The Functional Heart Murmur: A Wastebasket Diagnosis

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It is extremely helpful for the examiner to separate murmurs of nonorganic origin into one of two categories. The innocent heart murmur group defines five specific entities: the pulmonary systolic murmur, the vibratory systolic murmur, the supraclavicular systolic murmur, the mammary souffle, and the venous hum. All other nonorganic murmurs are classified as functional, and are produced by a clinically recognizable alteration in anatomy and/or physiology affecting the circulatory system. This paper discusses each category and provides information regarding bedside diagnosis of selected murmurs.

A physician often identifies a heart murmur during a routine physical examination. When the sound is due to an acquired or congenital pathological abnormality, the examiner is usually able to recognize its genesis. However, the physician is most frequently presented with a cardiovascular murmur which is an isolated finding, or which simply may not fit in with the other data observed at the bedside. It is in just such a setting that the examiner is most inclined to explain this finding on a functional or innocent heart murmur basis. Once the murmur is assigned this label, physicians at all levels of training and practice tend to show little interest in the further definition and analysis of the sound.

Perloff describes a cardiovascular murmur as a "relatively prolonged series of auditory vibrations that can be characterized according to intensity (loudness), frequency (pitch), configuration (shape), quality, duration, direction of radiation, and timing in the cardiac cycle."[1] When a murmur is so defined and characterized, and when it is considered in the context of "the company it keeps" (ie, clinical history, positive and pertinent negative physical findings, chest x-ray, and electrocardiogram), the physician is almost always able to diagnose the murmur accurately.

It is extremely helpful, even essential, to acknowledge that a genuine difference does exist between a functional and an innocent heart murmur. A functional murmur is invariably associated with certain clinically recognizable alterations affecting the anatomy and/or physiology of the circulatory system. The innocent murmur is not. The latter is genuinely harmless and should always imply a favorable prognosis. Using this line of reasoning, there are very few clinical situations in which the physician is presented with an innocent heart murmur. The functional murmur, on the other hand, is associated with a multiplicity of benign, and sometimes not so benign, pathophysiologic states.

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Innocent Heart Murmurs

There are five murmurs which comprise the innocent heart murmur group[1-3] (Table 1). Each murmur has unique and clearly identifiable clinical features. In addition, they are either systolic or continuous in timing, and are never confined to diastole alone.

The *pulmonary systolic murmur*[1] has its genesis in the pulmonary trunk. It is commonly observed in late childhood, adolescence, and in the young adult during pregnancy. It is best heard in the left second intercostal space, in the supine position, and its intensity increases on held expiration. It is usually of Grade 3 or less intensity, varies in frequency, and is confined to early and mid-systole, most often reaching its peak within the first half of systole. It may migrate toward the left clavicle. There is no associated ejection sound and splitting of the second sound is physiologic.

The *vibratory systolic murmur*[2] occurs almost exclusively in childhood; its highest incidence is noted between the ages of three and ten years. It is typically a Grade 3 or less, medium frequency, vibratory sound, confined to the first half of systole. It is best appreciated parasternally at the left third and fourth intercostal space, but may also be audible at the apex. It does not radiate widely or predictably and has a tendency to increase in intensity following exercise. Splitting of the second sound is physiologic and there is no associated ejection click. Patients with this murmur who have been followed for many years demonstrate a benign cardiovascular course.[2,3] This murmur disappears when adulthood is reached.

The *supraclavicular systolic murmur*[2] is typically confined to the right or left supraclavicular areas. However, on occasion it may migrate inferiorly, and is audible at the right or left second intercostal space. In this latter instance, it must be differentiated from aortic and pulmonic stenosis or an atrial septal defect. Characteristically, the murmur occurs in early to mid-systole, is harsh and may reach Grade 4 intensity. In the latter instance, it is associated with a thrill which is typically confined to the right supraclavicular fossa. Hyperextension of the arms, thus compressing the subclavian artery against the first rib, will attenuate or abolish the murmur. This is a useful differential bedside maneuver.

The genesis of the *mammary souffle*[2] is thought to be arterial. It is associated with pregnancy, lactation, and the early postpartum period. It may be audible to the right or left of the sternum and anywhere from the second to sixth intercostal spaces. The

murmur is either continuous or systolic, and when continuous the systolic component is more readily appreciated. It is typically described as a harsh murmur, variable in intensity, and confined to the higher frequencies. If the murmur is continuous it must be distinguished from a patent ductus arteriosus. If it occurs in systole alone other congenital and acquired pathological lesions must be considered. Specific bedside maneuvers may help the examiner in this differential. The mammary souffle is more intense in the supine position and usually diminishes or disappears completely when the patient assumes the upright position.[2] Local compression over the area of the sound usually attenuates or obliterates the murmur. Also, there is frequently cycle-to-cycle and day-to-day variation in the intensity and duration of the murmur.[2,3] Termination of the pregnancy or lactation results in eventual disappearance of the murmur.

Table 1. Innocent Heart Murmur Group

Pulmonary systolic murmur
Vibratory systolic murmur
Supraclavicular systolic murmur
Mammary souffle
Venous hum

The most common innocent murmur is the *venous hum.*[1-3] It is common in childhood and a hyperdynamic state is suggested when this hum is observed in an adult. The murmur is typically continuous, the diastolic component being the louder. It varies in intensity, rarely may even reach Grade 6, and may be audible either above or below the clavicles. When appreciated below the clavicles it is sometimes confused with the murmur of patent ductus arteriosus. Lateral rotation and extension of the head away from the side being examined tends to accentuate the murmur.[2] The sound diminishes or completely disappears during a Valsalva maneuver, return of the head to the normal

Table 2. Comparative Physical Findings: Innocent Heart Murmur Group

Characteristics	Pulmonary Systolic	Vibratory Systolic	Supraclavicular Systolic	Mammary Souffle	Venous Hum
Origin	Pulmonary trunk	Pulmonary valve	Brachiocephalic large arteries	Arteries of breast	Brachiocephalic large veins
Intensity (grade)	3 or less	3 or less	3 or less, rarely 4 in R supraclavicular fossa	3 or less	Variable, rarely may be 5 or 6
Pitch	Medium – high	Medium	Variable	High	Variable
Timing in cardiac cycle	Early to mid-systolic	Early to mid-systolic	Early to mid-systolic	Systolic or continuous with systolic component ↑	Systolic or continuous with diastolic component ↑
Radiation	L clavicle	No specific pattern	R and L 2nd ICS	No specific pattern	R and L 2nd ICS
Maximum Intensity	L 2nd ICS	L 3rd, 4th ICS, parasternally	R supraclavicular fossa	Variable	Variable, may be loudest below clavicles
Specific identifiable characteristics	physiological split S-2 no ejection sound best heard with diaphragm ↑—supine and on held inspiration	physiological split S-2 no ejection sound best heard with bell ↑—supine and after exercise	no ejection sound ↑R supraclavicular fossa ↓ or abolishes murmur on hyperextension of arms	no ejection sound ↑ supine or with light pressure over site of sound ↓ or abolishes in upright position or with firm pressure over site of sound	no ejection sound ↑ head rotated laterally away from site of ausculation ↓ or abolishes with Valsalva or pressure over vein of origin
Differential diagnosis	Pulmonic stenosis Atrial septal defect	Atrial septal defect	Aortic stenosis Pulmonic stenosis	Patent ductus arteriosus Mitral and pulmonary valvular lesions	Patent ductus arteriosus

position, or direct pressure over the vein of origin.[2,3] Table 2 compares the characteristics of the innocent heart murmur group.

Functional Heart Murmurs

An accurate and comprehensive classification of functional heart murmurs invariably results in a long list of dissimilar clinical situations. This is precisely why the physician so often encounters difficulty in assigning this finding to a specific diagnostic category. This results in the entry "functional heart murmur" on the problem list, with no further definition or explanation. It must be re-emphasized that a functional murmur is associated with some alteration in the anatomy or physiology affecting the circulatory system, or it may be the indirect result of a specific pathological abnormality. This is an extremely important axiom to keep in mind. It should be apparent that these murmurs must be very common and may occur in all phases of the cardiac cycle. A few specific examples may serve to reinforce and amplify this.

A significant loss of kyphosis of the dorsal spine,[4] a severe pectus excavatum[1] and idiopathic dilatation of the pulmonary artery,[2] may result in these observations at the bedside: (1) a palpable impulse in the left second intercostal space, (2) an ejection sound in systole, and (3) an early mid-systolic ejection murmur. They result from alterations in the anatomy and physiology of the circulatory system which attend these conditions, ie, the change in the orientation of the heart and great vessels within the thoracic cage, and the altered ejection and flow characteristics of blood pumped from the normal right ventricle into a dilated pulmonary artery. The triad suggests pulmonic stenosis or an atrial septal defect. However, the absence of a right ventricular parasternal lift, the existence of a normal ECG and the physiologic splitting of the second heart sound favor a functional basis for the murmur.

There are numerous clinical situations in which the cardiac rate and/or output are varied.[1,3] These may so affect the dynamics of blood flow through the cardiac chambers and great vessels that a systolic ejection murmur is produced. Fever, tachycardia, bradycardia, hyperthyroidism, pregnancy, and anemia are examples of causes of this phenomenon.

Traditionally, we are taught that diastolic murmurs should suggest an organic lesion. However, there are murmurs audible only in diastole which have a genuine functional basis and are the result of another associated primary cardiac defect. The following two examples will support this notion.[5,6] Moderate to severe rheumatic mitral regurgitation may have associated diastolic sound phenomena. A third heart sound and a mid-diastolic rumble are commonly audible. Rarely, an opening snap may be appreciated. These cardiovascular sounds are the result of alterations in the flow of blood from the left atrium into the left ventricle during early to mid-diastole in the setting of moderate to severe mitral insufficiency. When these findings are present, it is logical to suggest the diagnosis of organic mitral stenosis. It is extremely important to differentiate the latter from the former situation. The Austin Flint murmur is a low-frequency, apical diastolic rumble associated with moderate to severe aortic insufficiency. In this instance, antegrade flow across the mitral valve and regurgitation of blood across the aortic valve are both required to create the murmur. Again, the examiner must distinguish this from organic mitral stenosis.

Comment

Additions to this list could go on and on. The message here is obvious. The ease and accuracy of identifying the origin of a heart murmur depend upon a physician's factual data base, experience in auscultation, and developed clinical judgment. We must carefully define a so-called nonorganic murmur. If the diagnosis is innocent heart murmur, a specific clinical profile and favorable long-term prognosis are implied. A functional murmur, on the other hand, is categorized and defined by the altered anatomical and pathophysiological state producing it. This should be recognized clinically. If a murmur is not explained by either of these lines of reasoning, perhaps the physician should re-assess his/her clinical findings and analysis, for the murmur may, in fact, have an organic basis (consider the late systolic click, late systolic murmur syndrome[7] that was, until just recently, considered innocuous). For the beginning student of clinical medicine as well as the practicing physician who must continually work at maintaining and improving his/her skills in the identification and interpretation of physical findings, attention to clinical detail at the bedside remains paramount.

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