Pulse Oximetery as A Potential Screening Tool of Lower Extremity Arterial Disease

By

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ABSTRACT

The aim of our study is to asses the efficiency of pulse oximeter as a screening tool of peripheral arterial disease.

-Our study enrolled 150 patients, 50 patients above age of 60 year without symptoms of PVD, 50 asymptomatic patients with low ABI and 50 patients having symptomatic PVD.

-Duplex study of lower limbs, ABI measurement and oxygen saturation difference between index finger and toe were done to every patient.

-We considered abnormal pulse oximerter of the toes as a SaO2 value of more than 2% lower than the fingers value or a decrease of more than 2% on elevation of the leg (decrease from the value at the supine position), abnormal ABI < 0.9.

-We found good correlation between pulse oximerter result and ABI as it can detect (82.8%) of diseased limbs detected by ABI and (86.7%) of normal limbs detected by ABI.

-Pulse oximerter seems to be valuable since it can be performed in out-patient clinics and handle large numbers of patients in a short time and avoid the problem of media sclerosis.

-We found that pulse oximeter was highly sensitive (85%) to detect lower limb ischemia detected by duplex also it was highly specific (96.4%) to exclude lower limb ischemia excluded by duplex

Keywords:

Pulse oximerter - peripheral arterial disease – ankle brachial index

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Peripheral Arterial Disease

Introduction:

The circulatory system is a network of specialized tubes (known as blood vessels) that carry oxygen- and nutrient-rich blood to the organs and tissues of the body. There are 3 types of blood vessels: arteries, veins, and lymphatic.

The heart is the pumping organ of the body. It pumps oxygen- and nutrient-rich blood into the aorta, which is the main artery of the body. The branches of the aorta, known as the arteries, carry blood to the organs of the body, such as the kidneys, the liver, and the intestines, as well as to the arms and legs (extremities).[60]

Epidemiology of peripheral arterial disease:

The incidence of symptomatic PAD increases with age, from bout 0.3% per year for men aged 40–55 years to about 1% per year for men aged over 75 years.[163] The prevalence of PAD varies considerably depending on how PAD is defined, and the age (and, to a lesser extent, sex) of the population being studied.[63]

Using the definition of an ABPI less than 0.9, most epidemiological studies report the prevalence of PAD to be about 10%–25% in men and women over 55 years of age. [110]

Although only about 10%–20% of people with PAD identified in epidemiological studies are symptomatic (usually with intermittent claudication), this may be an underestimate because of under ascertainment of symptomatic cases [110,155].

The prevalence of PAD rises with age (from 10.6% in men aged 65–69 years to 23.3% in men aged 75–79 years in a population-based western Australian study[41]. On average, the prevalence of symptomatic disease at around 60 years of age is about 5 % [163].

PAD Is Atherosclerosis of the Extremities:

PAD is a medical condition caused by blockages of the arteries that provide blood flow to the arms or legs. You may have also heard of this problem referred to as peripheral vascular disease (PVD) or "bad circulation."

In PAD, the arteries become blocked by cholesterol plaque caused by atherosclerosis. Atherosclerosis is a common problem in Western societies. Atherosclerosis can involve almost all of the major arteries of the body.

Atherosclerosis of the arteries of the heart is known as coronary artery disease, the process that causes chest pain (angina) and heart attack (myocardial infarction).

Atherosclerosis of the arteries of the neck and brain, known as cerebrovascular disease, causes strokes. Atherosclerosis of the arteries of the arms and legs, as well as the aorta, is known as PAD.

Many frequently occurring conditions place people at risk for developing PAD. The conditions that increase the risk of PAD are the same risk factors that increase the risk of heart attack or stroke (see the box titled "Common Risk Factors for PAD").

Cigarette smoking, both tobacco and marijuana, is the most important correctable risk factor for the development of PAD, whereas age is the most significant nonreversible risk factor.

Researchers are actively working to figure out why PAD specifically and atherosclerosis in general develop in some people but not in others. Some of the newer areas of interest include chronic inflammation of blood vessels and inherited (genetic) factors.

Common Risk Factors for PAD:

- Smoking.
- Diabetes.
- High blood pressure.
- High cholesterol.
- Advanced age (greater than 70 years).[60]

Symptoms of PAD:

The most common complaint that is caused by PAD is leg pain brought on by walking this leg pain is also known as intermittent claudication. Claudication is a sensation of aching, burning, heaviness, or tightness in the muscles of the legs that usually begins after walking a certain distance, walking up a hill, or climbing stairs, and goes away after resting for a few minutes.

The ache can be felt in the buttocks, thighs, or calves. In some patients, particularly patients more than 70 years old, the feeling of claudication may be different from this classic or textbook description (such patients are said to have atypical symptoms).

Patients with severe PAD may have claudication after walking a short distance or may have pain in the legs or feet when at rest or when lying in bed at night. In severe cases, patients may develop a sore (ulcer) that will not heal on its own or blackened skin (gangrene) on the foot or toe.

Common symptoms:

- Buttock, thigh, or calf pain with exertion (claudication).
- No symptoms–diagnosed by abnormal ABI test.
- Erectile dysfunction.

Uncommon symptoms:

- Pain in legs and feet at rest.
- Sore (ulcer) on leg that does not heal.
- Arm pain with exertion (PAD of arms).
- Different blood pressures in the right and left arms of more than 15 points (PAD of arms).

Some patients can have PAD and claudication of the arms, although this is much less frequent than PAD of the legs. These patients may experience arm discomfort while performing routine housework or brushing their teeth or hair.

The diagnosis of PAD of the arms can generally be made by a doctor's examination. Patients with PAD of the arms often have a large difference in the blood pressure readings between the right and left arms.

PAD can also cause unusual symptoms. In some men, the only symptom of PAD may be the inability to have or maintain an erection (erectile dysfunction).

Finally, in many cases, patients who have significant blockages in the arteries supplying blood to the legs have no symptoms at all and can only be diagnosed by a doctor's examination and a test known as the ankle-brachial index (ABI),. We are becoming aware of the fact that *for each patient with PAD and claudication, there may be another patient with PAD who has no symptom* [60].

Importance of Diagnosing PAD:

Doctors are recognizing that PAD is a much more common problem than originally thought. According to published research, more than 1 in 5 people older than age 70 have PAD. Fewer than half of the patients with PAD know they have a problem; many patients with PAD do not have leg symptoms and can only be diagnosed by a doctor's examination or by the ABI test.

Patients with leg pain caused by PAD may have a limited ability to walk, exercise, perform their jobs, go shopping, or clean their homes. Leg pain from PAD can worsen a person's quality of life.

Many treatments for claudication are available that may greatly improve symptoms of PAD, but the first step in treatment is diagnosis.

Effectiveness of Early Detection:

Because surgery for PAD is offered only to patients with symptomatic disease, the rationale for the early detection of asymptomatic PAD is that risk factor modification following detection might lower subsequent morbidity and mortality from PAD and systemic atherosclerotic disease.

By virtue of its strong association with coronary atherosclerosis and coronary events [168] the early diagnosis of PAD might also lead to the detection of asymptomatic coronary heart disease.

Evidence of these benefits is lacking, however. There has been no research to examine whether the detection and treatment of asymptomatic persons with PAD reduces the morbidity or mortality observed in symptomatic patients.

It is clear that certain interventions are beneficial in symptomatic persons. There is evidence, for example, that patients who stop smoking have marked improvement in PAD symptoms and reduced overall cardiovascular mortality [157, 80, 77] certain anti thrombotic drugs may also be of benefit. [4]

It is unknown whether treatment measures used in symptomatic patients are beneficial in asymptomatic patients.[157,80] Examples include walking programs, control of weight and blood pressure, correction of elevated serum lipids and glucose, proper foot care, and certain drugs.

There are no official recommendations for physicians to screen asymptomatic persons for PAD, although inspection of the skin and palpation of peripheral pulses are often included in the physical examination of the extremities.

A recent international workshop sponsored by the American Diabetes Association and American Heart Association recommends annual screening for PAD in patients with diabetes. [3]

Most important, patients who have PAD likely have blockages in other arteries of the body, especially the arteries of the heart and brain,

patients with PAD are 3 to 6 times more likely to have a heart attack or stroke than are patients without PAD.

If the patient is diagnosed with PAD, the doctor will work closely with him to decrease his risk of having a heart attack or stroke.

How PAD Is Diagnosed:

In most cases, the doctor can diagnose PAD on the basis of a careful medical history and a thorough physical examination. The physical examination focuses on the heart and blood vessels. Because atherosclerosis occurs throughout the entire body, patients with PAD are at high risk for atherosclerosis in the other arteries of the body.

The doctor measures the blood pressure and carefully examines the heart and the pulses of the neck, arms, legs, and feet.

The doctor may also use a stethoscope to listen to the pulses in the neck (carotid arteries) and the groin (femoral arteries). In some cases, a doctor can hear a "whooshing" or blowing sound (known as a bruit), which is the result of blood flow past narrowing in these arteries.

The doctor may ask the patient to remove his socks and shoes and will carefully examine the feet and toes to make sure he has not developed any ulcers caused by poor circulation.

If the doctor suspects that the patient has PAD, he will do the ABI test, which can be performed by the doctor, a nurse, or a medical assistant. He may also be sent to a vascular laboratory for the ABI test. This index is a simple, non-invasive bedside tool for diagnosing PAD that can be used by any clinician. An ABPI of less than 0.9 is diagnostic of PAD. [147]

In addition to providing a semi-quantitative and objective measure of the severity of symptomatic PAD, the index also allows for identification of asymptomatic PAD. [60]

In some cases, additional tests may be necessary to confirm the diagnosis of PAD or to determine the location of the blockages in the arteries. These tests may include an ultrasound of the legs, a computed tomogram (CT scan), or a magnetic resonance angiogram (MRI test).

Duplex arterial testing has been proven to be a highly sensitive, specific and accurate method of assessing the patient with peripheral arterial disease (PAD) and in many cases can be obviate the need for angiography in patient's considering interventional or surgical treatment. [83, 5]

Doppler waveforms obtained from normal peripheral arteries are *triphasic* in nature and represent three distinct flow components: an initial, rapid upsweep to peak systolic velocity (PSV); a small flow reversal in early diastole; and a final forward flow in late diastole.

Triphasic waveforms are normally obtained from the common and superficial femoral, popliteal, posterior tibial, and dorsalis pedis arteries in the normal non-vasoconstricted lower extremity at rest.

As the atherosclerotic disease process begins to diminish the elasticity and compliance of the arterial wall, the Doppler waveform becomes *biphasic* with a loss of the third forward wave in late diastole.

As the disease progresses, blood flow becomes *monophasic* with both the early and late diastolic phases absent and only the systolic