



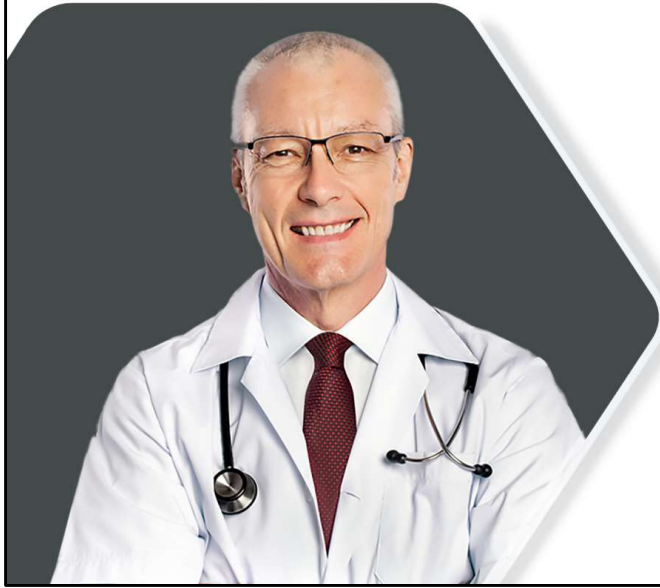
**ACCREDITED TRAINING FOR THE NATIONAL  
REGISTRY OF CERTIFIED MEDICAL  
EXAMINERS**

**MODULE 3**

**Dr. Jeffrey Carlson**  
*TeamCME Chief Medical Officer*



Welcome to module 3 of the accredited training for the National Registry of Certified Medical Examiners.



# HYPERTENSION

## Hypertension 391.41(b)(6) Appendix A: Advisory Criteria



- Most common condition leading to modification of certification interval
- Alone is unlikely to cause sudden collapse
- A potent risk factor for PVD, renal insufficiency and cardiovascular disease

Hypertension is the most common medical condition that causes issuance of a medical certificate for less than 2 years. Alone, it is not likely to cause sudden collapse or incapacitation, but it is a risk factor for cardiovascular disease, peripheral vascular disease, and renal insufficiency.

## Hypertension Concerns

MEs should evaluate those with hypertension for CV disease, peripheral artery disease, nephropathy, retinopathy, and other target organ damage.

**Counsel the driver regarding modifiable behaviors:**

- Smoking
- Obesity
- Lack of exercise



Medical examiners should ask drivers with a history of hypertension about whether their treatment is effective and if they have any symptoms or limitations. Drivers should be counseled regarding the behaviors they can change to reduce their risk such as smoking, obesity, and the lack of exercise. Drivers with hypertension should be evaluated for cardiovascular disease, peripheral artery disease, nephropathy, retinopathy, or other target organ damage.

## Hypertension Made Easy!



### **Problems with blood pressure measurement:**

- Placing cuff over clothing
- Using inappropriately sized cuff
- Incorrect arm position-heart height
- Insufficient relaxing time
- Sitting Position, legs uncrossed

### **Systolic pressure fluctuates in short term from:**

- Emotional and physical state
- Transient hypertension (white coat)

Good technique is required to obtain accurate measurements. The blood pressure cuff should not be placed over clothing. The correctly sized cuff should be used. The position of the arm should be at the same height of the heart. A cool-down waiting period of 5 minutes is recommended with the driver sitting in a relaxed position without talking or being asked questions. The legs should not be crossed, and the driver should keep their eyes closed and not speak until after the readings are taken. Normal fluctuations can be caused by the driver's emotion and physical state such as being with unfamiliar staff in an unfamiliar office or if the driver has white coat syndrome. Although not required, if measuring blood pressure in both arms, the ME should compare the values obtained.

## Hypertension Guidelines

An elevated BP should be confirmed by at least two measurements taken at different times during the exam on the same day. Additional measurements are allowed and should be recorded on the report form.

The lowest reading is used to determine stage of HTN.

If the driver is going to be disqualified, it is prudent that the medical examiner personally confirm the BP, rather than a staff member.



During the exam, an elevated BP should be confirmed by at least two measurements taken at different times during the exam on the same day. Additional measurements are allowed but should be recorded on the report form. The lowest reading taken is used to determine hypertension stage. If elevated, this confirms a diagnosis of hypertension. If the driver is going to be disqualified from driving and not issued a medical examiner's certificate, it is prudent for the medical examiner to confirm the disqualifying blood pressure personally.

## Hypertension Made Easy!



**Stage 1 Values:** 140/90 to 159/99

- Begins at: 140/90
- Ends at: 1 point below the beginning values for Stage 2

**Stage 2 Values:** 160/100 to 179/109

- Begins at: Add 20 to systolic & 10 diastolic Stage 1 values.
- Ends at: 1 point below the beginning values for State 3

**Stage 3 Values:** 180/110 and above

- Begins at: Add 20 to systolic and 10 diastolic Stage 2 values.

Medical examiners should be very familiar with the hypertension classifications and guidance. Stage 1 begins at 140 over 90 and ends 1 point below the beginning values for stage 2 . State 2 values are from 160/100 to 179/109. State 3 values are 180/110 and above. As the Stages go from Stage 1, to Stage 2, to Stage 3, to get the next higher stage's starting value, add 20 units to the lower stage's systolic value, and 10 units to the lower Stage's diastolic value to get the starting values for the next higher Stage.

Stage 1 Hypertension (140-159/90-99)		
Certification	DQ'd	Recertification
<p><i>For 1 year if:</i></p> <ul style="list-style-type: none"> <li>• Has no history of HTN</li> <li>• It is the first exam at which the driver has BP in stage 1</li> <li>• Does not use medication to control BP</li> </ul> <p><i>One-time 3-month certificate if:</i></p> <ul style="list-style-type: none"> <li>• History of HTN</li> </ul>	History of stage 3 HTN	<p><i>For 1 year if any of the following:</i></p> <ul style="list-style-type: none"> <li>• BP <math>\leq</math> 140/90</li> </ul> <p><i>On-time 3-month certificate if:</i></p> <ul style="list-style-type: none"> <li>• BP is stage 1 or stage 2</li> </ul> <p><i>6-month certificate if:</i></p> <ul style="list-style-type: none"> <li>• History of stage 3 HTN</li> <li>• BP <math>\leq</math> 140/90</li> </ul>
Stage 2 Hypertension (160-179/100-109)		
<i>One-time 3-month certificate</i>	History of stage 3 HTN	<p><i>For 1 year if:</i></p> <ul style="list-style-type: none"> <li>• BP <math>\leq</math> 140/90</li> </ul> <p><i>6-month certificate if:</i></p> <ul style="list-style-type: none"> <li>• History of stage 3 HTN</li> <li>• BP <math>\leq</math> 140/90</li> </ul>
Stage 3 Hypertension ( $\geq$ 180/110)		
Certification	Disqualified	Recertification
Disqualified	Disqualified until BP $\leq$ 140/90	<p><i>6-month certificate if:</i></p> <ul style="list-style-type: none"> <li>• BP <math>\leq</math> 140/90</li> </ul>

This chart was created to better understand the FMCSA guidelines concerning hypertension. The only time a driver presenting with a systolic blood pressure between 140 to 159 and/or a diastolic blood pressure between 90 to 99 can be certified for a year is if they do not have a history of hypertension and it is the first time that they have presented with the elevated blood pressure. Otherwise, a driver with stage 1 hypertension and a history of hypertension can only be given a one-time, 3-month certificate. A one-time certificate means that the examiner cannot issue two consecutive 3-month certificates to a driver due to hypertension. The driver with the 3-month certificate must have a new exam before getting recertified. Once they can produce a blood pressure below less than or equal to 140/90, they can be given a one-year certificate. A driver with stage 1 hypertension on exam but has a history of stage 3 hypertension cannot be certified until they demonstrate a blood pressure below less than or equal to 140/90 at which time, they can be certified for a maximum of 6 months. Regardless of whether a driver has a history of hypertension, if their blood pressure indicates stage 2 hypertension, the driver can only be given a one-time, 3-month certificate. When they return for a new exam, the driver's blood pressure must be less than or equal to 140/90, at which time they can be certified for up to one year. When a driver's lowest blood pressure values during a medical exam fall within Stage 3 values, they are disqualified and recommended to seek immediate medical care. If the driver returns at a later date and their blood pressure is less than or equal to 140/90, they may be issued a 6-month certificate. A driver with a history of Stage 3 hypertension can never be issued a medical certificate of more than 6 months.



## Hypertensive Medications



### Diuretics

- Furosemide (Lasix)
  - Be conscious of potassium (K<sup>+</sup>) depletion
- Hydrochlorothiazide (HCTZ)

### Calcium Channel Blockers

- Nifedipine
- Amlodipine
- Verapamil
- Diltiazem

### Angiotensin-2 Receptor Blockers (ARBs):

- Losartan
- Valsartan

### Beta-Blockers

- Metoprolol
- Propranolol
- Atenolol

### ACE Inhibitors

- Enalapril
- Lisinopril

This is a partial list of anti-hypertensive medications. Most antihypertensive medications are not a risk to safe driving as long as the driver's blood pressure is well-controlled, and the medication does not cause hypotensive episodes or other side effects that could be a risk to driving. MEs should be cautious if a driver has had a recent change in their hypertensive medications. For diuretics, the ME should be conscious of the possibility of potassium depletion.

## PRACTICE SCENARIO

42-year-old female with High blood pressure, taking HCTZ (Oretic) 25mg and Enalapril (Vasotec) 20mg which she tolerates meds well with no side effects. She also admits to smoking 1 ½ packs of cigarettes per day (for 20 years). She does short hauls for work and is home every night.

- Forgot to take meds before leaving home
- Came to exam after 10 hours driving without sleep
- Had several cups of coffee within past 2 hours
- Exam:
  - BP = 151/94
  - Pulse = 92 bpm and regular

**Should this driver be disqualified or certified? Why?**

**If the driver is certified, for what time interval?**

**What other requirements would there be?**

42-year-old female with High blood pressure, taking HCTZ (Oretic) 25mg and Enalapril (Vasotec) 20mg which she tolerates meds well with no side effects. She also admits to smoking 1 ½ packs of cigarettes per day (for 20 years). She does short hauls for work and is home every night. The driver forgot to take meds before leaving home. She came to exam after 10 hours driving without sleep and has had several cups of coffee within past 2 hours. The physical exam findings are significant for a pulse of 92bpm and a blood pressure of 151/94. Should this driver be disqualified or certified? Why? If the driver is certified, for what time interval? What other requirements would there be?

## PRACTICE SCENARIO ANSWER

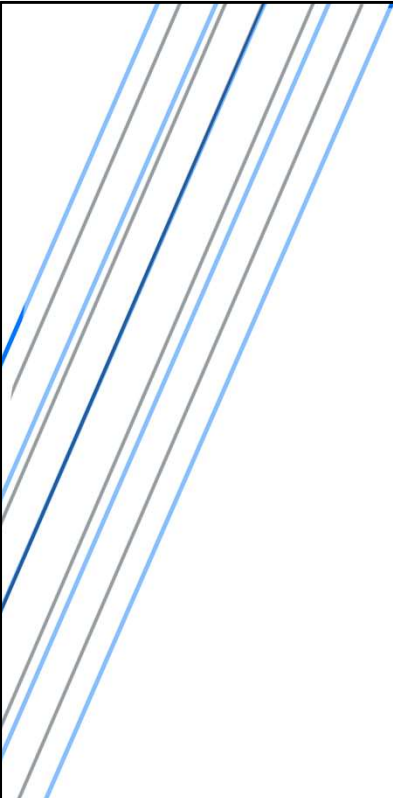
### Provide a 1-time certificate for 3 months

- Upon return for recertification, they must complete a new physical and have a BP  $\leq$ 140/90 to be certified for a year

The best outcome for this driver is for the medical examiner to provide the driver a one-time, 3-month certificate. The driver would need to return to the medical examiner when their blood pressure is less than or equal to 140/90 to be certified for a year.

# CARDIOVASCULAR DISEASE





“An ME’s fundamental task during the cardiovascular assessment is to establish whether a driver has a cardiovascular disease or disorder that is accompanied by or likely to cause *syncope, dyspnea, or collapse*, thus endangering driver and public safety and health.”

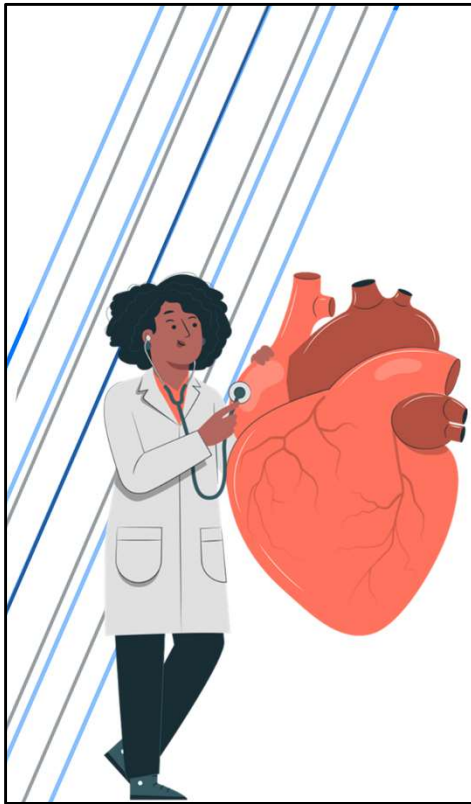
The ME should consider the nature and severity of the disease when determining the duration of medical certification.

The examination is based on:

- The driver’s history
- Physical examination
- Additional testing or consultation if necessary

Medical certification depends on a comprehensive medical assessment of overall health and informed medical judgment about the impact of single or multiple conditions.

“An ME’s fundamental task during the cardiovascular assessment is to establish whether a driver has a cardiovascular disease or disorder that is accompanied by or likely to cause *syncope, dyspnea, or collapse*, thus endangering driver and public safety and health.” The ME should consider the nature and severity of the disease when determining the duration of medical certification. The examination is based on the driver’s history, physical examination, and additional testing or consultation if necessary. Medical certification depends on a comprehensive medical assessment of overall health and informed medical judgment about the impact of single or multiple conditions.



## Cardiovascular Medication

**Anticoagulants & Blood Thinners:**

- *Coumadin (Warfarin): monthly monitoring required (INR 2-3)*

*Other anticoagulant monitoring parameters depend on **Kidney Function**: Creatinine Clearance (CRCL)*

- Xarelto (Rivaroxaban)
- Pradaxa (Dabigatran)
- Eliquis (Apixaban)
  - If CRCL > 50, check creatinine every 6-12 months
  - If CRCL < 50, check creatinine every 3 months

Drivers taking coumadin (warfarin) should have monthly International Normalized Ratio (INR) results between 2 and 3. Pradaxa, Xarelto, and Eliquis do not need monthly monitoring, but their creatinine level should be checked occasionally dependent on their kidney function. If their CRCL is greater than 50, creatinine should be checked every 6-12 months. If CRCL is less than 50, creatinine should be checked every 3 months.

## Evaluation/Documentation

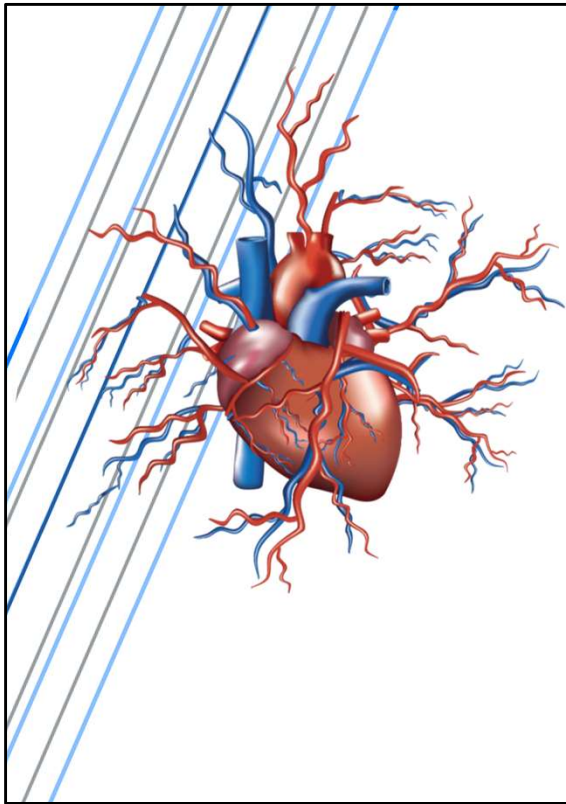
If a driver reports symptoms consistent with undiagnosed CVD, you should refer the driver to a specialist for further evaluation prior to certification.

If a driver gives a “Yes” answer to the question regarding heart surgery or a heart procedure, obtain documentation from the cardiologist before certifying.

Consider obtaining pertinent reports such as exercise tolerance test (stress test) and other documentation to adequately assess fitness for duty.



If a driver reports symptoms consistent with an undiagnosed CVD, the ME should refer the driver to a CV specialist for evaluation before qualifying the driver. If a driver says “yes” to a question regarding heart surgery or a heart procedure, the medical examiner should obtain documentation from the cardiologist before certifying the driver. Consider obtaining pertinent reports such as exercise tolerance test (stress test) and other documentation to adequately assess fitness for duty.



## Heart Transplantation

- Concerns are transplant rejection, post-surgical atherosclerosis, medication side effects

### Considerations:


- Does the driver have signs of cardiovascular disease?
- Does the driver have signs of rejection?
- Has treatment, including response to medications, been shown to be adequate and effective?
- Does the driver demonstrate compliance with the treatment plan?

### Anti-Rejection Medications:

- Tacrolimus (Prograf)
- Cyclosporine
- CellCept

Heart transplantation has post surgical risks that can affect driving status such as transplant rejection, post-surgical atherosclerosis, and side effects of the medications. used to reduce the risk of transplant rejection. When making a certification determination, the ME should consider the following: Does the driver have signs of cardiovascular disease? Does the driver have signs of rejection? Has treatment, including response to medications, been shown to be adequate and effective? And does the driver demonstrate compliance with the treatment plan? It would be helpful to remember these most commonly prescribed anti-rejection medications listed, particularly Tacrolimus (Prograf).





## Syncope

It is an immediate threat to public safety.

- Distinguish between *pre-syncope* (dizziness, lightheadedness) and true *syncope* (loss of consciousness)
- Verify that driver's medications are not predisposing them to decreased BP, electrolyte shifts and imbalances, fatigue
- Qualification determinations are made according to the standards of the underlying condition
  - Cardiac-based syncope
  - Neurologic-based syncope (migraine, seizure)
- Has treatment been shown to be adequate and effective?

Syncope is an immediate threat to safe driving and public safety. Medical examiners must distinguish pre-syncope, which is dizziness or lightheadedness, from true syncope, which is a loss of consciousness. Verify that driver's medications are not predisposing them to decreased BP, electrolyte shifts and imbalances, fatigue. Qualification determinations are made according to the standards of the underlying condition such as Cardiac-based syncope or Neurologic-based syncope (migraine, seizure). The ME should also consider if treatment has been shown to be adequate and effective.



# **PERIPHERAL VASCULAR DISEASE & ANEURYSMS**

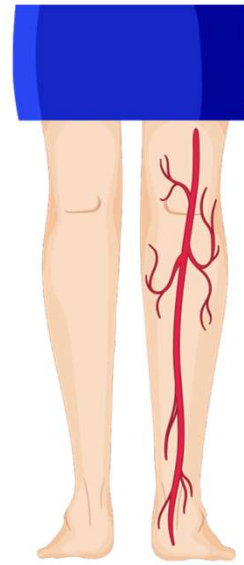
## VENOUS THROMBOEMBOLISMS & DISEASE

### Superficial Phlebitis

- A benign and self-limited disease. **Coexisting DVT needs to be excluded during the examination.**

#### Do Not Certify if:

- Coexisting DVT without meeting the DVT guidelines



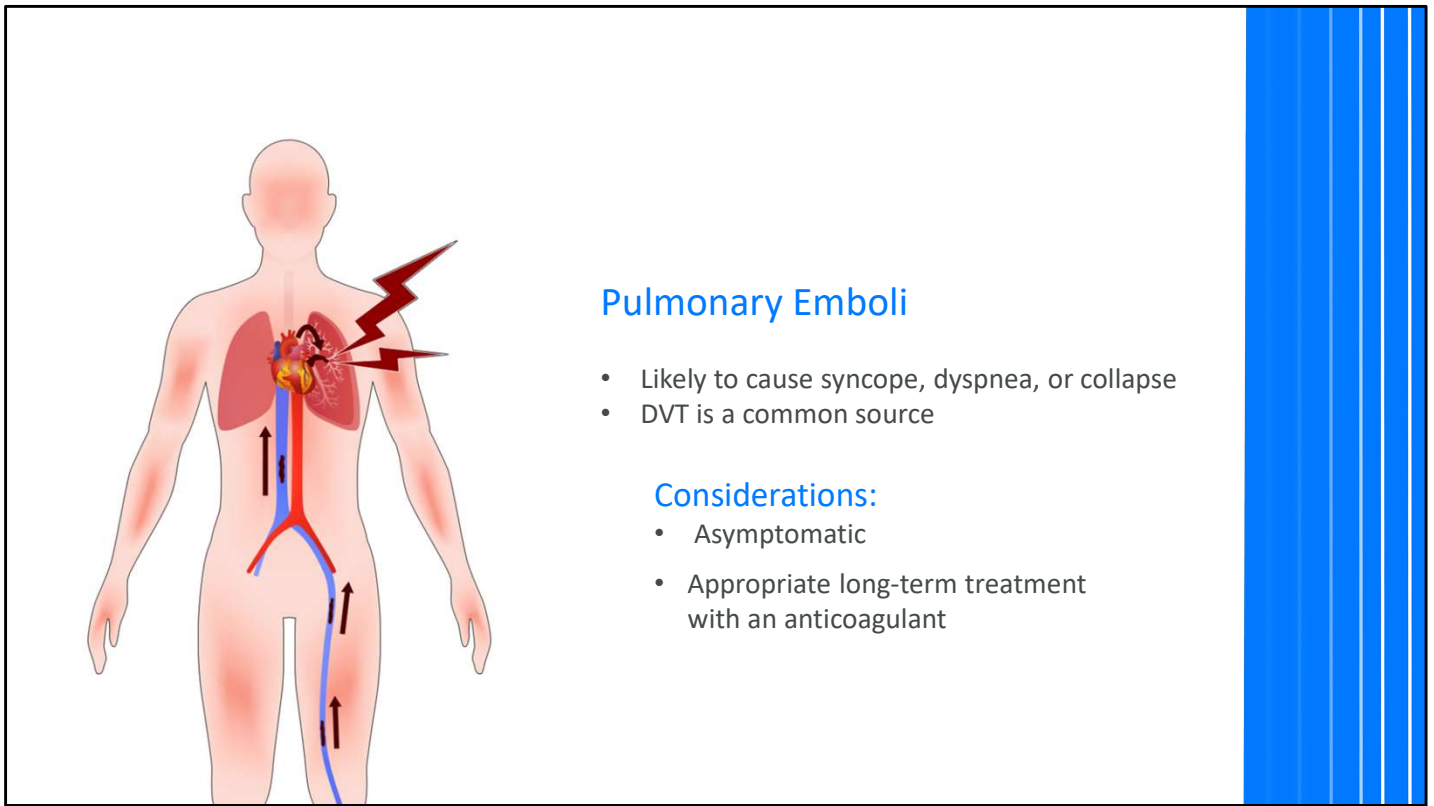
Superficial phlebitis is generally benign and self-limiting. However, it frequently coexists with deep vein thrombosis and the medical examiner should exclude this diagnosis during the examination. Do not certify drivers who have coexisting DVT unless they meet the deep vein thrombosis guidelines. Otherwise, they can be certified to drive for up to two years.

## Acute Deep Vein Thrombosis (DVT)



- Drivers have an increased risk for developing acute deep vein thrombosis due to long hours of sitting
- DVT can be the source of a pulmonary embolus
- Adequate treatment with anticoagulants decreases the likelihood of recurrent thrombosis by approximately 80%
- Certify drivers who meet the cardiovascular standards

Commercial drivers are at an increased risk for deep vein thrombosis due to inactivity and prolonged sitting. Deep vein thrombosis may cause a pulmonary embolus which results in incapacitation or even death. Drivers with a history of acute deep vein thrombosis should be counseled regarding how to avoid an event. Anticoagulant treatment will reduce the risk of a recurrent event by 80%. Certify drivers who meet the cardiovascular standards.



Pulmonary emboli are likely to result in syncope, dyspnea, or collapse and are often caused by a clot traveling from a DVT. When making a physical qualification determination, the medical examiner should consider whether the driver is asymptomatic and if there has been appropriate long-term treatment with an anticoagulant.

## Intermittent Claudication & Rest Pain



Intermittent claudication and rest pain are due to arterial insufficiency.

7-9% of individuals with peripheral vascular disease of the lower extremities develop intermittent claudication, leading to neuropathy, atrophy, and necrosis.

**Intermittent Claudication:** Pain in feet and/or legs that is reproducible by walking a specific distance which goes away with rest

**Considerations:**

- No rest symptoms
- Etiology has been confirmed
- Treatment is adequate, effective, safe, and stable

**Rest Pain:** Pain at rest (no activity involved), worse with elevation above level of hips. **Consider disqualification** due to reduced function of the affected limb.

Intermittent claudication and rest pain are due to arterial insufficiency. 7-9% of individuals with peripheral vascular disease of the lower extremities develop intermittent claudication, leading to ischemia, neuropathy, atrophy, and necrosis. The examiner should consider whether the etiology has been confirmed and if the treatment has been shown to be adequate, effective, safe, and stable. Drivers that have pain at rest should not be certified to drive due to the reduced function of the affected limb.

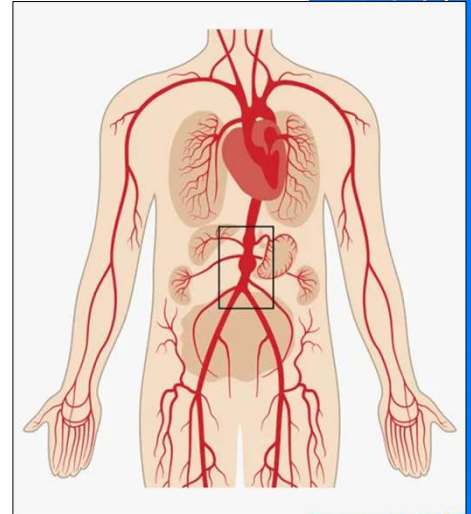
## Abdominal Aortic Aneurysm (AAA)

- Most are asymptomatic
- Rupture is related to the size of the aneurysm (< 4cm diameter rarely rupture)
- Aneurysms > 6cm diameter are detected on exam 90% of the time
- Auscultation of a bruit may indicate the presence of an aneurysm
- Ultrasound has nearly 100% sensitivity and specificity for detecting an AAA


### Risk Factors:

- Smoking is the strongest risk factor
  - Consider testing smokers
- 3:1 ratio of males to females
- Caucasian
- Family history

The ME may consult with specialists and request additional evaluation to assist in deciding whether a certificate can be issued. Consider the medical history, the driver's response to treatment, current medication regimen, current clinical best practices, and knowledge of the duties and responsibilities of commercial driving.



Most abdominal aortic aneurysms (AAA) are asymptomatic. Rupture is the most serious complication and is related to the size of the aneurysm. Aneurysms less than 4 cm rarely rupture. Aneurysms > 6cm diameter are detected on exam 90% of the time. Auscultation of a bruit may indicate the presence of an aneurysm. Ultrasound has nearly 100% sensitivity and specificity for detecting an AAA. The greatest risk factor for an AAA is smoking and the ME may consider further testing for these individuals. Other risk factors include being a Caucasian male and having a family history of heart disease and/or an AAA. The ME may consult with specialists and request additional evaluation to assist in deciding whether a certificate can be issued. Consider the medical history, the driver's response to treatment, current medication regimen, current clinical best practices, and knowledge of the duties and responsibilities of commercial driving.



## Thoracic Aortic Aneurysm (TAA)

**Determining risk for dissection or rupture:**

- Asymptomatic
- Size of the aorta
  - < 5cm are not likely to rupture

The size of the aorta is considered the major determining risk factor for dissection or rupture of a thoracic aneurysm. Thoracic aneurysms that are less than 5 cm and are asymptomatic are not likely to rupture.



**Which of the following medical conditions is most likely to result in incapacitation?**

- A. Pulse of 118bpm
- B. Auscultation of a bruit over the abdomen
- C. A recent HbA1c of 11%
- D. End-stage renal disease on dialysis

The correct answer is **B**. Auscultation of a bruit over the abdomen is indicative of an abdominal aortic aneurysm. 90% of aneurysms detected on exam are greater than 6cm in diameter and are at high risk of rupturing. There are many factors that may cause a pulse of 118bpm, and it is not likely to be the cause of incapacitation. A HbA1c of 11% indicates that the driver's diabetes is not well controlled, but it is extremely unlikely for this level of hyperglycemia to cause incapacitation.

Which of the following medical conditions is most likely to result in incapacitation?

- A. Pulse of 118bpm
- B. Auscultation of a bruit over the abdomen
- C. A recent HbA1c of 11%
- D. End-stage renal disease on dialysis

The correct answer is **B**. Auscultation of a bruit over the abdomen is indicative of an abdominal aortic aneurysm. 90% of aneurysms detectable on exam are greater than 6cm in diameter and are at high risk of rupturing. There are many factors that may cause a pulse of 118bpm, and it is not likely to be the cause of incapacitation. A HbA1c of 11% indicates that the driver's diabetes is not well controlled, but it is extremely unlikely for this level of hyperglycemia to cause incapacitation.



# ARRHYTHMIAS

## Pacemakers

Used to treat bradycardia. Consider the underlying disease when making a certification determination.

- Sinus node dysfunction and atrioventricular (AV) block have variable long-term prognoses, depending on the underlying disease

### Considerations:

- Are there signs that the pacemaker is not working properly?
  - Bradycardia
  - Alternating bradycardia and tachycardia
  - Syncope
  - Weakness or tiredness



A pacemaker is an implantable device used to treat bradycardia. The ME should consider the underlying disease when making a certification determination. Both sinus node dysfunction and atrioventricular (AV) block have variable long-term prognoses, depending on the underlying disease. The ME should also consider whether there are signs that the pacemaker is not working properly such as bradycardia, alternating bradycardia and tachycardia, syncope, and weakness or tiredness.

## Implantable Cardioverter-Defibrillator (ICD)



- Treats ventricular fibrillation and ventricular tachycardia by delivering shock therapy to the heart
  - Likely to cause syncope or collapse
- Will stop a current arrhythmia but DOES NOT prevent arrhythmias

*Do not certify drivers with an implanted defibrillator or a combination defibrillator/pacemaker.*

An implantable cardioverter/defibrillator (ICD) treats ventricular fibrillation and ventricular tachycardia by delivering shock therapy to the heart. This shock is likely to cause syncope or collapse. ICDs will stop a current arrhythmia but DOES NOT prevent arrhythmias. Drivers that receive pacemakers sometimes are given a combination defibrillator pacemaker. Drivers with an implanted defibrillator are disqualified from commercial driving.

## Supraventricular Arrhythmias

**Supraventricular Tachycardia (SVT):** a common arrhythmia usually *not consider a risk for sudden death*.

- Occasionally can cause loss of consciousness or compromise cerebral function
- Treatment by catheter ablation is usually curative and allows withdrawal of drug therapy

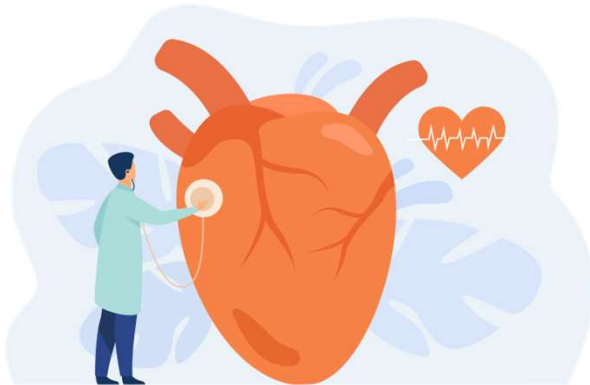
**Atrial Fibrillation:**

- Associated with embolus formation which can cause stroke
- Anticoagulant therapy decreases this risk in individuals with risk factors for stroke



Supraventricular arrhythmias consist of two main categories. Supraventricular Tachycardia (SVT) is a common form of arrhythmia that is usually not a risk for sudden death. However, when severe, it can cause the driver to lose consciousness or experience compromised cerebral function. When treated by catheter ablation, the result is usually curative, even to the point where drug therapy can be withdrawn. Atrial fibrillation, however, comes with a risk of embolus formation leading to stroke. Drivers with atrial fibrillation are usually treated with anticoagulant therapy to decrease the risk of that occurring.

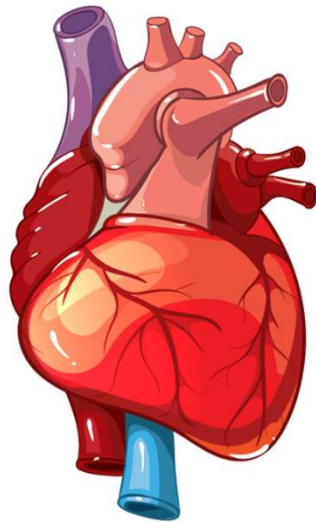
## Atrial Fibrillation



### Considerations:

- Heart rate is controlled
- Treatment for emboli prevention is effective and tolerated
- Clearance from CV specialist
- Complies with anticoagulant therapy guidelines

Drivers with a history of atrial fibrillation can be certified for one year if their heart rate is controlled, their treatment for prevention of embolus formation is effective and well tolerated, they comply with anticoagulant therapy guidelines, and they have clearance from a cardiovascular specialist.



## Ventricular Arrhythmias

### Ventricular Fibrillation, Ventricular Tachycardia

- Responsible for most of cardiac sudden death

#### Considerations:

- Is the cause known and does the cause preclude the driver from qualification?
- Is the driver symptomatic?
- Does the driver have sustained ventricular tachycardia?
- Has the driver been evaluated by a CV specialist?

The majority of sudden deaths are due to ventricular fibrillation or tachycardia. The ME should consider the following: Is the cause known and does the cause preclude the driver from qualification? Is the driver symptomatic? Does the driver have sustained ventricular tachycardia? Has the driver been evaluated by a CV specialist?



# CARDIOVASCULAR TESTS



## Exercise Tolerance Test (ETT)

The Bruce protocol treadmill test is the most common test used to evaluate workload capacity and detect cardiac abnormalities.

Bruce Treadmill Test Stages, Speeds, and Inclines

Stage	Treadmill Speed	Treadmill Incline
1	1.7 mph	10% grade
2	2.5 mph	12% grade
3	3.4 mph	14% grade
4	4.2 mph	16% grade
5	5.0 mph	18% grade
6	5.5 mph	20% grade
7	6.0 mph	22% grade

- The Bruce protocol involves increasing speed and incline on a treadmill every three minutes per stage
  - Test stops when you've hit 85% of your maximum heart rate, **OR**
  - Heart rate exceeds 115 beats per minute for two stages, **OR**
  - It is deemed that the test should no longer continue

The Bruce protocol treadmill test is the most common exercise tolerance test (ETT) used to evaluate workload capacity and detect cardiac abnormalities. The Bruce protocol involves increasing speed and incline on a treadmill every three minutes. Stage 1 has a treadmill speed of 1.7mph at a 10% grade incline. Stage 2 has a treadmill speed of 2.5mph at a 12% grade incline. For each stage there is an increase incline grade of 2% and a speed increase ranging from 0.5mph to 0.9mph. The treadmill test stops when the individual achieves 85% of their maximum heart rate, or their heart rate exceeds 115 beats per minute for two stages, or it is deemed that the test should no longer continue.

## Exercise Tolerance Test (ETT)

Metabolic equivalent of task (METs) is a unit that estimates the energy used during physical activity, measured in calories

- Can be used to compare activities over a range of body weights and intensities
- 1 MET: The energy cost of sitting quietly
- Under 3 METs: Light-intensity activity
- 3-6 METs: Moderate-intensity activity
- Over 6 METs: Vigorous-intensity activity

### A "Normal" ETT:

- Exceed 6 METs through Bruce protocol Stage 2
- No Angina
- <1 mm ST depression in 2 or more leads
- Exceed 85% of age-predicted max heart rate
- 20 mmHg or more rise in systolic BP

Metabolic equivalent of task (METs) is used as a measurement unit that estimates the energy used during physical activity, measured in calories. It can be used to compare activities over a range of body weights and intensities. One MET would be the energy cost of sitting quietly. Light-intensity activity is considered to be under 3 METs. Moderate-intensity activity is 3-6 METs and vigorous or intense activity is over 6 METs. To pass the ETT, the individual must exceed 6 METs through Bruce protocol Stage 2, have no angina, have <1 mm ST depression in 2 or more leads, exceed 85% of age-predicted max heart rate, and have 20 mmHg or more rise in systolic BP.

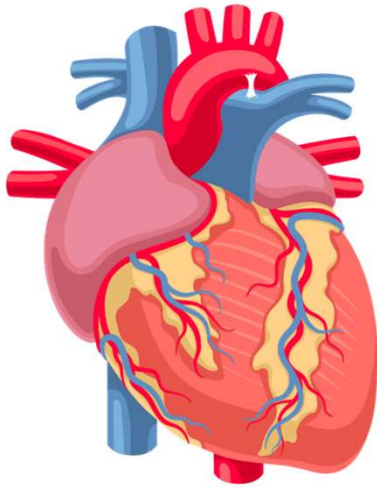
## Echocardiogram (ECHO)

- Uses sound waves to create pictures of the heart to detect abnormalities such as leaking heart valves or stenosis
- Has superior sensitivity and specificity compared to the standard ETT
- Indicated in the presence of an abnormal resting electrocardiogram or non-diagnostic ETT
- Assesses left ventricular ejection fraction (LVEF)
  - Ejection fractions of 55-70% are normal
  - 40-55% are slightly below normal
  - 35-39% are moderately below normal
  - < 35% is severely below normal

The echocardiogram (ECHO) uses sound waves to create pictures of the heart to detect abnormalities such as leaking heart valves or stenosis. It has superior sensitivity and specificity compared to the standard ETT and is indicated in the presence of an abnormal resting electrocardiogram or non-diagnostic ETT. The ECHO assesses left ventricular ejection fraction (LVEF). An LVEF of 55-70% is normal while an LVEF of 40-55% is slightly below normal. An LVEF of 35-39% is moderately below normal and an LVEF < 35% is severely below normal.

# CORONARY HEART DISEASES





The major clinical manifestations of coronary heart disease (CHD) are acute myocardial infarction, angina pectoris (either stable or unstable), congestive heart failure, and sudden death.

The major independent predictor of CHD survival is **left ventricular function**.

**Considerations:**

- Has the treatment been shown to be adequate, effective, safe, and stable?
- Is the driver compliant with the treatment plan?
- Is the driver knowledgeable about medications used while driving?

The major clinical manifestations of coronary heart disease (CHD) are acute myocardial infarction, angina pectoris (either stable or unstable), congestive heart failure, and sudden death. The major independent predictor of CHD survival is left ventricular function. The ME should consider the following: Has the treatment been shown to be adequate, effective, safe, and stable? Is the driver compliant with the treatment plan? And is the driver knowledgeable about medications used while driving?

## Myocardial Infarction (MI)

- The greatest risk of mortality following an MI is within the first few months

### Considerations:

- Asymptomatic
- No left ventricular dysfunction
- No exercise-induced myocardial ischemia on ETT
- Are they compliant with treatment?
- Has treatment been shown to be adequate, effective, safe, and stable?

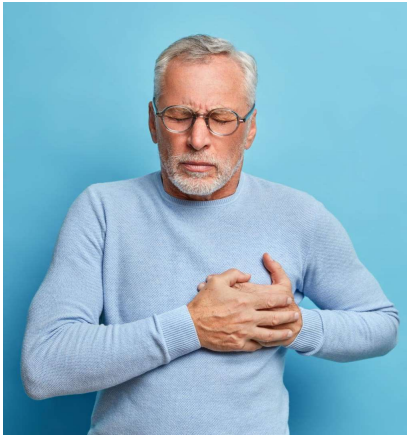
*Cardiologists recommend that an ETT be performed 4 to 6 weeks after an MI and be repeated at least every 2 years.*



The greatest risk of mortality following an MI is within the first few months. Drivers may safely return to any occupational task, provided that the driver is asymptomatic and there is no exercise-induced myocardial ischemia or left ventricular dysfunction. Also, the driver must be compliant with their treatment plan and treatment should be shown to be adequate, effective, safe, and stable. Cardiologists recommend that an ETT be performed 4 to 6 weeks after an MI and be repeated at least every 2 years.

## Angina Pectoris

**Stable = Predictable:** Pain may be precipitated by exertion, emotion, extremes in weather, sexual activity



**Unstable = Unpredictable:**

- Pain at rest
- Change in pattern (increased frequency and longer duration)
- Decreased response to medication

**Considerations:**

- Is the driver asymptomatic?
- How long has the angina been stable?
- How long has the driver had changes in the angina pattern?
- Is the driver compliant with the treatment plan?
- Has treatment been shown to be adequate, effective, safe, and stable?

*Commonly prescribed medications for angina are nitroglycerin and nifedipine.*

Drivers with stable angina can usually be certified to drive if they meet all the requirements. Stable angina is a low risk for safe driving, and usually is caused by narrowing of at least one artery. Stable angina is pain that is predictable, and occurs from exertion, emotion, weather change, or sexual activity. Unstable angina is unpredictable and is characterized by pain at rest, has progressive symptoms such as increased frequency and longer duration, and decreased response to medication. When making a physical qualification determination, the medical examiner should consider the following. Is the driver asymptomatic? How long has the angina been stable? How long has the driver had changes in the angina pattern? Is the driver compliant with the treatment plan? Has treatment been shown to be adequate, effective, safe, and stable?

## Coronary Artery Bypass Grafting (CABG)

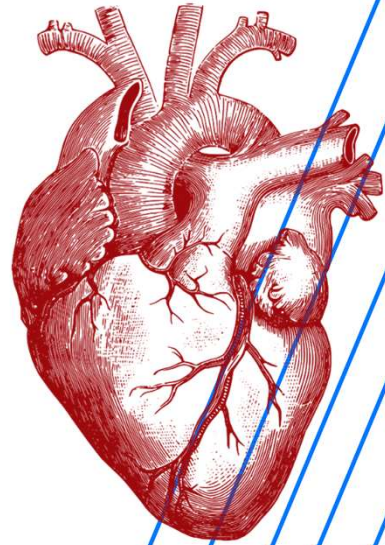
Greatest risk for complications occur in the first 3 months after surgery.  
Also, the sternum generally takes 3 months to heal.

There is a high long-term re-occlusion rate of the bypass graft

- Typically, occurring after 5 years
- May indicate the necessity of a stress test (ETT)

### Considerations:

- Has the sternum healed completely?
- Is the driver asymptomatic?
- Has treatment been shown to be adequate and effective?
- Any orthostatic symptoms relating to cardiovascular medications?
- Does the driver demonstrate compliance with the treatment plan?



The greatest risk of complications from a coronary artery bypass graft (CABG) occur in the first 3 months after surgery. Also, the sternum takes approximately 3 months to heal. After 5 years, there is a high re-occlusion rate, and the ME may consider requesting an ETT before certification. When making a physical qualification determination, the ME should consider the following: Has the sternum healed completely? Is the driver asymptomatic? Has treatment been shown to be adequate and effective? Any orthostatic symptoms relating to cardiovascular medications? Does the driver demonstrate compliance with the treatment plan?



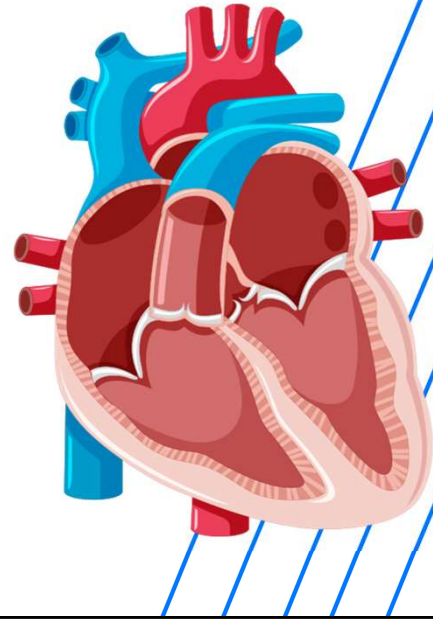
## Congestive Heart Failure

A progressive disease that results from damaged muscles of the heart, affecting the ability to pump blood.

- Leading to fatigue, shortness of breath, reduced physical activity, and swelling of the ankles or legs
- Heart failure is measured by LVEF

### Considerations:

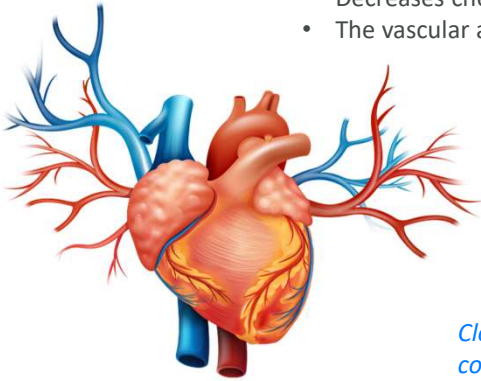
- Is the driver symptomatic?
- Has treatment been shown to be adequate and effective?
- Any orthostatic symptoms relating to cardiovascular medications?
- Does the driver have a stable LVEF?
- Does the driver demonstrate compliance with the ongoing treatment plan?



Congestive heart failure is a progressive disease that results from damaged muscles of the heart that affect their blood pumping action. It reduces the blood supplied throughout the body, leading to fatigue, shortness of breath, reduced physical activity, and swelling of the lower extremities. The degree of heart failure is measured by the left ventricular ejection fraction. When making a physical qualification determination, the ME should consider the following: Is the driver symptomatic? Has treatment been shown to be adequate and effective? Any orthostatic symptoms relating to cardiovascular medications? Does the driver have a stable LVEF? Does the driver demonstrate compliance with the treatment plan?

## Percutaneous Coronary Intervention (PCI) [Angioplasty/Stent Placement]

- Nonsurgical procedure formally known as angioplasty with stent placement
- Decreases chest pain by improving blood flow
- The vascular access site usually heals within 1 week



### Considerations:

- Is there evidence of injury at the vascular access site?
- Does the driver demonstrate compliancy with the ongoing treatment plan?

*Clopidogrel (Plavix) is an antiplatelet agent commonly prescribed after stent placement.*

A percutaneous coronary intervention (PCI), previously known as an angioplasty with stent placement, is a nonsurgical procedure that improves blood flow and decreases chest pain. The vascular access site is usually healed within a week. When making a physical qualification determination, the ME should consider the following: Is there evidence of injury at the vascular access site? And does the driver demonstrate compliancy with the ongoing treatment plan? *Clopidogrel (Plavix) is an antiplatelet agent commonly prescribed after stent placement.*

A 62-year-old male who had CABG five weeks ago states “I feel 10 years younger!”. The only medication he takes is a daily aspirin and he denies any post-surgery episodes of angina.

- Cardiologist report dated 3 ½ weeks post-CABG surgery is provided with clearance for driving
  - LVEF is not included in medical records
- A median sternotomy scar from surgery is noted
- The rest of the exam is unremarkable

**Should this driver be disqualified or qualified and why?**

**Is there a need for any additional testing?**

A 62-year-old male who had CABG five weeks ago states “I feel 10 years younger!”. The only medication he takes is a daily aspirin and he denies any post-surgery episodes of angina. Cardiologist report dated 3 ½ weeks post-CABG surgery is provided with clearance for driving. However, a LVEF is not included in medical records. A median sternotomy scar from surgery is noted. The rest of the exam is unremarkable. Should this driver be disqualified or qualified and why? Is there a need for any additional testing?

- It is recommended that the driver complete a 3-month waiting period post CABG as this is when there is the greatest risk of complications. It is also to allow for the sternum to heal.
- The determination pending status cannot be used because the remaining portion of the waiting period is longer than 45 days

**The driver should be disqualified from driving**

- At the completion of the waiting period, the driver should have a new exam. If he meets all requirements, he may be certified

It is recommended that the driver complete a 3-month waiting period post CABG as this is when there is the greatest risk of complications. It is also to allow for the sternum to heal. The determination pending status cannot be used because the remaining portion of the waiting period is longer than 45 days. The best outcome for a driver should be disqualification from driving. At the completion of the waiting period, the driver should have a new exam and if he meets all the requirements, he may be certified.



# CONGENITAL HEART DISEASE

## Congenital Heart Disease/Congenital Heart Defect

- One or more defects with the heart's structure that has existed since birth
- Can change the way blood flows through the heart
- Some congenital heart defects might not cause any problems while others can be life-threatening

### Congenital heart diseases:

- Patent ductus arteriosus (PDA)
- Ebstein anomaly
- Tetralogy of Fallot
- Coarctation of the aorta
- Pulmonary valve stenosis
- Transposition of the great vessels
- Ventricular septal defect
- Atrial septal defect
- Marfan syndrome

### Considerations:

- What is the anatomic diagnosis?
- What is the severity of the defect?
- How likely is syncope, dyspnea, collapse, or congestive cardiac failure?
- Did the driver undergo successful repair of the congenital defect?
- Does the driver have cardiac enlargement?

Congenital heart disease is also known as a congenital heart defect. This consists of one or more defects with the heart's structure that has existed since birth which can change the way blood flows through the heart. Some congenital heart defects might not cause any problems while others can be life-threatening. Some congenital heart diseases include patent ductus arteriosus (PDA), Ebstein anomaly, Tetralogy of Fallot, coarctation of the aorta, pulmonary valve stenosis, transposition of the great vessels, ventricular septal defect, atrial septal defect, and Marfan syndrome. When making a physical qualification determination, the ME should consider the following: What is the anatomic diagnosis? What is the severity of the defect? How likely is syncope, dyspnea, collapse, or congestive cardiac failure? Did the driver undergo successful repair of the congenital defect? Does the driver have cardiac enlargement?

# CARDIOMYOPATHY



## Hypertrophic Cardiomyopathy

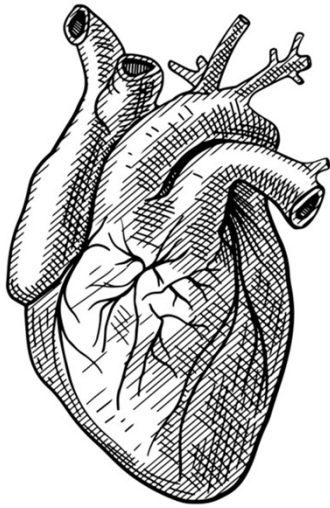
- Most have no symptoms and a near-normal life expectancy
- When symptomatic, individuals have progressive symptoms
  - Can be benign
  - For some, sudden death is the first manifestation

### Signs and symptoms (especially during exercise or exertion):

- chest pain
- syncope
- heart murmur
- sensation of rapid, fluttering, or pounding palpitations
- shortness of breath

Most individuals with hypertrophic cardiomyopathy have no symptoms and a near-normal life expectancy. When an individual is symptomatic, they generally have progressive symptoms. These symptoms can be benign but for some, the first manifestation is sudden death. Signs and symptoms include chest pain, syncope, heart murmur, sensation of rapid, fluttering, or pounding palpitations, and shortness of breath.





## Restrictive Cardiomyopathy

- Least common form of heart disease
- Increased myocardial stiffness leading to impaired ventricular filling

### Signs or symptoms:

- Fatigue
- Shortness of breath
- Pedal edema
- Weakness
- Arrhythmias and conduction disturbances

*MEs should evaluate whether the driver meets the physical qualification standards and may consider obtaining an evaluation by a cardiologist.*

Restrictive cardiomyopathy is the least common form of heart disease. It results from increased myocardial stiffness that leads to impaired ventricular filling. Signs and symptoms include fatigue, shortness of breath, pedal edema, weakness, arrhythmias, and conduction disturbances. *Examiners should evaluate whether the driver meets the physical qualification standards and may consider obtaining an evaluation by a cardiologist.*



# VALVULAR HEART DISEASES

## Heart Murmurs

Murmurs are a common sign of valvular heart conditions

- May be associated with other cardiovascular conditions

### Types of murmurs:

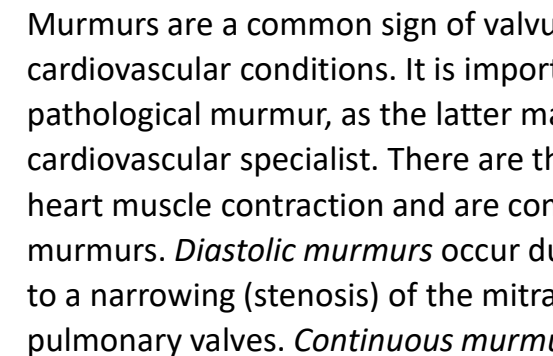
*Systolic murmurs* occur during a heart muscle contraction

- Ejection murmurs
  - Due to blood flow through a narrowed vessel or irregular valve
- Regurgitant murmurs

*Diastolic murmurs* occur during heart muscle relaxation between beats

- Due to a narrowing (stenosis) of the mitral or tricuspid valves
- Or regurgitation of the aortic or pulmonary valves

*Continuous murmurs* occur throughout the cardiac cycle



Murmurs are a common sign of valvular heart conditions and may be associated with other cardiovascular conditions. It is important to distinguish between a functional murmur and a pathological murmur, as the latter may result in disqualification upon being evaluated by a cardiovascular specialist. There are three types of murmurs. *Systolic murmurs* occur during a heart muscle contraction and are composed of both ejection murmurs and regurgitant murmurs. *Diastolic murmurs* occur during heart muscle relaxation between beats. They are due to a narrowing (stenosis) of the mitral or tricuspid valves or regurgitation of the aortic or pulmonary valves. *Continuous murmurs* occur throughout the cardiac cycle.

## Heart Murmur Loudness

Graded according to their intensity

**Grade 1:** Must strain to hear murmur

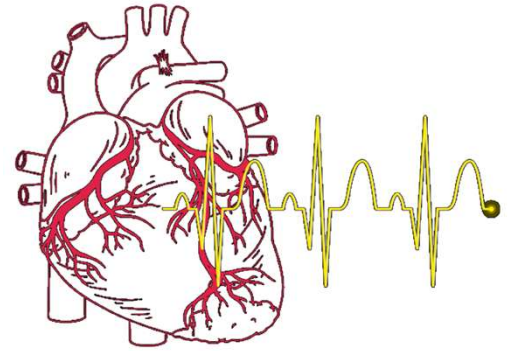
**Grade 2:** Can hear a faint murmur without straining

**Grade 3:** Can easily hear a moderately loud murmur

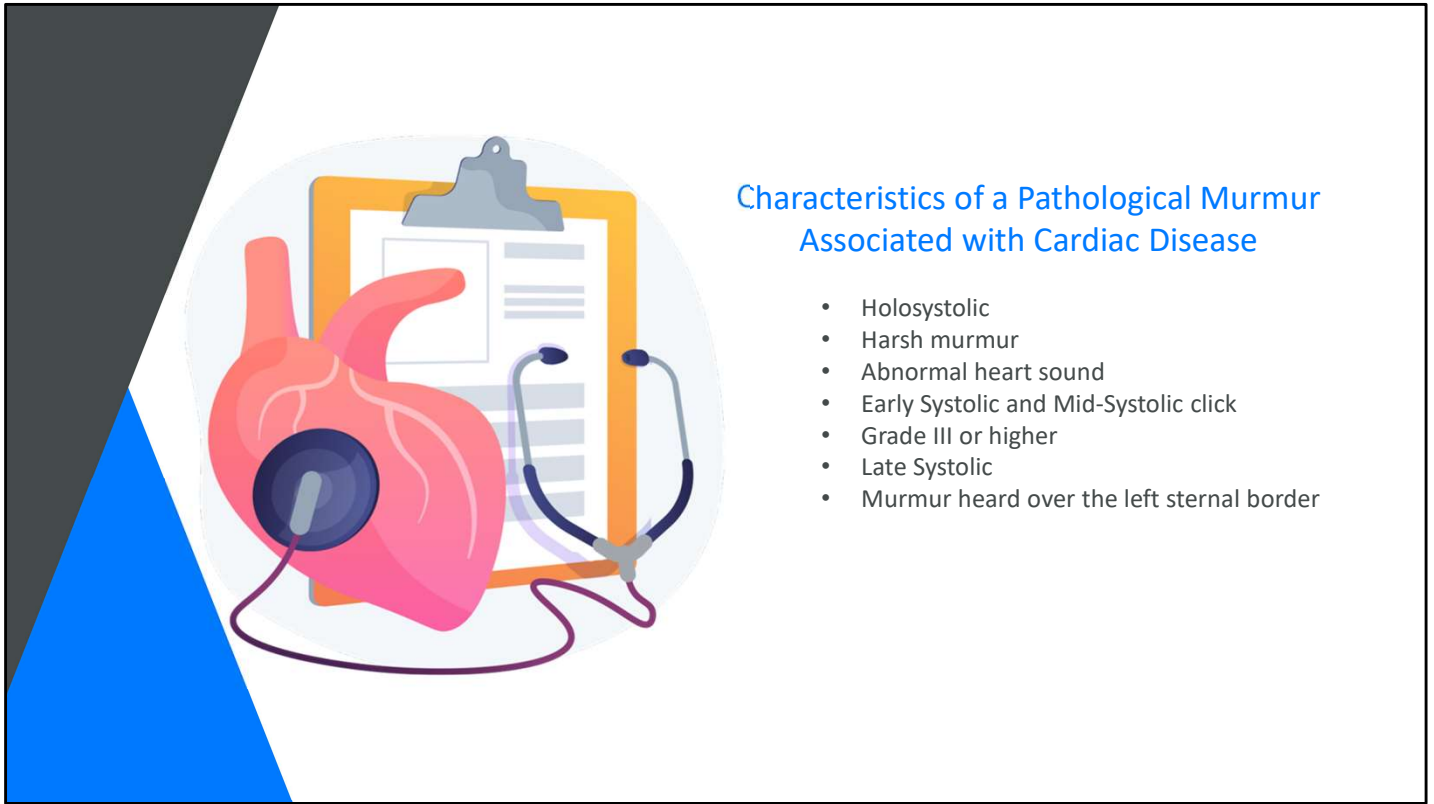
**Grade 4:** Can easily hear a moderately loud murmur with a thrill

**Grade 5:** Can hear the murmur when only part of stethoscope is in contact with the skin

**Grade 6:** Can hear the murmur with the stethoscope close to the skin (not in contact)



Murmurs are classified on a scale from 1-6 according to their volume. With a grade 1 murmur, you must strain to hear the sound. With a grade 2 murmur, you can hear a faint murmur without straining. A grade 3 murmur can easily be heard and is a moderately loud murmur. A grade 4 murmur can easily be heard, that has a thrill which is like the purring of a cat. Only part of the stethoscope must be in contact with the skin to hear a grade 5 murmur and a grade 6 murmur can be heard with the stethoscope close but not even contacting the skin.



### Characteristics of a Pathological Murmur Associated with Cardiac Disease

- Holosystolic
- Harsh murmur
- Abnormal heart sound
- Early Systolic and Mid-Systolic click
- Grade III or higher
- Late Systolic
- Murmur heard over the left sternal border

Here is a list of characteristics of pathological murmurs associated with cardiac disease. They are holosystolic murmurs, harsh murmurs, abnormal heart sounds, early systolic or a mid-systolic click, a grade III murmur or higher, a late systolic murmur, and murmurs heard over the left sternal border.

## Aortic Regurgitation

- Chronic condition
- Gradual left ventricular dilation
- Normal left ventricular systolic function
- Prolonged periods of time when it is asymptomatic
- Conditions such as infective endocarditis and aortic dissection can result in acute severe aortic regurgitation
- **Mild or moderate** = little to no enlargement of the left ventricle
- **Severe** = significant enlargement of the left ventricle

### Considerations:

- Severity of the diagnosis
- Size and function of the left ventricle
- Any symptoms that may cause syncope, dyspnea, or collapse

Aortic regurgitation is a chronic condition with gradual left ventricular dilation, normal left ventricular systolic function, and prolonged periods of time when it is asymptomatic. Some conditions such as infective endocarditis and aortic dissection can result in acute severe aortic regurgitation. When there is little to no enlargement of the left ventricle, this is considered mild or moderate aortic regurgitation. Significant enlargement of the left ventricle is considered to be a sign of severe aortic regurgitation. When making the qualification determination, MEs should consider the severity of the diagnosis, the size and function of the left ventricle, and whether the driver is having any symptoms that may cause syncope, dyspnea, or collapse.

## Aortic Stenosis

Aortic stenosis is characterized by the aortic valve being difficult or stiff to open or does not open fully.

### Symptoms:

- Chest pain
- Tiredness after exertion
- Shortness of breath after exertion
- Heart palpitations

### Treatment:

- Mild cases may not need treatment, but severe cases would need surgery to repair the valve.
  - Balloon valvuloplasty
  - Surgical commissurotomy

### Considerations:

- The severity of the diagnosis
- The presence of signs or symptoms that are likely to cause syncope, dyspnea, or collapse



Aortic stenosis is characterized by the aortic valve being difficult or stiff to open or does not open fully. Symptoms include chest pain, tiredness after exertion, shortness of breath after exertion, and heart palpitations. Mild cases may not need treatment, but severe cases would need surgery to repair the valve, such as balloon valvuloplasty or surgical commissurotomy. The medical examiner should consider the severity of the diagnosis and the presence of signs or symptoms that are likely to cause syncope, dyspnea, or collapse.

## Aortic Valve Repair



### Mechanical valves:

- No risk of rejection
- Do not wear out as quickly
- Require anticoagulation

### Biological valves:

- Harvested from a pig or a cow
- Have a risk of rejection by the body
- Last 7 to 10 years
- Usually do not require long-term anticoagulation therapy

Aortic valves can be repaired with either mechanical valves or biological valves. Mechanical valves last longer and have no risk of rejection but require anticoagulation. Biologic valves are harvested from a pig or cow. These do not require long-term anticoagulation therapy but do have a risk of rejection. The 2013 Expert Panel recommends that drivers who have had aortic valve repair be certified for one year if they are asymptomatic, have a mandatory three-month waiting period, have an LVEF > 40%, are compliant with anticoagulation therapy, and have clearance from a cardiologist.



## Mitral Regurgitation

- The valve between the left heart chambers does not completely close
- The most common type of heart disease
- In severe cases, the heart does not deliver sufficient blood to the body, resulting in:
  - Fatigue
  - Dyspnea
  - Orthopnea

MEs should assess the severity of the diagnosis and the presence of signs or symptoms.

Mitral regurgitation is the most common type of heart disease. It results when the valve between the left chambers of the heart does not completely close. In severe cases, the heart does not deliver sufficient blood to the body, resulting in Fatigue, Dyspnea, and Orthopnea. Medical examiners should assess the severity of the diagnosis and the presence of signs or symptoms. Dyspnea at night indicates a poor prognosis.

## Mitral Stenosis

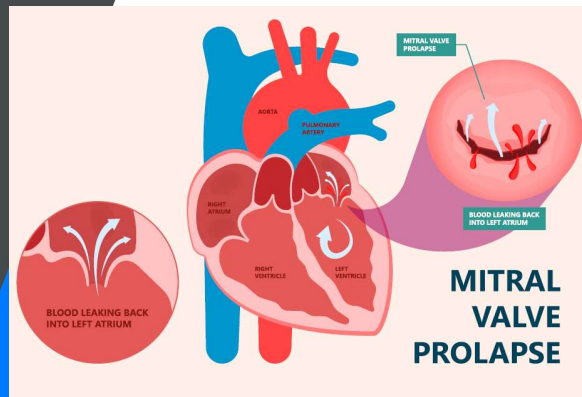
- Narrowing of the valve between the left heart chambers
- Symptoms indicate a poor prognosis:
  - Angina
  - Syncope
  - Fatigue
  - Dyspnea

Treatment options include enlarging the mitral valve or cutting the band of mitral fibers.

MEs should assess the severity of the diagnosis and the presence of signs or symptoms.

Mitral stenosis is a narrowing of the valve between the left heart chambers. The development of symptoms such as angina, syncope, fatigue, and dyspnea is a marker of a poor prognosis. Treatment options include enlarging the mitral valve or cutting the band of mitral fibers. The medical examiner should assess the severity of the diagnosis and the presence of signs or symptoms.

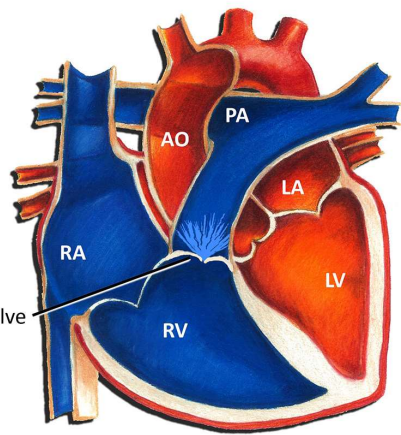
## Mitral Valve Prolapse



Mitral valve prolapse is a common cause of mitral regurgitation.

- Mostly benign
- May manifest with dizziness or lightheadedness, fatigue, arrhythmia, heart murmur, difficulty breathing, or chest pain
- Progression can cause atrial fibrillation, left sided heart enlargement, and congestive heart failure

Mitral valve prolapse is a common cause of mitral regurgitation. Although most cases are benign, it may manifest with dizziness or lightheadedness, fatigue, arrhythmia, heart murmur, difficulty breathing, or chest pain. Progression can cause enlargement of the left ventricle and left atrium, atrial fibrillation, and congestive heart failure.



## Pulmonary Valve Stenosis

- Usually a well-tolerated condition with gradual progression
- Incapacitation and/or sudden death can occur if the stenosis is severe

MEs should assess the nature and severity of the medical condition to determine whether the driver meets the cardiovascular standard.

Pulmonary valve stenosis is generally a well-tolerated condition that has a gradual progression. However, sudden incapacitation or even sudden death can occur. MEs should assess the nature and severity of the medical condition to determine whether the driver meets the cardiovascular standard.



This is the conclusion of Module 3 of the Accredited Training for the National Registry of Certified Medical Examiners.