

Screening Practices for Cardiovascular Diseases

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Abstract

Background: Cardiovascular disease is a leading cause of morbidity and mortality worldwide. CVD is also the number 1 cause of death globally with an estimated 17.7 million deaths in 2015, according to the World Health Organization (WHO). The goals of screening are to improve life expectancy and quality of life by preventing MI and heart failure through the early detection of significant CVD.

Aim: In this review, we look into the screening practices for cardiovascular diseases.

Methodology: The review is comprehensive research of PUBMED since the year 1993 to 2018.

Conclusion: Many methods for CVD screening have insufficient evidence to currently recommend use in a general, asymptomatic adult population. Nonetheless, there is good evidence for some specific CVD screening modalities when used in the proper risk setting. Risk assessment is a vital first step in determining the appropriate approach to CVD screening.

Keywords: Screening; Cardiovascular Disease; Screening for CVD

Introduction

Cardiovascular disease is a leading cause of morbidity and mortality worldwide. CVD is also the number 1 cause of death globally with an estimated 17.7 million deaths in 2015, according to the World Health Organization (WHO). The burden of CVD further extends as it is considered the most costly disease even ahead of Alzheimer disease and diabetes with calculated indirect costs of \$237 billion dollars per year and a projected increased to \$368 billion by 2035 [1].

Cardiovascular disease is preventable through effective control and management of its risk factors. Data from researches provide sufficient evidence to suggest that the primary prevention of CVD represents a cost-effective approach to reducing this burden [2].

Risk for CVD varies across different populations, including race/ethnicity, age, and gender. Risk factors for CVD include family history, hypertension (HTN), dyslipidemia, smoking history, and diabetes mellitus. Smoking is associated with a three to fivefold increase in the risk of AAA and AAA mortality. While the majority of people with CVD have at least one conventional risk factor, it is important to know that almost 15% of men and 10% of women with CVD do not have any of the conventional risk factors [3,4].

CVD risk factors and risk behaviors can be detected in childhood, and the extent of their presence has been linked to the severity of atherosclerosis in childhood and in adulthood. There is also growing evidence that CVD risk factors and behaviors track to various degrees into adulthood, contributing to the risk of diseases decades later [5].

The assessment and screening of individual risk factors for cardiovascular disease (CVD) is a critical component of CVD prevention strategies in general practice (GP). The goals of screening are to improve life expectancy and quality of life by preventing MI and heart failure through the early detection of significant CVD [6].

Symptoms of coronary heart disease include chest pain and trouble breathing, especially with activity. However, some people who have heart disease do not have any symptoms and may benefit from screening. Generally, people at higher risk of cardiovascular disease benefit more from screening and treatment. Knowing which people fall into this high-risk category is important [7].

Various strategies and interventions have been used to increase individuals' participation in CVD risk factors screening. Their effectiveness varied from study to study, ranging from no benefit to an 80% increase in the participation rate from baseline [8,9]. Jepson, *et al.* conducted a comprehensive systematic review to examine factors associated with the uptake of screening programs and to assess the effectiveness of methods used to increase uptake [10].

Screening tests

The CVD risk factors screening included for assessment in the review were measurements of blood pressure (BP), weight, body mass index (BMI), waist circumference (WC), glucose, lipids, total cardiovascular risk score and history taking regarding smoking, physical activity, or nutritional intake [11].

Blood pressure measurement: Hypertension is a common, preventable risk factor for the development of CVD and death. Individuals with HTN have a much higher risk of stroke, myocardial infarction, heart failure, peripheral vascular disease, and AAA than those without HTN. The relationship between blood pressure and cardiovascular risk is continuous [12]. Office blood pressure measurement with an appropriately sized upper arm cuff is the standard screening test for HTN. In practice, errors may occur in measuring blood pressure as a result of instrument, observer, or patient factors. This includes issues with the manometer, stethoscope, poorly fitting cuffs for the patient's arm size, trouble hearing Korotkoff sounds, inattention on the part of the observer, rapid release of air from the blood pressure cuff, and many more [13]. While no direct evidence for HTN screening exists, indirect evidence supports screening adults for HTN because it is an important risk factor for CVD events and is reliably detected through office blood pressure screening. Additionally, treatment with lifestyle and pharmacologic therapy can effectively reduce blood pressure and CVD events [12].

Blood tests: It's important to remember that one blood test alone doesn't determine the risk for heart disease.

A cholesterol test, also called a lipid panel or lipid profile, measures the fats (lipids) in blood. The measurements can indicate risk of having a heart attack or other heart disease. There are known associations between elevations in total cholesterol, low-density lipoproteins (LDL), and triglycerides as well as reductions in high-density lipoproteins (HDL) and CVD. Fasting lipid profiles including these four

lipid biomarkers are widely used in screening and decision-making in contemporary medicine. In recent years, some have advocated for measuring elevations in lipoprotein (a) as well. The test typically includes measurements of [14]:

- **Total cholesterol:** This is a sum of blood's cholesterol content. A high level can put individual at increased risk of heart disease. Ideally, your total cholesterol should be below 200 milligrams per deciliter (mg/dL) or 5.2 millimoles per liter (mmol/L).
- **Low-density lipoprotein (LDL) cholesterol:** This is sometimes called the "bad" cholesterol. Too much of it in blood causes the accumulation of fatty deposits (plaques) in your arteries (atherosclerosis), which reduces blood flow. These plaque deposits sometimes rupture and lead to major heart and vascular problems.

LDL cholesterol level should be less than 130 mg/dL (3.4 mmol/L). Desirable levels are under 100 mg/dL (2.6 mmol/L), especially if you have diabetes or a history of heart attacks, heart stents, heart bypass surgery, or other heart or vascular conditions.

- **High-density lipoprotein (HDL) cholesterol:** This is sometimes called the "good" cholesterol because it helps carry away LDL cholesterol, keeping arteries open and blood flowing more freely. Ideally, HDL cholesterol level should be over 40 mg/dL (1.0 mmol/L) for a man, and over 50 mg/dL (1.3 mg/dL) for a woman.
- **Triglycerides:** Triglycerides are another type of fat in the blood. High triglyceride levels usually mean that individual eat more calories than burn. High levels can increase risk of heart disease. Ideally, triglyceride level should be less than 150 mg/dL (1.7 mmol/L). The American Heart Association (AHA) states that a triglyceride level of 100 mg/dL (1.1 mmol/L) or lower is considered "optimal."
- **Non-HDL cholesterol:** Non-high density lipoprotein cholesterol is the difference between total cholesterol and high-density lipoprotein cholesterol (HDL-C). Non-HDL-C includes cholesterol in lipoprotein particles that are involved in hardening of the arteries (atherosclerosis). This includes low-density lipoprotein (LDL), lipoprotein (a), intermediate-density lipoprotein and very-low-density lipoprotein.

Inflammation appears to play an important role in the development of atherosclerosis. C-reactive protein (CRP) is a biomarker that rises in response to inflammation in the body. An elevated CRP level has been suggested as a potential nontraditional risk factor to use in estimating risk for those without known CVD [15].

Genetic Screening: Family history plays an important role in assessing risk of CVD. In most cases, multiple genetic changes, which individually do not result in disease, are working together with environment and behavior to cause disease. Examples of these include familial hyperlipidemia, some forms of hypertrophic and dilated cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy, long-QT syndrome, and Brugada syndrome. Genetic testing can help determine which relatives are at risk for developing a condition but cannot predict whether it will develop or its severity [16].

Electrocardiography: Both resting and exercise ECG are used for the diagnostic evaluation of suspected CVD, which has led to the suggestion that ECG could also be used to screen asymptomatic persons to identify those who would benefit from earlier, more intensive management of modifiable risk factors, preventive interventions, or both. Resting ECG records cardiac electrical activity while the patient is at rest, over a short period of time. Standard ECG testing is performed with 12 leads, although some tests use fewer leads. More recently, ECG leads have been built into blood pressure cuffs, smartphones, and other devices. Exercise ECG records cardiac electrical activity during physical exertion, often at a prespecified intensity level. The most common method of exercise ECG is the treadmill test, but other methods, such as those using bicycles and ergometers, have also been used. Both resting and exercise ECG look for markers of previous

myocardial infarction, myocardial ischemia, and other cardiac abnormalities (such as left ventricular hypertrophy, bundle branch block, or arrhythmia) that may be associated with CVD or predict future CVD events [17,18].

Reclassification into a higher-risk category might lead to more intensive medical management that could lower the risk of CVD events but might also result in harms, including adverse medication effects such as gastrointestinal bleeding and hepatic injury. Regardless of ECG findings, persons who are already at high risk of CVD events should receive intensive risk factor modification. Persons who are classified as low risk are unlikely to benefit from screening with ECG. For persons in certain occupations, such as pilots and operators of heavy equipment, for whom sudden incapacitation or death may endanger the safety of others, considerations other than the health benefit to the patient may influence the decision to screen with ECG to prevent CVD events [19].

A pooled analysis including 63 prospective cohort studies demonstrated that ST-segment or T-wave abnormalities, left ventricular hypertrophy, bundle branch block, or left-axis deviation on resting ECG or ST-segment depression with exercise, failure to reach maximum target heart rate, or low exercise capacity on exercise ECG are associated with an increased risk of cardiovascular event after adjusting for traditional risk factors [20].

Imaging: New imaging methods, such as magnetic resonance imaging and computed tomography to detect coronary calcifications or ultrasonography to measure CIMT, can be used to detect asymptomatic individuals at high risk of cardiovascular events. The European guidelines refer to these methods as an extra option to identify patients at high risk for new cardiovascular events [21].

A variety of imaging tools have been studied and are increasingly used in practice to screen for CVD, including coronary artery calcium (CAC) obtained by computed tomography (CT), carotid artery ultrasound, and abdominal aorta ultrasound. Molecular imaging in cardiology often involves the application of targeted imaging probes paired with conventional clinical and preclinical forms of non-invasive imaging such as radionuclide imaging; magnetic resonance imaging (MRI), ultrasound, computed tomography (CT), and optical imaging [22].

Imaging of CAC with CT can play an important role in detecting established disease that is in progress and may be headed for high risk phenotype (mid-stage disease). By imaging molecular or cellular characteristics plaque, it may be possible to better understand the nature of the plaque with regards to likelihood for future rapid growth or development more high risk features [23].

Conclusion

Many methods for CVD screening have insufficient evidence to currently recommend use in a general, asymptomatic adult population. Nonetheless, there is good evidence for some specific CVD screening modalities when used in the proper risk setting. Risk assessment is a vital first step in determining the appropriate approach to CVD screening.

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