Clinical Aspects of Gallop Rhythm with Particular Reference to Diastolic Gallops

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Gallop rhythm represents one of the most important but still very confused aspects of clinical auscultation of the heart. Most gallop rhythms are unrecognized or misinterpreted. This is unfortunate because a gallop, depending on the type, often represents the earliest clinical evidence of congestive heart failure. After analyzing the various classifications of gallops1-21 we have used the following clinical classification which we consider physiologic, practical, and simple. Gallops are first divided into systolic and diastolic gallops (fig. 1).

The systolic gallop (or click) is an extra sound occurring in systole, generally best heard at the apex and usually representing a benign finding.7-8-18 Its exact etiology is not known, but in a number of cases appears to be extracardiac in origin. A few of the patients with this benign systolic sound have a past history of severe pneumonia, pleurisy, or less commonly empyema. One could speculate in such cases as to the possibility of adhesions contributing to this sound. The majority, however, have a completely negative history. In addition to this benign type of systolic sound there may be systolic sounds heard in conjunction with organic heart disease. For example, in aortic insufficiency a systolic sound may be heard at the apex, base, and peripheral arteries which has been termed a systolic ejection sound, "pistol shot," systolic click, or gallop.5, 6, 13, 14 When this is present (e.g., with aortic insufficiency) one usually has no difficulty in determining the presence of organic heart disease. In aortic insufficiency of a severe degree the first heart sound is often faint and the ejection sound is early, thereby at times causing confusion with the first heart sound. In addition, a systolic sound may likewise be heard over an enlarged pulmonary artery from any cause such as atrial septal defect, ventricular septal defect, pulmonic stenosis, primary pulmonary hypertension, idiopathic dilatation of the pulmonary artery, etc. We have found this sound commonly associated with enlargement of the pulmonary artery segment, and it is best heard over the pulmonic area or third left intercostal space rather than at the apex, as is the case with the benign systolic click or gallop. This sound occurring in systole has been termed an ejection sound, and as with the systolic sound produced with aortic insufficiency, it is probably produced by sudden filling of the pulmonary artery during ventricular systole. The finding of this systolic sound in association with organic heart disease does not of itself indicate a poor prognosis, but its presence may be a valuable auscultatory clue to the presence of a pulmonary artery enlarged from various causes, such as congenital heart disease.

Diastolic Gallops. After determining that the gallop occurs in diastole it must be further subdivided into 2 components, the atrial diastolic gallop and the ventricular (or third heart sound type) diastolic gallop (fig. 1). Further classification of the diastolic gallop in this manner is a necessity because the atrial gallop does not usually carry the same serious prognosis that is associated with the ventricular diastolic gallop.

Atrial Gallop. This gallop sound is related to atrial contraction and may occur in the absence of any evidence of cardiac decompensation. It is frequently heard when there is a delay in atrioventricular conduction and the P-R interval is prolonged (fig. 2 top). In

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1. SYSTOLIC GALLOP

![Graph showing systolic gallop]

2. DIASTOLIC GALLOP

![Graph showing diastolic gallop]

**Fig. 1. Upper Tracing.** Benign systolic gallop (or click) (**G**) in a 17-year-old girl with no heart disease. **Left Lower Tracing.** Atrial diastolic gallop (**G**) in patient with acute renal insufficiency. No failure. **Right Lower Tracing.** Ventricular diastolic gallop (**G**) in patient with arteriosclerotic heart disease, congestive failure, previous myocardial infarction.

such an instance one hears the atrial sound, the first heart sound (which is faint because of the prolonged P-R interval), and the second heart sound. Also, when the P-R interval is still within upper normal limits, an atrial gallop sound is sometimes heard (fig. 2 *middle*).

A patient has been observed who had an attack of acute rheumatic fever 20 years previously. No valvular deformity resulted, but a conduction defect in the form of first degree heart block persisted. An atrial diastolic gallop was often present, usually dependent on heart rate. It was usually best heard with a slight tachycardia in the range of 100. At no time had he ever shown any signs or symptoms of heart failure. His gallop, though diastolic, naturally has not represented one of poor prognosis. He had always been instructed to lead a normal life and not restrict his activities in any way.

Atrial gallop is frequently heard in hypertension (fig. 3) without prolongation of the P-R interval. This may be present before the onset of any heart failure, and in itself does not necessarily denote serious heart disease. Once failure ensues, however, the atrial gallop may persist, but now there appears the ventricular gallop (of third heart sound type), the gallop of heart failure (fig. 3 *top*). Why the atrial sound is accentuated with hypertension is unclear. Infrequently we have heard an atrial sound sometimes simulating a gallop rhythm in a perfectly normal heart.

**Ventricular (Third Heart Sound) Gallop.** This is the gallop which appears to be almost always associated with heart failure (figs. 3-6). It often occurs as the first sign that one can detect clinically of serious heart disease and cardiac decompensation. This gallop sound appears in the earlier part of diastole, later in timing than an opening snap, but at the same time as the physiologic third heart sound in children and youths (the basis for the term “third heart sound gallop”). The normal physiologic third sound, a common
finding in children and young adults, becomes less frequent in the years 20 to 30, after 30 still less common, and after 40 rare as a benign finding. As a rule, a sound with this timing in a person in his forties, fifties, and over, represents a ventricular diastolic gallop. The ventricular gallop is the most important as well as the most common type of gallop. The exact cause of this sound is a matter of debate at the present time, although we feel that it is probably related to movements of the A-V valves. The ventricular diastolic gallop is found commonly, if one searches for it, in the presence of congestive heart failure. It is more rare in patients with mitral stenosis, where, instead, the opening snap is heard. In fact, the presence of a ventricular diastolic gallop makes most unlikely the diagnosis of the uncomplicated "tight" mitral stenosis. The common denominator when a ventricular diastolic gallop is present, regardless of the etiology of heart disease, is congestive heart failure, and except in rare instances indicates a serious heart derangement.

Like all gallops, the ventricular diastolic is best heard in the apical region with the patient recumbent. At times it is better heard after slight effort when blood flow and heart rate are somewhat accelerated. However, a gallop sound occurring at a slow rate has the same significance as if it were heard at a fast rate. A gallop is a gallop, regardless of the ventricular rate. The majority of ventricular diastolic gallops are faint, being of low frequency, and are therefore commonly overlooked. To hear it, one must listen specifically for this sound in early diastole, using the bell of the stethoscope with very light pressure, just making an air seal with the skin over the precordium. If the normal amount of pressure is applied, the extra sound may be greatly decreased or even become inaudible. The area where the gallop is best heard is generally along the lower left sternal border or apex, with the patient lying recumbent or turning to the left lateral position. Often listening while the patient is turning from flat to the left lateral position, or having the patient cough 5 or 6 times, may "bring out" this faint gallop sound. If the patient has any degree of emphysema or an increase in anteroposterior diameter of the chest, it should be kept in mind that auscultation over the xiphoid process or just under the ribs at the attachment of the diaphragm may be advantageous. With such a patient, having him sit up and lean forward may also serve to bring the faint sounds closer to the stethoscope. Using these technics, one can train himself to detect this faint gallop sound at lower heart rates. The same gallop with a sinus tachycardia (e.g., 110 to 120) is usually easily heard, whereas at a rate of 70 may be poorly heard unless one mentally "tunes in" on this low frequency sound and uses these technics.

Fig. 2. Three patients with atrial gallop. Upper Tracing, Male, (52 years old) with anemia and first degree block (P-R 0.25 sec.). Note atrial gallop (G), faint first sound (S₁) and split second sound (S₂). Middle and Lower Tracings. Atrial gallop (G), with P-R intervals 0.20 second and 0.16 second respectively.
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AURICULAR AND VENTRICULAR DIAST. GALLOPS

VENT. DIAST. GALLOP—A.S.H.D., CONG. FAILURE

Fig. 3. Upper Tracing. Man with malignant hypertension and congestive failure. Blood pressure 280/160. Died 3 months later. Note atrial gallop (A.G.) preceding first sound ($S_1$) and ventricular gallop ($V.G.$) after second sound ($S_2$). Lower Tracing. Ventricular diastolic gallop ($G$) in male with arteriosclerotic heart disease and advanced congestive failure. Breath sounds ($X$) related to patient’s dyspnea. Died several weeks later.

The importance of paying attention to this sound was first emphasized to us a number of years ago when we had the opportunity of following a large number of patients in the older age groups, before, during, and after various surgical procedures. We quickly learned that on examining patients prior to surgery, those having a ventricular diastolic gallop, even in the absence of other signs of cardiac decomposition, represented a “key group” which were prone to develop pulmonary edema or evidence of cardiac decompensation during or after the surgical procedure. By preparing preoperatively with digitalization, salt restriction, and mercurial diuretics, they were usually able to withstand their operation without any difficulty.

Prognosis of Ventricular Diastolic Gallops. There is no clear cut evidence to date as to the life expectancy once a gallop of this type is detected. In the past prognosis usually has been related to a gallop occurring in diastole, without specifying whether it is atrial or ventricular. As has been previously emphasized, the prognosis depends on the type of gallop present. It is obvious that a systolic click (or systolic gallop) and the atrial diastolic gallop in the absence of failure, do not carry the grave prognosis of ventricular diastolic gallop. We are at present in the process of studying the life expectancy of a large number of patients observed over the past 8 years where this type of classification has been used and the faint type of diastolic gallop has been carefully searched for. Although our figures are not completed at the present time, it appears that the prognosis after finding such a gallop will be approximately 3 to 5 years.

There are some points worthy of discussion concerning prognosis of ventricular diastolic gallops. The louder the gallop, the poorer the prognosis. In general, this statement appears to correlate well with a decrease in life expectancy, particularly if there is a persistence of the gallop rhythm despite adequate medical treatment. For example, it is relatively common to hear a ventricular diastolic gallop following an acute myocardial infarction during the early acute stages. In the usual case, with the passage of time (several days to several weeks) the gallop sound may disappear. However, when it is particularly loud and persists after the acute episode, it generally is associated with permanent heart damage and chronic failure, and thus represents the poorer prognosis. The patient may have an acute myocardial infarction and a ventricular diastolic gallop coincident with the attack, and subsequently be left with no evidence of gallop or any other signs of heart failure. Naturally, this represents a temporary sign of failure, with recovery, and indicates good myocardial reserve. The prognosis in this individual would then be related to other aspects of his underlying disease rather than to congestive heart failure. It appears also that persistent gallops well heard and associated with slight sinus tachycardia have more evidence of permanent serious heart failure, elevation of heart rate being an additional sign of a compensatory mechanism for cardiac decompensation. The patient may have a gallop rhythm of this type and concomitant extrasystoles. Following the extrasystoles for a few beats there is often an ac-
centuation of the intensity of the gallop sound. This is known as the postextrasystolic accentuation of a gallop. On the other hand, an occasional patient without any evidence of heart disease, but having numerous extrasystoles, may have a few beats following the extrasystoles that have a third sound at the timing of a gallop. These are of no prognostic significance. In addition, coincident with and sometimes persisting for a while after tachycardias such as atrial tachycardia, a gallop rhythm may be heard which disappears shortly after termination of the attack. This also is usually benign. The faint ventricular diastolic gallop which has a better prognosis is that detected as an early sign of failure which disappears after routine measures for control of congestive failure. As a rule, treatment should be continued, which should result in prolongation of life in these patients.

Timing of Atrial and Ventricular Diastolic Gallops. When the heart rate is slow or normal, this is not difficult. The atrial diastolic gallop follows the atrial contraction in presystole, and therefore usually just precedes the first sound. The ventricular diastolic gallop (or third heart sound type) occurs at the timing of the physiologic third heart sound in early diastole, and is easily identified in the presence of a normal ventricular rate. However, when the rate becomes rapid, differentiation of the atrial from the ventricular type
Fig. 5. Two patients with ventricular diastolic gallop (G) in presence of congestive failure and atrial fibrillation. Depending on length of diastole the same gallop might be called by different observers, protodiastolic, mesodiastolic, or presystolic.

may be quite difficult, if not impossible, unless slowing occurs. We have found carotid sinus pressure of great value for this differentiation (fig. 4). When the heart rate is slowed, the atrial gallop will be heard in relation to the first sound in presystole during the slower intervals. On the other hand, a ventricular diastolic gallop sound will remain in conjunction with the second heart sound, occurring shortly after it. When carotid sinus pressure causes a slowing of the heart rate, there may be a temporary period of several beats where no gallop sound is detected, but with the gradual resumption of heart rate, the extra sound can be identified without difficulty in its proper place. Sometimes the gallop sound does not disappear with the slowing, even for a few beats. The technic of listening to the heart at the same time carotid sinus pressure is applied is recommended. When doing so, the stethoscope can be placed on the chest wall and left there, or can be held by another observer. Pressure is applied usually on the right side at the angle of the jaw, making sure a carotid arterial pulsation is felt. Pressure should be firmly applied, but only for a duration of several seconds, releasing for 4 to 5 seconds, and then re-applying intermittently. Once slowing is heard, the pressure is stopped and one can pay strict attention to the auscultatory events.

To show the importance and necessity of differentiating the atrial from the ventricular type of diastolic gallop, the following case is cited. A 44-year-old woman was seen for evaluation of a sound occurring in diastole. Her past history was of importance in that as a young girl her bedroom was next to that of her grandmother's who had heart disease and subsequently died from it. Apparently her grandmother had a prolonged course, characterized by chronic congestive heart failure, and this made a lasting imprint on this young girl. Four to 5 years later because of an episode, the details of which were not too clear, a diagnosis of embolus from the heart going to one of her arms was made. No residual resulted from this, but from that time on she was sure that she had heart disease and a cardiac neurosis was firmly entrenched. Although no specific etiology of heart disease had been established, she was seen by a number of physicians concerning her heart and approximately 20 years later, at the time of her examination, she was relatively incapacitated because of fatigue, periods of palpitation, weakness, and sighing respiration. Physical examination was not remarkable except for a diastolic gallop rhythm. By the old criteria and classification, the finding of a diastolic rhythm would mean a poor prognosis. When first examined her heart rate was elevated because of a sinus tachycardia, and the differentiation between an atrial and a ventricular diastolic gallop was not possible. However, with carotid sinus pressure a slowing of her ventricular rate occurred and it was evident that the gallop sound was atrial in type. This finding immediately removed the serious prognosis associated with a diastolic gallop. The next problem was an explanation of the atrial gallop. She had no hypertension, but there was a prolongation of her P-R interval to 0.23 seconds.
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On reviewing her history, she was taking quinidine which had been given in an effort to control her sinus tachycardia. On the possibility that the P-R interval could be related to the quinidine, this was discontinued. Following this, the P-R interval shortened to upper normal limits with the disappearance of the gallop rhythm. This case illustrates that the mere labeling of a diastolic gallop in such a woman with a fixed cardiac neurosis, would only have served to add fuel to the fire. She was reassured that no heart disease was present. Unfortunately, her cardiac neurosis was so firmly established by this time that she will probably always have symptoms referable to her heart.

A ventricular diastolic gallop may indicate an unsuspected myocarditis, such as that of lupus erythematosus, or alert one’s suspicion, in a patient with atypical chest pain, that myocardial damage is present despite a negative electrocardiogram at that particular time.

A ventricular diastolic gallop is almost always associated with slight pulsus alternans. Vice versa, the finding of a significant degree of pulsus alternans is almost always associated with a ventricular diastolic gallop. Both of these findings mean a failing heart, and too little attention has been paid to them in the past. In a similar fashion, alternation of heart sounds or alternation of heart murmurs is likewise frequently associated with a diastolic gallop rhythm and pulsus alternans, and all are generally associated with some degree of heart failure. In fact, gallops are often palpated, and in some patients a gallop may be even more easily felt than heard. As a rule, however, using the techniques previously described to “bring out” a faint ventricular diastolic gallop, this will be heard if palpated.

A former clinical impression has been that gallops disappear with atrial fibrillation. This is certainly true of the atrial type diastolic gallop, since with the onset of fibrillation there is no contraction of the atra to produce the atrial gallop sound. On the other hand, the ventricular diastolic gallop does not disappear with atrial fibrillation (fig. 5). Because of the irregular heart rate it is more difficult to detect. A triple rhythm occurring with a regular rate is readily identified, whereas with an irregular rate, more concentration and longer auscultation are necessary. However, by listening specifically in the early portion of diastole, it will be heard, if present. The intensity of the gallop varies considerably with atrial fibrillation. After some beats it is inaudible or very faint, whereas after others it is well heard. This likewise adds to the difficulty in hearing the gallop with auricular fibrillation.

The fainter types of ventricular diastolic gallop tend to vary some with normal respiration. Sometimes a gallop sound is evident only on every third to fourth beat, again making it more difficult to detect.

Combination of Gallops. Occasionally one hears an extra loud gallop sound in diastole, or one may hear 2 sounds in diastole giving not a triple rhythm, but a quadruple rhythm (figs. 3 (top) and 6 (bottom). As already discussed, an atrial gallop may be heard for a number of years in a patient with hypertension but without signs or symptoms of heart failure. Once failure ensues, the ventricular gallop becomes evident, thus making 2 gallop sounds in addition to the 2 normal heart
sounds (fig. 3). Or, an individual having an acute coronary occlusion plus first degree heart block may likewise present 2 gallops, an atrial sound related to the prolonged P-R interval and a ventricular diastolic gallop associated with myocardial failure. The 2 normal sounds plus 2 gallop sounds result in 4 sounds, and this type of combination has been given descriptive terms at times, such as 'cogwheel' or 'locomotive' type.

Summation Gallop. In addition, it is possible to have both atrial and ventricular diastolic gallops occurring simultaneously. This often results in a very loud diastolic gallop, sometimes even louder than either of the 2 heart sounds. When analyzed on the phonocardiogram, it may be seen that these sounds coincide exactly. This is designated as summation gallop. When present, it may be possible when the heart rate slows (normally, or with carotid sinus pressure) to separate the atrial from the ventricular gallop, neither of which is as loud as the summation gallop made by both of them (fig. 6). It is also possible to have a systolic gallop in combination with a diastolic gallop or gallops. This is uncommon.

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