ORIGINAL ARTICLE

Vascular Ultrasound and Noninvasive Physiological Testing for Peripheral Arterial Disease: Are These Tests Being Overused?

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Abstract

Purpose: To examine recent trends in the use of duplex ultrasound and noninvasive physiologic tests (NPTs) for determining the presence of peripheral arterial disease (PAD).

Methods: Medicare Part B databases for 2001-2013 were used. The two *Current Procedural Terminology, version four* codes for duplex ultrasound of lower-extremity arteries, and the three codes for NPTs of extremity arteries were selected. Procedure volumes of both types of examinations were determined, and utilization rates per 100,000 beneficiaries were calculated. Medicare specialty codes were used to determine what proportions were performed by the major specialty groups involved in these examinations: surgeons, cardiologists, radiologists, and primary care physicians (PCPs).

Results: Between 2001 and 2010 (the peak year), the total utilization rates per 100,000 of duplex ultrasound and NPTs increased by 94% and 84%, respectively. During the ensuing three years, small declines occurred in both. In 2013, utilization rates of both types of tests were far higher than they had been in 2001 (88% higher for duplex ultrasound; 63% higher for NPTs). From 2001 to 2013, use of duplex ultrasound increased 235% among cardiologists, 90% among surgeons, 76% among radiologists, and 53% among PCPs. Utilization rates of NPTs among surgeons were already high in 2001 and increased an additional 23% by 2013. The NPT utilization rates increased 180% among PCPs, 179% among cardiologists, and 61% among radiologists.

Conclusions: During a period when little growth occurred in the incidence of PAD, sharp growth occurred in testing for the disease.

Key Words: Medical economics, peripheral arterial disease, noninvasive physiologic testing, duplex ultrasound, radiology and radiologists, socioeconomic issue

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Atherosclerotic peripheral arterial disease (PAD) is common in the United States, particularly among older individuals who have a smoking history or diabetes. In 2004, Selvin and Erlinger [1] used a national survey to estimate the prevalence of this disease in individuals over age 40 years. All subjects had ankle-brachial indices (ABIs) measured, and anyone with an ABI less than 0.9 in either leg was considered to have PAD. Using this criterion, they estimated that the prevalence of PAD in the United States was 4.3%, or approximately five million people. However, Meijer et al [2] showed that a large majority of people with an ABI of less than 0.9 had no symptoms. Thus, the number of people in the United States with symptomatic PAD may be somewhat lower [2,3]. A more recent study by Nehler et al [4] estimated the prevalence of PAD in the adult US population to be 10.7%.

PAD generally has a gradual progressive onset, and in most instances, does not have sudden catastrophic consequences [5,6], as can other forms of cardiovascular disease, such as coronary and carotid artery disease. A smaller subset of patients with PAD have critical limb ischemia (CLI), a much more severe form of the disease characterized clinically by severe, resting leg or foot pain, nonhealing wounds or ulcers, or gangrene. A high incidence of amputation and death occurs with CLI [3,4].

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Fowkes et al [7] recently studied temporal trends in the prevalence of PAD. Using a complex epidemiologic model, they estimated that only a very small increase occurred between 2000 and 2010 in high-income countries such as the United States.

In 1999, the Society of Cardiovascular and Interventional Radiology (now the Society of Interventional Radiology, SIR) launched the *Legs For Life* campaign [8-12], the stated goals of which were to raise public awareness and understanding of PAD, encourage risk-factor modification as appropriate, encourage walking programs, and promote screening for the disease. The ankle-brachial index (ABI) is the noninvasive physiologic test (NPT) most commonly recommended for early detection of PAD. Other NPTs used for detecting PAD include pulse volume recordings, segmental blood pressure measurements, and bidirectional Doppler waveform analysis. The NPTs do not employ imaging.

The imaging test most commonly used for early detection is duplex ultrasound scanning of the lower-extremity arteries. Along with the SIR, other organizations have recommended screening of asymptomatic patients, [3,13-15], as have commercial companies that offer PAD screening as part of a larger package of screening tests for various cardiovascular conditions [16,17].

On the other hand, the Society for Vascular Surgery recently took the position that the existing evidence does not support broad population screening of asymptomatic patients for PAD [18]. The ACR Appropriateness Criteria® state that NPTs should be used to examine patients only if they have symptoms and findings suggestive of PAD [19]. Other organizations such as the US Preventive Services Task Force and the American Academy of Family Practice have taken somewhat neutral positions, finding that the current evidence is insufficient to assess the balance of benefits and harms of screening for PAD [20,21]. The American College of Cardiology supported use of NPTs and duplex ultrasound in patients with signs or symptoms of PAD, but it was silent on the issue of using those techniques for screening asymptomatic individuals [22].

Aside from screening for PAD, NPTs and duplex ultrasound are also used in several other clinical circumstances. For example, they are commonly used in patients with typical signs and symptoms of PAD (such as claudication and diminished foot pulses) to confirm the presence of obstructive disease. They are used in patients with atypical lower-extremity pain to help determine whether the symptoms are due to PAD, or whether the ordering physician's attention should be directed to other possibilities, such as arthritis, venous disease, or peripheral neuropathy. They are used to monitor progression of disease in those being treated medically. Finally, in patients who have undergone endovascular or surgical therapy for PAD, they are used to monitor for possible restenosis or occlusion of the bypass graft or angioplasty/stent site. In view of the variability of opinion among the aforementioned organizations on the use of testing for possible PAD, we undertook to study trends in recent utilization of lower-extremity duplex ultrasound and NPTs.

METHODS

We used the Medicare Part B Physician/Supplier Procedure Summary Master Files from 2001 through 2013 as our data sources. They cover all beneficiaries in traditional fee-for-service Medicare (37.3 million in 2013), but not those in Medicare Advantage plans (15.1 million in 2013). For every code in the *Current Procedural Terminology, version four,* manual, these files provide procedure volume, allowed payments, and other administrative data. We analyzed the two codes for duplex ultrasound scans of lower-extremity arteries: 93925 for a complete bilateral study; 93926 for a limited or unilateral study. In addition, we analyzed the three codes for NPTs of extremity arteries: 93922 for limited studies; 93923 for complete studies; and 93924 for studies done at rest and after treadmill exercise. Complete studies include some combination of ABIs, pulse volume recordings, segmental blood pressure measurements, and/or bidirectional Doppler waveform analyses. Global and professional component-only claims were tabulated, but those for just the technical component were excluded, to avoid double counting.

The numbers of fee-for-service Medicare beneficiaries each year were determined from the CMS Medicare Advantage State/County Penetration Reports, and those numbers were used to calculate the utilization rates per 100,000 beneficiaries. Medicare's physician specialty codes were used to categorize physician providers into groups as follows: radiologists, surgeons, cardiologists, primary care physicians (PCPs), and all others. Trends between 2001 and 2013 were reviewed. Data analysis was performed using SAS version 9.3 for Windows (SAS Institute, Inc, Cary, North Carolina).

RESULTS

The total volume of Medicare fee-for-service duplex ultrasound scans of lower-extremity arteries among all