbA1c (serum glucose < 100 mg/dL and HbA1c < 5.7% for ages 12 years and above)
- Achieve an average of 7 to < 9 hours of sleep per night (both too little and too much sleep confers cardiovascular risk)

Abbreviations: BMI, body mass index; DBP, diastolic blood pressure; SBP, systolic blood pressure
Data from Refs. [34]

Box 4
Common stroke symptoms: BE-FAST[a]

- The following symptoms occur in a large majority of ischemic strokes. Sudden onset of the below symptoms is particularly concerning.

- **B** = Balance (trouble with balance, coordination, standing)
- **E** = Eyes (blurred vision; double vision; loss of vision in one or both eyes, especially when there is no pain)
- **F** = Facial Drooping (droop on one side of the face or numbness)
- **A** = Arm Weakness (weak or numb arm; when raised, one arm drops or drifts)
- **S** = Speech Difficulty/Trouble (unable to form words or speak coherently; slurred speech; cannot repeat a simple sentence)
- **T** = Time to call emergency services/seek care (early intervention for stroke is critical)

Data from Refs. [60]
[a]This box represents common stroke symptoms. Symptom experiences may vary, and exceptions to the symptoms included in this box are possible.

Box 5
Clinics Care Points: Recognizing diverse descriptions and experiences of "chest pain" related to coronary artery disease and acute coronary syndrome[a]

- The term *chest pain* may not truly capture the sensation experienced by individuals with CAD or ACS, given that the sensation is not always considered by patients to be "painful" or a type of "pain."
- Chest pain related to CAD/ACS is often described using a variety of narrative terms:
  - Pressure, squeezing, gripping, heaviness, tightness, dull, aching, discomfort
- Chest pain related to CAD/ACS is more often:
  - Centrally located or located on the left side of the chest
- Obtaining a complete history of chest symptoms is important, considering:
  - Location, character/quality, quantity/severity, timing, setting/situation, aggravating or relieving factors, associated factors or symptoms, and the patient's perception of the symptoms
- Shoulder, arm, neck, back, upper abdominal, and jaw pain/pressure/tightness/ discomfort and shortness of breath are potentially chest pain equivalents. As such, these symptoms may occur with CAD/ACS, even absent a chest symptom.

Abbreviations: ACS, acute coronary syndrome; CAD, coronary artery disease
Data from Refs. [49]
[a]This box represents common chest pain characteristics. Symptom experiences may vary, and exceptions to the characteristics included in this box are possible.

Figure Legend

Figure 1. This figure illustrates the four levels of prevention.