Ankle Brachial Index and Exercise Transcutaneous Oxygen Pressure Measurement in Patients with Peripheral Artery Disease and Lumbar Spinal Stenosis

To the Editor

We read with great interest the paper from Han et al (1) entitled "Clinical and Radiological Characteristics of Concomitant Peripheral Arterial Obstructive Disease in Patients with Lumbar Spinal Stenosis." In this paper, the authors found that "concomitant peripheral artery disease (PAD) in patients with lumbar spinal stenosis (LSS) is associated with old age, diabetes, the presence of aortic calcification, and Ankle Brachial Index (ABI) < 0.90."

First, although the authors concluded "concomitant PAD in patients with LSS is associated with old age," this result did not appear in the multivariate logistic regression (Table 4).

Second, the ABI measurements performed in this study merit several comments. Resting ABI was first described by Winsor (2) in 1950 and corresponds to the ratio of the systolic blood pressure measured at the ankle to the systolic blood pressure measured at the brachial artery (3-5).

Recent American Heart Association (AHA) guidelines have recommended using the Doppler method on the posterior tibial artery and dorsalis pedis artery to determine the ABI (6). In the Han et al study (1) they used a photoplethysmographic (PPG) sensor placed on the great toes, whereas the cuff was placed on the lower calves (just above the ankle). Jönsson et al (7) have compared ABI measured with Doppler to ABI measured with PPG, but with the PPG sensor placed at the ankle level (7). The PPG and Doppler methods aim at detecting the onset of the blood flow when the pressure cuff is released beneath the suprasystolic level. In the Han et al study (1), due to the distance between the cuff and the PPG sensor, the recorded ankle pressure is probably lower than the pressure which would have been recorded at the ankle (8). Carter and Lezack (9) have shown that the difference between ankle pressure and toe pressure (Ankle pressure-Toe pressure) ranged from 30 ± 4 to 72 ± 8 mm Hg in different groups.

Furthermore, the ABI cutoff value to diagnose PAD is ≤ 0.90 when the measurement is performed at the tibial posterior artery or dorsalis pedis artery with a pressure cuff placed at the ankle level. When the measurement is performed at the toe level with a cuff placed at the base of the toe, the index is called the toe-brachial index (TBI) (9,10). The cutoff value of TBI to consider a patient as abnormal is debated (10). A TBI < 0.70 is considered as abnormal in the TASC II guidelines (8). In this condition, the so-called "ABI values" of this paper have to be considered with caution.

Third, the authors wrote that ABI can be inaccurate, especially in the case of noncompressible arteries. In this case, they "recommend performing Computed Tomography Angiography (CTA) to confirm the diagnosis of PAD" (1). We would like to underline that recent AHA recommendations suggest that "when the ABI is > 1.40 (i.e., ABI value when arteries are non-compressible) and there is a clinical suspicion of PAD, a TBI or other non-invasive tests including imaging should be used" (6). Performing a TBI or Doppler waveforms analysis is safer compared to CTA because contrast agents used for CTA can induce renal or allergic complications.

Finally, we would like to point out that resting ABI, Doppler waveforms, penile brachial index, and postexercise ABI can be normal when a patient has an isolated internal iliac artery stenosis (11,12). Proximal claudication (lower back, hip, buttock, or thigh pain) due to vascular origin is a pain that is absent at rest, appears during walking, and is relieved by rest that often forces the patient to stop. This claudication relies on significant stenosis localized on arteries toward the pelvic circulation. A good way to find the origin of the claudication is to perform an exercise transcutaneous oxygen pressure measurement (Exercise-TcPO2). Exercise-TcPO2 has demonstrated good sensitivity (79%) and specificity (86%) to detect significant lesions (≥ 75%) in the arterial tree toward the pelvic circulation compared to angiograms as the gold standard (13). In brief, after a 10-minute rest period, a baseline measurement of TcPO2 is performed using calibrated TcPO2 probes. The temperature of each probe is 45°C to allow for maximal

cutaneous vasodilation, thereby decreasing the arterial to skin surface oxygen pressure gradient. A reference electrode is placed on the back (between the scapulae) to measure systemic changes (14). This probe is called the chest probe. One electrode is positioned on each buttock, 4 to 5 cm behind the bony prominence of the trochanter. Once the electrodes are in position, a pre-test stabilization period of 10 minutes in the standing position is required. The treadmill test is performed at a 10% slope and speed of up to 2 mph (3.2km/h) for up to 15 minutes (15). The Delta from Resting of Oxygen Pressure (DROP) index is calculated in real-time by dedicated software which allows real-time monitoring of the blood flow at the different levels where the probes are placed (13). The DROP index is the absolute change in TcPO2 from rest value in each of the 2 limb probes, corrected for the absolute change in TcPO2 from rest in the chest electrode. This DROP index is a value expressed in mm Hg. The minimum DROP value during exercise is highly accurate and reliable in predicting the presence/absence and severity of angiographically proved lesions (stenosis ≥ 75%) at both the buttock and ankle levels (13,16). Consistent with previous results at the buttock (13), the presence of ischemia on each of the two limb TcPO2 probes during exercise is defined as a DROP value greater than -15 mm Hg.

Diagnosis of proximal claudication (lower back, hip, buttock, or thigh pain) is challenging, especially in a population of patients with vascular risk factors. Further studies are needed to determine a comprehensive diagnostic algorithm in patients who suffer from proximal claudication and to specify the place of vascular investigations.

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