OSLER'S MANEUVER AND PSEUDOHYPERTENSION

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Abstract We describe a simple bedside procedure (which we call "Osler’s maneuver") that differentiates patients with true hypertension from those whose blood pressure is spuriously elevated because of excessive sclerosis of the large arteries ("pseudohypertension"). The maneuver is performed by assessing the palpability of the pulseless radial or brachial artery distal to a point of occlusion of the artery manually or by cuff pressure. We classified 24 elderly hypertensive patients as either Osler-positive (n = 13) or Osler-negative (n = 11), and measured their intraarterial pressure, arterial compliance, and systemic hemodynamics. Patients with pseudohypertension (Osler-positive) had falselv raised blood-pressure readings, with a difference of 10 to 54 mm Hg between cuff and intraarterial pressure. Arterial compliance was lower in Osler-positive subjects and correlated with the difference between cuff and intraarterial pressures, indicating that the stiffer the artery, the more pronounced the degree of pseudohypertension. Pseudohypertension is common in the elderly and becomes more severe as arterial compliance decreases and sclerosis of large arteries progresses. (N Engl J Med 1985; 312:1548-51.)

It may be difficult to estimate how much of the hardness and firmness is due to the tension of the blood within the vessel and how much to the thickening of the wall. If, for example, when the radial artery is compressed with the index finger the artery can be felt beyond the point of compression, its walls are sclerosed.

THESE sentences were written by Sir William Osler in his first edition of Principles and Practice of Medicine, published in 1892, more than a quarter of a century before blood pressure began to be measured routinely in clinical practice. Osler not only described an entity that is known today as "pseudohypertension" but also suggested a clinical maneuver for its identification. Pseudohypertension can be defined as a condition in which the cuff pressure is inappropriately high as compared with the intraarterial pressure, because of excessive atheromatosis. Presumably, a higher cuff pressure is needed to compress a sclerotic and calcified artery than a normal one. A systematic evaluation of pseudohypertension by Spence et al. indicated that discrepancies of up to 64 mm Hg can be demonstrated between

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cuff and intraarterial pressures in certain elderly patients. Clearly, such an overestimation of arterial pressure has important clinical and therapeutic implications.

The present study was designed to evaluate "Osler's maneuver" (as we propose to call it) for the detection of pseudohypertension in elderly patients with a diagnosis of essential hypertension. Arterial compliance and cardiovascular findings were evaluated among patients found to have various degrees of pseudohypertension as judged by a positive Osler maneuver, and these findings were compared with those in subjects with true elevation of arterial pressure.

**Methods**

Twenty-four hypertensive patients over age 65 were studied. Hypertension was said to be present when arterial pressure (cuff readings) remained consistently above 160/95 mm Hg in the outpatient setting. All the patients were classified in the outpatient clinic as being either Osler-positive or Osler-negative. Osler's maneuver was performed by inflating the blood-pressure cuff above systolic pressure and carefully palpating the radial or brachial artery. Whenever either of these arteries remained clearly palpable (despite being pulseless), the patient was described as being Osler-negative. In contrast, when it collapsed and could not be palpated, the patient was described as being Osler-positive. Antihypertensive medication was discontinued in all patients at least one week before the study. Clinical features of the patient population are described in Table 1.

A systemic hemodynamic evaluation was performed, as previously reported, by an investigator who was at that time not aware of the result of the Osler maneuver. The patient was brought to our laboratory after fasting overnight. Small catheters were inserted by the Seldinger technique into the brachial vessels and advanced until their tips were in the aorta and the superior vena cava. Cardiac output was determined by indocyanine green in triplicate. Intraarterial pressure was measured and compared simultaneously with the cuff pressure in the same arm. To avoid observer bias, the two pressures were recorded blindly by two independent persons. Two different indices of arterial compliance (pulse-wave velocity and exponential analysis of the pressure decay during diastole) were estimated as previously reported. Cardiac function and structure were further assessed with M-mode echocardiography.

Statistical analysis was done by a one-way analysis of variance. Linear-regression analysis was employed to correlate indices of arterial compliance with the difference between the cuff pressure and the mean arterial pressure.

**Results**

Average cuff pressures (systolic, diastolic, and mean) were significantly higher in Osler-positive than in Osler-negative patients, but no significant difference in intraarterial pressure was seen between the two groups (Table 2). For both systolic and diastolic pressure, the difference between cuff and intraarterial values averaged more than 15 mm Hg in Osler-positive patients, yielding a spurious diastolic reading that was 21 per cent above the true intraarterial value (Fig. 1). Diastolic and mean arterial cuff pressures were consistently higher than intraarterial pressures in all Osler-positive subjects. Surprisingly, in two of the Osler-positive patients, the intraarterial systolic pressure repeatedly exceeded the cuff systolic pressure, although concomitant diastolic cuff pressures remained at least 12 mm Hg above the intraarterial pressures. The degree of pseudohypertension (the difference between cuff and intraarterial pressure) ranged from 10 to 54 mm Hg in Osler-positive subjects.

The indexes of arterial compliance were lower in Osler-positive than in Osler-negative patients: the pulse-wave velocity and the pressure-decay index during diastole differed by 56 and 20 per cent, respectively (Table 3). Systemic hemodynamics — i.e., cardiac output, total peripheral resistance, and echocardiographic measurements — were similar in the two groups.

The difference between the mean cuff and the intraarterial systolic pressures, which is a measure of the degree of pseudohypotension, correlated well with the pulse-wave velocity in all patients (r = 0.46, P<0.02); the correlation was even closer when the two subjects described above were excluded (r = 0.68, P<0.001). The difference between the cuff and intraarterial measurements of mean or diastolic pressure also correlated directly with the pulse-wave velocity (r = 0.47, P<0.02, and r = 0.38, P<0.05, respectively).
simple bedside procedure. Patients in our study who were found to be Osler-positive had falsely elevated blood-pressure readings ranging from 10 to 54 mm Hg. Arterial compliance was distinctly lower in the group with pseudohypertension than in the group with true elevation of arterial pressure.

The presence of pseudohypertension has important epidemiologic, clinical, and therapeutic implications. The Framingham Study data allow us to calculate that an increase in arterial pressure of 15 mm Hg (such as that simulated in the Osler-positive subjects in the present study) would increase the risk of a stroke fourfold, of congestive heart failure threefold, and of myocardial infarction twofold in an elderly population.8,9 Although patients with pseudohypertension do have excessive atheromatosis of the vascular tree, their intraarterial pressure may be normal.

Clinical consequences arising from such spurious elevation of arterial pressure are most important. Subjects misdiagnosed as having essential hypertension may be subjected needlessly to the inconvenience, cost, risk, and adverse effects of antihypertensive treatment. Elderly hypertensive patients have been reported to be particularly susceptible to the adverse effects of antihypertensive drugs.10 Could part of this susceptibility be due to the fact that arterial pressure is often overestimated and therefore overtreated in this age group because of the concomitant or sole presence of pseudohypertension? Not surprisingly, inappropriate antihypertensive therapy in the elderly has been shown to lead to transient ischemic episodes as well as to more severe, even fatal neurologic events.11-13

Patients who have pseudohypertension have lower arterial compliance than those with true hypertension, despite a similarity in intraarterial pressures. This would indicate that the reduction of arterial compliance in pseudohypertension was the result of risk factors other than the arterial pressure. Indeed, serum cholesterol levels were somewhat higher in our Osler-positive than in our Osler-negative subjects. The observed correlation between the degree of pseudohypertension (difference between cuff pressure and intraarterial pressure) and arterial compliance indicates that pseudohypertension becomes progressively more severe as arterial compliance decreases or as sclerosis of the arterial tree progresses. The presence of pseudohypertension does not, of course, rule out true hypertension, since both entities can coexist in the same patient. Osler’s maneuver is a simple clinical tool that allows the physician to differentiate patients with true hypertension from those with a spurious elevation of blood pressure.

## Table 3. Systemic Hemodynamic Findings and Indexes of Arterial Compliance in 13 Osler-Positive and 11 Osler-Negative Patients with Hypertension.

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<thead>
<tr>
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<th>OSLER-POSITIVE</th>
<th>OSLER-NEGATIVE</th>
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<tbody>
<tr>
<td>Heart rate (bpm)</td>
<td>80.2±14.9</td>
<td>79.1±11.9</td>
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<tr>
<td>Cardiac output (liters/min)</td>
<td>5.2±1.5</td>
<td>5.6±1.3</td>
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<td>Cardiac index (liters/min/m²)</td>
<td>3.1±0.7</td>
<td>3.3±0.7</td>
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<tr>
<td>Stroke volume (ml)</td>
<td>65.9±19.1</td>
<td>72.2±15.8</td>
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<tr>
<td>Total peripheral resistance (U)</td>
<td>23.7±8.5</td>
<td>22.1±9.1</td>
</tr>
<tr>
<td>Mean left ventricular ejection rate (U)</td>
<td>209.3±60.1</td>
<td>212.6±55.8</td>
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<tr>
<td>Left ventricular stroke work (U)</td>
<td>156.4±40.9</td>
<td>153.0±40.7</td>
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<tr>
<td>Plasma volume (ml)</td>
<td>2802.7±669.2</td>
<td>2498.0±575.8</td>
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<tr>
<td>Pulse-wave velocity (m/sec)</td>
<td>12.7±4.0</td>
<td>8.1±1.5</td>
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<tr>
<td>Diastolic-pressure decay (ml/mm Hg)</td>
<td>1.6±0.6</td>
<td>2.0±0.8</td>
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*P<0.01.
†P<0.01 as compared with Osler-positive patients.

## References

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