

Evaluation of Systolic Murmurs

Medplex Clinic - August 2008

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1. Match the maneuver with the physiology and murmur response:

- | | |
|--------------------------|--|
| _____ Valsalva | a. Decreases RV and LV volume - Increases HCM, moves MVP murmur earlier |
| _____ Bilateral handgrip | b. Increases SVR, venous return and arterial pressure- decreases HCM, moves MVP murmur later |
| _____ Squatting | c. Increases venous return to RV, decreases venous return to LV- increases R sided murmurs |
| _____ Standing | d. Increases systemic arterial pressure and heart rate - increases MR, AR, MS and decreases AS, HCM |
| _____ Inspiration | e. Decreases LV and RV volume, increases HR, decreases arterial BP - increases HCM, moves MVP murmur earlier |

2. A 72 year old male comes for a periodic health evaluation. He has excellent exercise tolerance and denies chest pain, DOE, or syncope. On cardiac examination there is a II/VI cooling early systolic ejection murmur best heard over the right second interspace. There is no S₄, the carotid upstroke is normal, S₂ is normal, and there is no apical to carotid delay. There is a soft R carotid bruit that disappears as you trace it to the clavicle. EKG, Hematocrit and TSH are normal. What is the most likely diagnosis?

- Aortic stenosis
- Pulmonic stenosis
- Aortic sclerosis
- HCM
- Transmission of the carotid bruit

3. A 19 year old male presents for a routine sports physical. He is asymptomatic. On examination he has a II/VI systolic ejection murmur best heard at the LLSB. there is an audible A₂, and carotid upstroke is brisk. The murmur is augmented by Valsalva and diminished by squatting.

True statements about this patient include:

- An EKG, CXR, and echocardiogram should be obtained.
- All noncontact, contact, and collision sports should be prohibited.
- As the severity of this condition worsens, a paradoxically split S₂ may appear.
- A bisferiens pulse may be present.
- The patient should be placed on medications before appearance of symptoms.

4. A 20 year old female comes for evaluation of a three day illness with cough, rhinorrhea, sneezing, and low grade fever. On cardiac examination, she has a II/VI mid-late systolic murmur best heard at the LLSB and apex along with a questionable mid-systolic click.

True statements about this patient include:

- a. A valsalva maneuver will likely move the murmur and click earlier in systole.
 - b. An echocardiogram is not indicated since diagnosis and management can be done on history and physical examination alone.
 - c. There may be associated chest wall abnormalities (pectus excavatum, scoliosis).
 - d. This patient has an increased risk of both stroke and endocarditis.
 - e. In contrast to HCM, this illness is not felt to be genetically determined.
5. A 20 year old female comes for a periodic health examination prior to leaving for France for language study. She is asymptomatic. On examination she has a II/VI early to mid-systolic murmur heard best at the LLSB which decreases on Valsalva and upright position.

True statements about this murmur would include:

- a. EKG, CXR, and echo should be obtained.
 - b. Anemia and hyperthyroidism are causes of this kind of murmur.
 - c. Bacterial endocarditis prophylaxis is recommended.
 - d. This type of murmur is much more common in young women than young men.
6. A 14 year old asymptomatic male is referred for evaluation because of a loud heart murmur present on routine physical examination. Physical examination reveals normal BP, arterial pulses and jugular venous pulses. Lungs are clear. A systolic thrill and corresponding grade IV/VI long systolic murmur are maximum at the LLSB, and the second heart sound splits normally with inspiration. The murmur diminishes with Valsalva and increases with handgrip. CXR and EKG are normal.

The most likely diagnosis is:

- a. HCM
 - b. MR
 - c. Congenital AS
 - d. Congenital PS
 - e. VSD
7. All of the following are true about prognosis in patients with MVP except:
- a. Asymptomatic patients with echo evidence of mitral prolapse only have a benign course.
 - b. Women are at increased risk for complications as compared to men.
 - c. Complications occur mostly in patients with diagnostic auscultatory findings.
 - d. Redundant mitral leaflets and/or increased LIV size are associated with a high frequency of serious complications.
 - e. The incidence of endocarditis for the MVP population is low.

8. A 20 year old female comes to you for evaluation of mild DOE. On cardiac examination the S₂ is widely split, perhaps fixed, and there is a II-III/VI systolic ejection murmur over the left second interspace. There is also a I-II/VI mid-diastolic murmur at the LLSB.

True statements about this condition include:

- a. An opening snap is often present.
 - b. Bacterial endocarditis prophylaxis should be recommended for procedures causing bacteremia.
 - c. This patient likely had acute rheumatic fever as a child.
 - d. An EKG, CXR, and echo should be obtained.
 - e. Surgery is indicated unless there is severe pulmonary hypertension.
9. A 21 year old asymptomatic male comes to you for a sports physical. On cardiac examination you detect a II-III/VI mid-high pitched systolic murmur at the apex that radiates to the axilla and to the LLSB. The murmur decreases with Valsalva, increases with handgrip and is unchanged on respiration. S₁ is obliterated.

True statements about this patient's illness are:

- a. Yearly follow-up with echocardiogram is indicated if initial evaluation shows mild severity.
 - b. Echo is a useful test to determine etiology.
 - c. Appearance of symptoms generally heralds severe decompensation, and surgery will be required.
 - d. The presence of an S₃ suggests severe disease.
10. A 19 year old asthenic female student is found to have multiple systolic clicks on physical examination prior to a sports physical. An echocardiogram shows mitral valve prolapse with thin, normal-appearing mitral valve leaflets. There is no mitral regurgitation.

Which of the following statement is/are true about this patient?

- a. She has an increased risk of developing severe mitral regurgitation requiring mitral valve replacement over the next decade.
- b. She should be advised against becoming pregnant.
- c. She should have infective endocarditis prophylaxis for routine dental work.
- d. She has an increased risk for sudden death.
- e. If she develops atypical chest pain, a beta blocker is indicated.
- f. None of the above is true.

Evaluation of Systolic Murmurs
ANSWERS

(FYI) 10 causes of an isolated systolic murmur.

- a. Aortic stenosis**
- b. Hypertrophic cardiomyopathy**
- c. Pulmonic stenosis**
- d. Atrial septal defect**
- e. Aortic valve sclerosis**
- f. Innocent (benign flow) murmurs - fever anemia, hyperthyroidism, pregnancy, etc.**
- g. Mitral regurgitation**
- h. Tricuspid regurgitation**
- i. Ventricular septal defect**
- j. Mitral valve prolapse**

1. Match the maneuver with the physiology and murmur response:

- | | |
|---------------------------------|---|
| <u> e </u> Valsalva | a.. Decreases LV volume - Increases HCM, MVP |
| <u> d </u> Bilateral handgrip | b. Increases venous return and arterial pressure-
decreases HCM, MVP |
| <u> b </u> Squatting | c. Increases venous return - increases [Ⓜ] sided murmurs |
| <u> a </u> Standing | d. Increases systemic arterial pressure and heart rate
-increases MR, AR, MS and decreases AS, HCM |
| <u> c </u> Inspiration | e. Decreases LV and RV volume - increases HCM, MVP |

Comment: There is little difference between standing and the Valsalva maneuver physiologically.

2. A 72 year old male comes for a periodic health evaluation. He has excellent exercise tolerance and denies chest pain, DOE, or syncope. On cardiac examination there is a II/VI cooing early systolic ejection murmur best heard over the right second interspace. There is no S₄, the carotid upstroke is normal, S₂ is normal, and there is no apical to carotid delay. There is a soft R carotid bruit that disappears as you trace it to the clavicle. EKG, Hematocrit and TSH are normal. What is the most likely diagnosis?

- a. Aortic stenosis
- b. Pulmonic stenosis
- * **c. Aortic sclerosis**
- d. HCM
- e. Transmission of the carotid bruit

Comments: This is classic aortic sclerosis which may require an Echo to rule out aortic stenosis. 25% of adults over age 65 have aortic sclerosis which is correlated with risk factors for atherosclerosis. There can be progression to AS. Note: The absence of all symptoms and sign attributable to aortic stenosis.

3. A 19 year old male presents for a routine sports physical. He is asymptomatic. On examination he has a II/VI systolic ejection murmur best heard at the LLSB. there is an audible A2, and carotid upstroke is brisk. The murmur is augmented by Valsalva and standing and diminished by squatting.

True statements about this patient include:

- T a. An EKG, CXR, and echocardiogram should be obtained.**
T b. All noncontact, contact, and collision sports should be prohibited.
T c. As the severity of this condition worsens, a paradoxically split S₂ may appear.
T d. A bisferiens pulse may be present.
e. The patient should be placed on medications before appearance of symptoms.

Hypertrophic Cardiomyopathy

This is familial (autosomal dominant) with early and late onset disease, and first degree relatives should be repeatedly screened with echo cardiography. Symptoms and evidence of obstruction are associated with worsened outcomes and with sudden cardiac death, CHF, and stroke. Patients with outflow obstruction should be treated with B-blockers. Dual-chamber pacing may improve symptoms and reduce outflow gradient. Myectomy or ethanol ablation can be used if continued severe symptoms. Use an ICD if end-stage HCM for primary prevention of sudden death. Class I A sports could conceivably be permitted - billiards, bowling, cricket, curling, golf, and riflery.

4. A 20 year old female comes for evaluation of a three day illness with cough, rhinorrhea, sneezing, and low grade fever. On cardiac examination, she has a II/VI mid-late systolic murmur best heard at the LLSB and apex along with a questionable mid-systolic click.

True statements about this patient include:

- T a. A valsalva maneuver will likely move the murmur and click earlier in systole and accentuate it.**
b. An echocardiogram is not indicated since diagnosis and management can be done on history and physical examination alone.
T c. There may be associated chest wall abnormalities (pectus excavatum, scoliosis).
T d. This patient has an increased risk of both stroke and endocarditis.
e. In contrast to HCM, this illness is not felt to be genetically determined.

MVP

MVP is an autosomal dominantly inherited condition with incomplete penetrance. Overall incidence in men and women is the same. Secondary MVP may occur in connective tissue disorders, papillary muscle dysfunction, etc. It is occasionally associated with thoracic skeletal abnormalities. Most patients are asymptomatic. Palpitations, chest pain or dyspnea may occur. Endocarditis prophylaxis is no longer required. Beta blockers may be useful with arrhythmias and/or chest pain. Association with TIA and stroke is unclear but has been reported.

5. A 20 year old female comes for a periodic health examination prior to leaving for France for language study. She is asymptomatic. On examination she has a II/VI early to mid-systolic murmur heard best at the LLSB which decreases on Valsalva and upright position.

True statements about this murmur would include:

- a. EKG, CXR, and echo should be obtained.
- T b. Anemia and hyperthyroidism are causes of this kind of murmur.**
- c. Bacterial endocarditis prophylaxis is recommended.
- T d. This type of murmur is much more common in young women than young men.**

Benign flow murmur (innocent murmur)

6. A 14 year old asymptomatic male is referred for evaluation because of a loud heart murmur present on routine physical examination. Physical examination reveals normal BP, arterial pulses and jugular venous pulses. Lungs are clear. A systolic thrill and corresponding grade IV/VI holosystolic murmur are maximum at the LLSB, and the second heart sound splits normally with inspiration. The murmur diminishes with Valsalva and increases with handgrip. CXR and EKG are normal.

The most likely diagnosis is:

- a. HCM
- b) MR
- c. Congenital AS
- d. Congenital PS
- * e. VSD**

VSD

HCM murmur increases with Valsalva. MR murmur should be loudest at the apex. AS in patients < age 30 is usually caused by a unicuspid valve. A loud murmur at the right 2nd IS, an ejection click and an S₄ would be typical along with a slowly rising pulse and possibly paradoxical splitting of S₂. Pulmonic stenosis will often have a prominent "a" wave, RV heave, and an ejection click. The murmur in the question above often increases on handgrip and is classic for VSD. Thirty percent close spontaneously in childhood. In a patient without symptoms, no evidence of volume overload, and no pulmonary hypertension, no treatment is required and no endocarditis prophylaxis.

7. All of the following statements are true about the prognosis for patients with MVP except:
- T a. Asymptomatic patients with echo evidence of mitral prolapse only have a benign course.**
- b. Women are at increased risk for complications as compared to men.
- T c. Complications occur primarily in patients with diagnostic auscultatory findings.**
- T d. Redundant mitral leaflets and/or increased LIV size are associated with a high frequency of serious complications.**
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True statements about this condition include:

- a. An opening snap is often present.
- b. Bacterial endocarditis prophylaxis should be recommended for procedures causing bacteremia.
- c. This patient likely had acute rheumatic fever as a child.
- T d. An EKG, CXR, and echo should be obtained.**
- T e. Surgery is indicated unless there is severe pulmonary hypertension.**

Atrial Septal Defect

This is a L to R shunt (until late in course) causing RV overload. There is an association with MVP. There is a fixed split S₂ and a soft pulmonic ejection murmur. There may be a diastolic murmur across the tricuspid valve or from pulmonic regurgitation. Endocarditis prophylaxis is unnecessary in this low flow state. The rare combination of ASD and mitral stenosis is Lutembacher's syndrome.

9. A 21 year old asymptomatic male comes to you for a sports physical. On cardiac examination you detect a II-III/VI mid-high pitched systolic murmur at the apex that radiates to the axilla and to the LLSB. The murmur decreases with Valsalva, increases with handgrip and is unchanged on respiration. S₁ is obliterated.

True statements about this patient's illness are:

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- T c. Appearance of symptoms generally heralds severe decompensation, and surgery will be required.**
- T d. The presence of an S₃ suggests severe disease.**

Mitral Regurgitation

A murmur radiating to the apex is usually mitral in origin. Handgrip which increases afterload increases this murmur. An Echo can often distinguish rheumatic HD, MVP, endocarditis, papillary muscle dysfunction, and dilatation. Symptoms develop gradually. S₃ and signs of pulmonary hypertension are late findings. The S₃ does not necessarily indicate CHF, but may be due to rapid ventricular filling 2^o to large amount of blood stored in the left atrium. In patients with mild MR, no LV enlargement or dysfunction, no symptoms, and no pulmonary HTN, yearly follow-up without Echo is acceptable. Moderate MR needs a yearly Echo. Surgery should be performed even in asymptomatic patients if LVEF \leq 60% or end-systolic dimension \geq 40 mm.

10. A 19 year old asthenic female student is found to have multiple systolic clicks on physical examination prior to a sports physical. An echocardiogram shows mitral valve prolapse with thin, normal-appearing mitral valve leaflets. There is no mitral regurgitation. Which of the following statement is/are true about this patient?
- a. She has an increased risk of developing severe mitral regurgitation requiring mitral valve replacement over the next decade.
 - b. She should be advised against becoming pregnant.
 - c. She should have infective endocarditis prophylaxis for routine dental work.
 - d. She has an increased risk for sudden death.
 - e. If she develops atypical chest pain, a beta blocker is indicated.
 - f. None of the above is true.
- T**

References:

1. Lembo NJ et al. "Beside Diagnosis of Systolic Murmurs," NEJM. 1988; 328:1572-1578.
2. Fiebach, et al. Principles of Ambulatory Medicine. Lippincott, Williams & Wilkins. 2007.
3. Fink JC et al. "A decision aid for referring patient with systolic murmurs for echocardiography." J. Gen Intern Med. 1994;9:479-484.
4. Harrison's Principles of Internal Medicine 2008.
5. Wilson W. et al. Prevention of Infective Endocarditis. Circulation. 2007;116:1736-1754.
6. UpToDate -16.2. 2008.

