

## CLINICAL PRESENTATION AND RADIOLOGY QUIZ QUESTION

A 53 year old man with a history of hypertension presents with bilateral lower extremity pain and weakness. The patient is a smoker with at least a 40 pack-year history. His blood pressure is 122/84 (he is on medication for his hypertension), his pulse is 80, his temperature is 98.6, and his respiratory rate is 20. Upon examination of his lower extremities, he has no clubbing, cyanosis, or edema. He has decreased strength in both legs. Deep tendon reflexes are +2 bilaterally at the patella. He reports that his leg pain and weakness become worse with walking. The patient is also an alcoholic with a history of Vitamin B12 deficiency, and has had intermittent bouts of low back pain.

Which of the following studies is the best first step in evaluation of this patient's bilateral leg pain which worsens with walking, and why?

- (a) plain films of the lower extremities to evaluate for stress fractures
- (b) computed tomography (CT) angiography from the diaphragm through the ankles (CT "runoff" study) to evaluate the lower extremity vascular tree
- (c) ankle-brachial index to evaluate the lower extremity vascular tree
- (d) magnetic resonance (MR) imaging of the lumbar spine to evaluate for spinal stenosis

## RADIOLOGY QUIZ QUESTION, ANSWER, AND EXPLANATION

A 53 year old man with a history of hypertension presents with bilateral lower extremity pain and weakness. The patient is a smoker with at least a 40 pack-year history. His blood pressure is 122/84 (he is on medication for his hypertension), his pulse is 80, his temperature is 98.6, and his respiratory rate is 20. Upon examination of his lower extremities, he has no clubbing, cyanosis, or edema. He has decreased strength in both legs. Deep tendon reflexes are +2 bilaterally at the patella. He reports that his leg pain and weakness become worse with walking. The patient is also an alcoholic with a history of Vitamin B12 deficiency, and has had intermittent bouts of low back pain.

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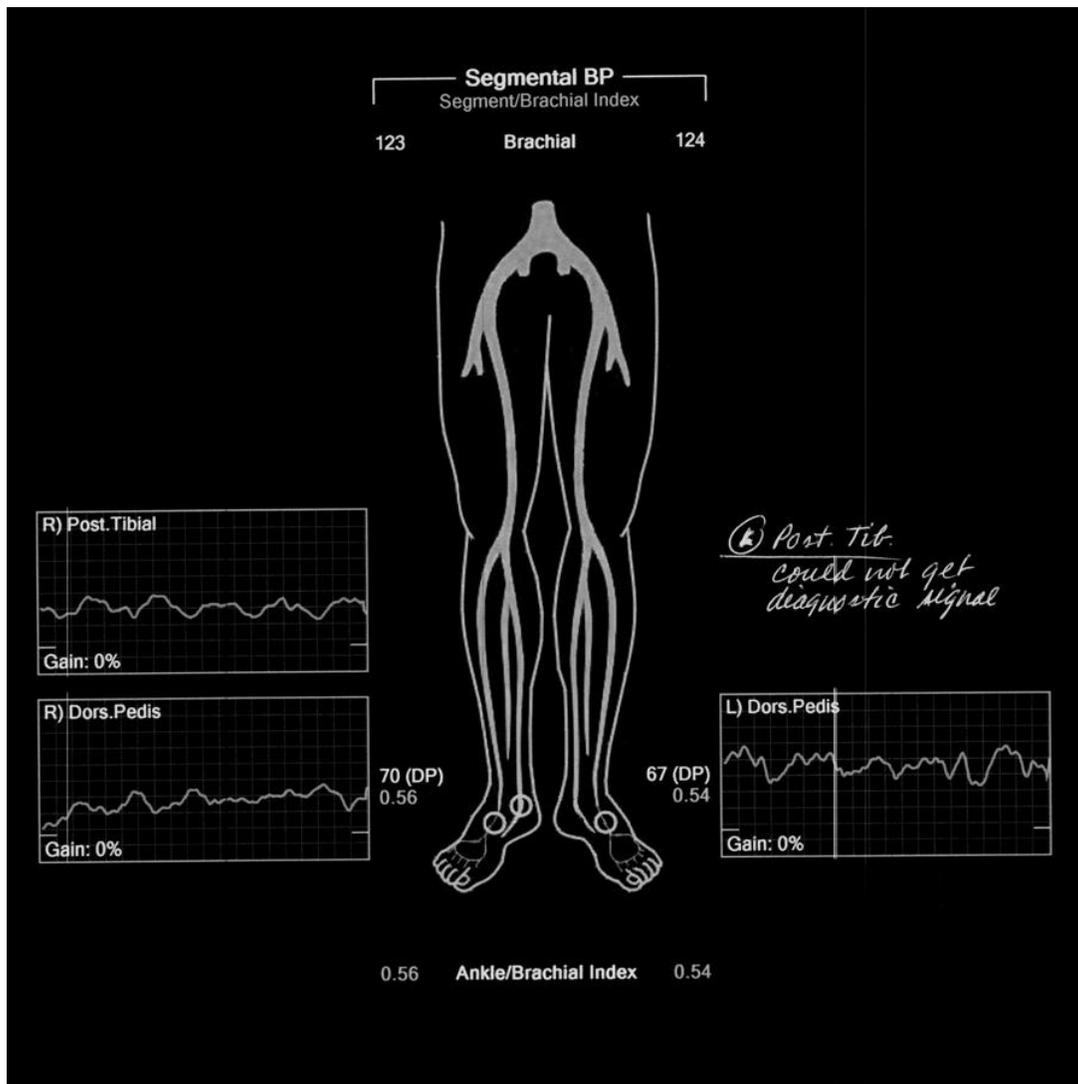
- (a) plain films of the lower extremities to evaluate for stress fractures
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Ankle-brachial index to evaluate the lower extremity vascular tree (c) is the best first step to evaluate bilateral lower extremity pain with walking in this patient, and therefore (c) is the correct answer. The ankle-brachial index is calculated for each lower extremity by taking the peak systolic pressure at the level of the ankle (either the posterior tibial or dorsalis pedis artery) and dividing this by the higher of the two arm pressures.

Plain films of the lower extremities to evaluate for stress fractures (a) might be reasonable in a younger patient who did not have a history of hypertension or smoking and who had a history of avid exercise or an occupational factor causing abnormal repeated lower extremity stress. In this case, however, arterial vascular disease is far more likely to be the cause of his leg pain and weakness, and (a) is incorrect. A CT "runoff" study, given the cost, radiation exposure, and necessity of contrast injection, is probably better done *after* rather than *before* the ankle-brachial index, and (b) is incorrect. Spinal stenosis may cause neurogenic claudication with pain and weakness of the lower extremities, but, especially given the patient's history of hypertension and smoking, is far less likely to be the cause of his symptoms than is lower extremity arterial disease, and the lumbar MR should be done *after* rather than *before* an ankle-brachial index, so (d) is incorrect.

## IMAGING STUDY AND QUESTIONS

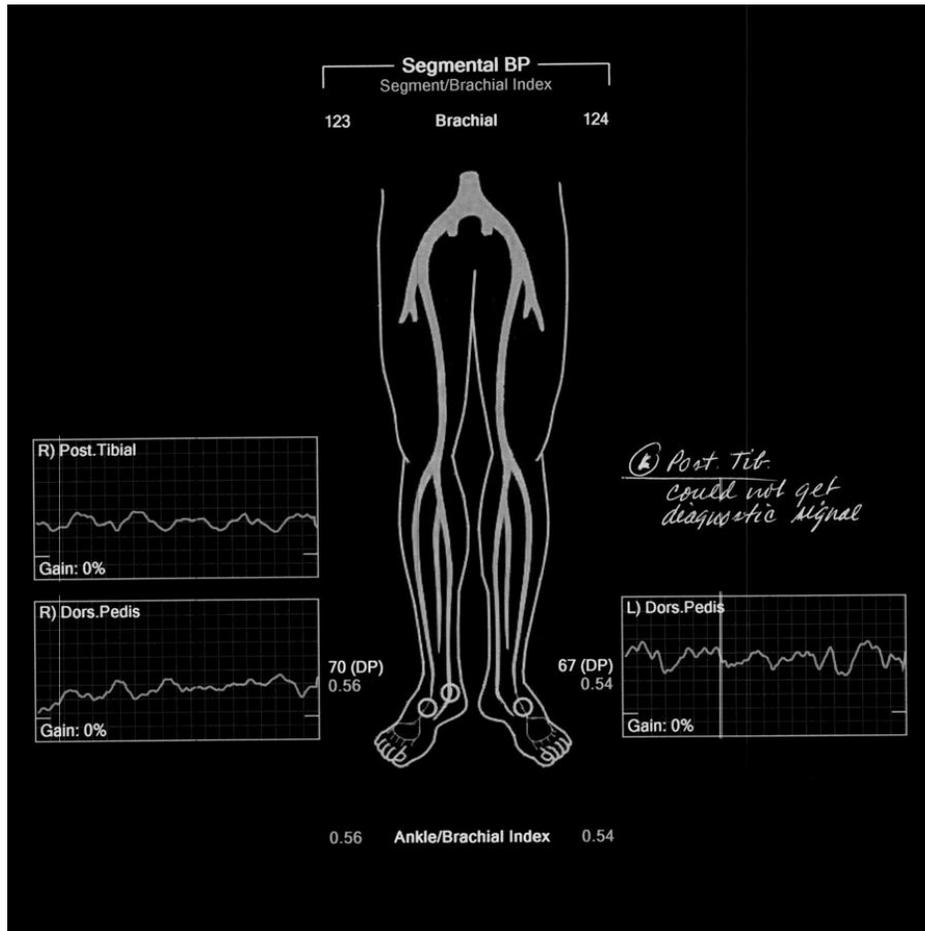
The patient underwent a diagnostic test:



Imaging questions:

- 1) What type of study is illustrated?
- 2) Are there any abnormalities?
- 3) What is the most likely diagnosis?
- 4) What is the next step in management?

## IMAGING STUDY QUESTIONS AND ANSWER

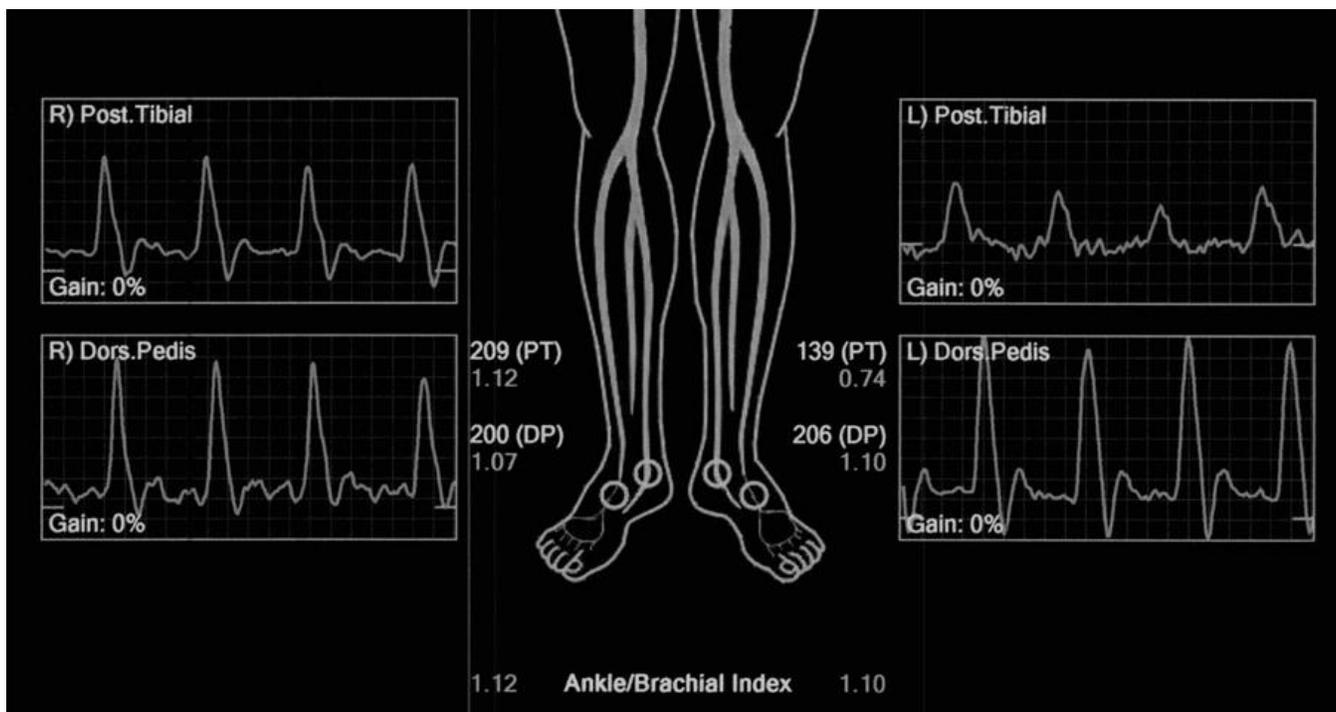


### Imaging questions:

- 1) What type of study is illustrated? An ankle brachial index examination.
- 2) Are there any abnormalities? Yes. The lower extremity ankle brachial index is bilaterally abnormally decreased (normal is greater than 1.0, with 0.9 to 1.0 considered borderline). Readings of less than 0.85 generally correspond with moderate arterial impairment. In addition, the wave forms are abnormal, being weakly biphasic.
- 3) What is the most likely diagnosis? Atherosclerotic vascular disease of the lower extremity arteries causing ischemia during ambulation.
- 4) What is the next step in management? Referral to a vascular surgeon or interventional radiologist for further evaluation for possible revascularization.

## PATIENT DISPOSITION, DIAGNOSIS, AND FOLLOW-UP

The patient was referred to a vascular surgeon. A diagnostic arteriogram was performed. Access to the abdominal aorta was not possible from the usual groin/femoral artery approach, and the arteriogram was performed from the left brachial artery. The aorta was occluded below the renal arteries. The common iliac arteries and external iliac arteries were also occluded. The internal iliac arteries were reconstituted via lumbar and superior mesenteric artery collaterals. The femoral arteries were open. Bilateral aortic-bifemoral bypass grafts were placed. Although the patient had transient renal insufficiency following the procedure, his renal function gradually returned to normal. The patient recovered from surgery well and his lower extremity pain and weakness were eliminated. A follow-up ankle-brachial index study was performed:



Ankle brachial index study (image is cropped) on a 53 year old man following revascularization surgery for bilateral lower extremity disease (for a pre-procedure study, see page 3). The ankle brachial index has improved from abnormal values on the pre-operative study to normal values of greater than 1.0 on this study. In addition, the wave forms are now triphasic (at least in the right posterior tibial, right dorsalis pedis, and left dorsalis pedis vessels).

## SUMMARY

**Presenting symptoms:** Bilateral leg pain may have a variety of causes including arterial insufficiency, deep venous thrombosis, venous insufficiency, bilateral stress fractures, other bilateral musculoskeletal injury, arthritis, and spinal lesions. Imaging evaluation needs to take into account other clinical factors such as the patient's age, history of injury, history of smoking, history of hypertension, history of arterial disease elsewhere (stroke, heart attack, and renovascular hypertension).

**Imaging work-up:** In this case, ankle brachial index examination was performed. In the ankle brachial index examination, the blood pressure at the level of the ankles is compared to the blood pressure in the arms. In a normal subject, this ratio should be greater than 1.0. The ankle brachial index does not necessarily require any imaging equipment, but a Doppler probe can be useful in not only obtaining the pressures but also in documenting the arterial wave form pattern. Ankle brachial index examination is generally a good first choice for evaluation of suspected lower extremity ischemic symptoms in a non-emergent setting, since it is relatively low-cost and involves no radiation exposure or injection of contrast material. It is probably best to leave the decision of whether to perform CT angiography, MR angiography, or to proceed to a catheter study which may allow both diagnosis and therapy at the same time to the health care provider responsible for revascularization.

**Establishing the diagnosis:** While an ankle brachial index of less than 0.9 has a high positive predictive value for lower extremity arterial occlusive disease, an imaging study (CT, MR, or catheter angiography) is generally required to document the level and severity and plan intervention in those patients who are candidates for revascularization.

**Take-home message:** In patients with lower extremity pain who are suspected to have arterial disease (for example, those with hypertension, those who are smokers, and those who have arterial disease elsewhere), ankle brachial index examination is a good first step in evaluation of the lower extremity arterial supply. For those patients who are candidates for revascularization, it makes sense to leave the decision of which additional study to perform (for example, CT or MR angiography versus catheter studies) to the health care provider who will be performing revascularization.

## FURTHER READING

Mohler ER. Noninvasive vascular diagnosis in lower extremity peripheral arterial disease. UpToDate, accessed 11/23/09.

Renfrew, DL. Vascular imaging. Chapter 12 of *Symptom Based Radiology*, Symptom Based Radiology Publishing, Sturgeon Bay, WI, 2010, available for no charge at [www.symptombasedradiology.com](http://www.symptombasedradiology.com).