Editor's Note

Teaching Proper Cardiovascular Physical Diagnosis

Key words: cardiovascular physical diagnosis

Introduction

At the recent American College of Cardiology Annual Scientific Session in Orlando, Florida (March 2005), I was approached by a colleague, Clarence J. Vincent, M.D., a practicing physician in Cum-

berland, Maryland. He asked me (as Editor-in-Chief of *ACC*) why we don't discuss teaching proper cardiovascular physical diagnosis. He reminded me that Proctor Harvey spent a lifetime teaching these skills to students, residents, fellows-in-training, and colleagues both junior and senior. This editorial is written to remind all of us that we should continue that tradition, despite several impediments to doing so.

Some have made the argument that modern noninvasive imaging techniques can assess anatomy, physiology, and pathology and are so readily available that it is no longer necessary to be skilled in physical diagnosis. Six imaging techniques come easily to mind:

1. the electrocardiogram at rest and during stress to assess myocardial ischemia;
2. the chest x-ray to assess cardiac size and pulmonary congestion;
3. cardiac and peripheral vascular ultrasound to assess anatomy, physiology, and pathology of cardiac and vascular structures;
4. nuclear studies to assess myocardial ischemia and ventricular function;
5. contrast computed tomography to assess coronary artery disease and pulmonary emboli;
6. magnetic resonance imaging to assess cardiac structure and function.

There is no doubt that the cardiologist needs these noninvasive tests to practice modern cardiology with some degree of precision. However, these investigations should be used to confirm, refute, and quantitate the clinical impression derived from the history and physical exam, not as a substitute for the history and physical. Many of the diagnostic procedures listed above are performed for little or no clinical reason. The classic example is the patient sent for cardiac ultrasound because of a "murmur" with no diagnostic impression. This type of behavior leads to the dilution of physical exam skills by undue reliance on noninvasive testing.

Cardiac Diagnosis

In an editorial in 1997 entitled, "The Stethoscope: The Forgotten Instrument in Cardiology," I commented that proper ex-

amination of the heart is not a casual event.¹ It requires a quiet room with the patient and the physician in comfortable positions. Cardiac auscultation is one of the cornerstones of cardiac diagnosis since it is essential to the diagnostic process—the process being the history, the physical, the chest x-ray, the electrocardiogram, and the other diagnostic tests such as cardiac ultrasound, and so forth. The five finger approach of Dr. Proctor Harvey is the best way to come up with at least a working cardiac diagnosis.

Bedside Teaching

In 2005, medical students, housestaff, and fellows in cardiovascular training are not learning the simple skills of cardiac physical exam on the inpatient ward services. Part of the reason relates to noise and difficulty examining the patients. During rounds on the inpatient services, televisions are blaring, i.v.'s are beeping, alert systems are going off regularly, and the patient's chest is obscured by wires measuring continuous electrocardiograms—and that is in the patient who is not critically ill or recovering from cardiac surgery. In another editorial entitled, "Quiet! Hospital Zone," I commented that inpatient services in hospital should convey the atmosphere of a church rather than that of video game arcades.² These obstacles can be overcome, but they remain part of the reason teachers are discouraged from trying to demonstrate the examination of the patient. It is much easier to teach this technique in the outpatient setting.

Modern Teaching Technology—Example of a Tutorial

There is no substitute for bedside teaching, but there are some teaching aids that are quite wonderful and can be used to integrate all aspects of cardiovascular diagnosis.³ Modern technology can incorporate not only physical examination findings, but physiology, anatomy, and the pathology responsible for the physical findings. While writing this editorial, I accessed www.blaufuss.org, a website that contains a tutorial as well as a heart sounds quiz. The heart sound tutorial focuses on the four most common valvular lesions of the left heart, that is, aortic regurgitation, aortic stenosis, mitral regurgitation, and mitral stenosis. The authors of this teaching device are Dr. Richard Wong and Dr. John Michael Criley of Harbor—UCLA Medical Center. This tutorial allows the user to examine actual patients with the above lesions. By moving a virtual stethoscope over the chest, the examiner can listen to the heart at several listening locations and simultaneously see a video of pulsations in the patient's neck, precordium, or extremities. These findings are also explained with a simple text and illustrated with phonocardiograms, hemodynamic data, and computer animations. There is no doubt in my mind that this is much better than sitting in a dark room listening to heart sounds without any other input.

Normal Cardiac Anatomy

The Criley tutorial begins with an elegant display of the frontal anatomy of the chest going from back to front. This illustration is so well done that the complex anatomy of the heart is easily understood. For example, many physicians do not recognize that the left atrium is the most posterior portion of the heart. One needs to see this moving cartoon to best appreciate it, but study of this series of pictures imparts better understanding of where the pulmonary veins, left atrium, left ventricle, aorta, right atrium, right ventricle, pulmonary arteries, and ribs sit in relation to one another.

Criley then, in a cartoon, illustrates the cardiac cycle showing pressures of the left ventricle, aorta, and left atrium, as well as the phonocardiogram in the normal heart. At the same time, a cartoon illustrates the contraction of the heart, the opening and closing of the aortic valve, and the opening and closing of the mitral valve. This is all illustrated with the electrocardiogram as well as the right heart pressures.

Pathologic Conditions

Aortic Insufficiency. In the teaching exercise on aortic insufficiency, a cartoon of aortic pressure and the cardiac sounds and murmurs is demonstrated and compared with normal. The phonocardiogram shows the systolic and the diastolic murmur in relation to the carotid pulse tracing. In addition, there is an illustration of the carotid pulse, which is quite prominent and bounding (Corrigan's pulse). Blanching and reddening of the lightly compressed nail bed (Quincke's pulse) is also demonstrated. Palpation of the apex reveals displacement of the apical impulse in the axillary line, and, in the patient presented, a mid-diastolic murmur that sounds like mitral stenosis without an opening snap is shown (Austin-Flint).

Aortic Stenosis. The first part of the illustration for aortic stenosis is the demonstration of the slow rising and narrow pulse pressure of aortic stenosis, (pulsus parvus and pulsus tardus). The carotid pulse and its upstroke reflect what is transpiring in the heart, namely, a very slow-rising pressure and a slow-rising and slow-falling apical impulse consistent with obstruction of the aortic valve. There are several illustrations of the physiology, phonocardiography, heart sounds, and murmurs in this presentation of aortic stenosis. These findings are compared with normal cardiac function and the normal cardiac cycle, so that the learner can easily see some of the differences.

Mitral Insufficiency. The cartoon illustrating mitral insufficiency shows the holosystolic nature of the murmur—that is, it begins with the first heart sound and ends with the second heart sound. In the illustration provided, there is a third heart sound that frequently accompanies severe mitral regurgitation in the setting of normal left ventricular function.

Mitral Stenosis. Mitral stenosis is not common in 2005 in the United States, but is quite common throughout the world. The illustrations provided are unique. They allow the learner to listen to the first and second heart sounds, opening snap, de-

crescendo, rumbling diastolic murmur, presystolic accentuation, and a loud first heart sound. In addition, the viewer can separate the different phases of the cardiac cycle, eliminating the murmur, and so forth. This imparts a good feel and understanding of the auditory aspects of mitral stenosis. The physiology of this condition is illustrated with left ventricular and left atrial pressure curves showing the diastolic pressure difference occurring after the opening of the mitral valve (opening snap) and prior to closure of the mitral valve (first heart sound).

Heart Sound Quizzes

The heart sound quizzes provided allow visitors to test themselves before and after they have had instruction. This is done with a virtual stethoscope, but in a more sophisticated version of this testing, there are palpators and stethoscopes that one can apply to auscultate the sound, allowing integration of the pulse with sounds and murmurs.

Conclusion

Of course, there is no substitute for examining the patient, but these modern teaching tools have provided an opportunity to emphasize the importance of the cardiovascular physical exam. Demonstrations of carotid pulse, apical impulses, cardiac cycle physiology, heart sounds and murmurs are shown in patients with all four conditions. Illustrations of the opening and closing of the mitral and aortic valves along with contraction of the ventricle are shown in all these examples. In addition, one can manipulate the phonocardiogram to hear the heart sounds with or without murmurs. One can then add the murmurs and extra sounds, for example, the opening snap, and get a clear understanding of the sounds that one must evaluate. This teaching tool allows the learner to see the heart contract, the valves open and close, blood flow across obstructive valves and leaks across incompetent ones. The learner has the opportunity to view the physiologic events of the cardiac cycle and hear the heart sounds and murmurs simultaneously. Since the cardiovascular system easily lends itself to bedside physiologic diagnosis, I am convinced that using this technology will improve bedside examination of patients because the examiner will have a better understanding of the underlying physiopathology responsible for the physical finding.

This technology is a wonderful investment for anyone teaching this subject.

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References

1. Conti CR: The stethoscope: The forgotten instrument in cardiology? *Clin Cardiol* 1997;20(11):911–912
2. Conti CR: Quiet! Hospital zone. *Clin Cardiol* 2004;27:251–252
3. Conti CR: Cardiovascular diagnosis: What is the best way to teach this complex subject? *Clin Cardiol* 1996;19(3):163