# Event Information

## Event Info:

**Centennial Park**  
2000 West 1st Street  
Fort Myers, Florida 33901

**General Inquiries**  
Nancy Holland  
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(239) 495-4905

**Event Sponsorship Inquiries**  
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(239) 495-4901

**Donation Mailing Address**  
American Heart Association  
ATTN: Lee Heart Walk  
28441 Bonita Crossings Rd  
Bonita Springs, FL 34135

## Event Location:

Centennial Park

## Event Schedule:

**HEART WALK**  
Activities Begin  
Walk Begins  
12/13/2014 8:00 am  
12/13/2014 9:00 am

## Fees:

Free. No Fees  
Walkers are eligible for a Heart Walk t-shirt once they have raised a minimum of $100.
Chest Pain in Adolescents

Eric Eason, DO, MPH
Introduction

- Chest pain is a common presenting complaint among those in early to mid-adolescence.
- In the United States, persons aged 10 to 21 pay up to 650,000 visits per year to clinicians or emergency departments because of chest pain.
- Generally considered benign and self-limiting from a clinical perspective, chest pain can nonetheless cause substantial anxiety and concern—particularly if patients have a family history of cardiovascular disease (CVD).
Epidemiology

• The prevalence is six per 1,000 children who presented to an urban emergency department or walk-in clinic.

• Chest pain is reported to be the seventh most common health problem among urban black adolescents, one-third of whom seek medical care
Pathophysiology

• No single, identifiable mechanism for chest pain exists, largely because of the complex interplay between innervations of the viscera and musculoskeletal components of the trunk.

• Chest pain, as perceived by patients, may emanate from the cardiovascular, pulmonary, musculoskeletal, or gastrointestinal system.
### Classification

#### TABLE 2. Noncardiac Causes of Pediatric Chest Pain

<table>
<thead>
<tr>
<th>Classification</th>
<th>Causes</th>
</tr>
</thead>
</table>
| **Musculoskeletal disorders** | • Chest wall strain  
• Direct trauma/contusion  
• Rib fracture  
• Costochondritis |
| **Respiratory disorders** | • Severe cough  
• Asthma  
• Pneumonia  
• Pneumothorax/pneumomediastinum  
• Pulmonary embolism |
| **Psychologic disorders** | • Stress-related pain |
| **Gastrointestinal disorders** | • Reflux esophagitis  
• Esophageal foreign body |
| **Miscellaneous disorders** | • Sickle cell crises  
• Abdominal aortic aneurysm (Marfan syndrome)  
• Pleural effusion (collagen vascular disease)  
• Shingles  
• Pleurodynia (coxsackievirus)  
• Breast tenderness (pregnancy, physiologic) |
| **Idiopathic**             |                                                                                                                   |

#### Table 1. Noncardiac Causes of Chest Pain in Children (4–6)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Causes</th>
</tr>
</thead>
</table>
| **Musculoskeletal**       | • Costochondritis/costosternal syndrome  
• Tietze syndrome  
• Nonspecific or idiopathic chest-wall pain  
• Slipping rib syndrome  
• Trauma and muscle strain—overuse injury  
• Xiphoid pain (xiphoidalgia)  
• Sickle cell vaso-occlusive crisis |
| **Pulmonary or Airway-related** | • Bronchial asthma  
• Exercise–induced or cough variant asthma  
• Bronchitis  
• Pleurisy  
• Pneumonia  
• Pneumothorax  
• Pulmonary embolism  
• Acute chest syndrome |
| **Gastrointestinal**      | • Gastroesophageal reflux disease  
• Esophageal spasm  
• Peptic ulcer disease  
• Drug-induced esophagitis/gastritis  
• Cholecystitis |
| **Miscellaneous**         | • Panic disorder  
• Hyperventilation  
• Breast-related conditions  
• Herpes zoster  
• Spinal cord or nerve root compression |
## CARDIAC DISEASE

<table>
<thead>
<tr>
<th>TABLE 1. Cardiac Disorders Leading to Pediatric Chest Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coronary artery disease—Ischemia/Infarction</strong></td>
</tr>
<tr>
<td>• Anomalous coronary arteries</td>
</tr>
<tr>
<td>• Coronary arteritis (Kawasaki disease)</td>
</tr>
<tr>
<td>• Long-standing diabetes mellitus</td>
</tr>
<tr>
<td><strong>Arrhythmia</strong></td>
</tr>
<tr>
<td>• Supraventricular tachycardia</td>
</tr>
<tr>
<td>• Ventricular tachycardia</td>
</tr>
<tr>
<td><strong>Structural abnormalities</strong></td>
</tr>
<tr>
<td>• Hypertrophic cardiomyopathy</td>
</tr>
<tr>
<td>• Severe pulmonic stenosis</td>
</tr>
<tr>
<td>• Aortic valve stenosis</td>
</tr>
<tr>
<td>• Mitral valve prolapse</td>
</tr>
<tr>
<td><strong>Infection</strong></td>
</tr>
<tr>
<td>• Pericarditis</td>
</tr>
<tr>
<td>• Myocarditis</td>
</tr>
</tbody>
</table>
History

• A complete history is essential to diagnosing adolescent health problems in general, and chest pain in particular
• Clinicians should immediately classify chest pain as life-threatening or non-life-threatening
• After establishing the system or organ involved, clinicians should then focus on characteristics of the chest pain that will indicate the severity of the problem
• Rarely are office visits an attempt to malinger or manipulate
### History

**Chest Pain Characteristics: Implications**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Considered Benign</th>
<th>Needs Further Work-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset</td>
<td>At rest</td>
<td>During or after exertion</td>
</tr>
<tr>
<td>Location</td>
<td>Confined to one area</td>
<td>Covers wide area of precordium*</td>
</tr>
<tr>
<td>Radiation</td>
<td>Localized*</td>
<td>To the back, with sensation of ripping or tearing</td>
</tr>
<tr>
<td>Duration</td>
<td>Fleeting or brief duration, or constant over days</td>
<td>Longer than a few minutes</td>
</tr>
<tr>
<td>Reproducibility</td>
<td>Yes, especially when affected area is palpated</td>
<td>No</td>
</tr>
<tr>
<td>Quality</td>
<td>Sharp (of brief duration) or dull</td>
<td>Described as pressure or tearing</td>
</tr>
<tr>
<td>Intensity</td>
<td>Mild</td>
<td>Severe, debilitating; may awaken patient</td>
</tr>
<tr>
<td>Associated symptoms</td>
<td>None</td>
<td>Nausea, vomiting, sweating, weakness, dizziness, syncope, palpitations, tingling, or numbness</td>
</tr>
<tr>
<td>Limitation of daily activity</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Certain musculoskeletal pain radiates to the side or back.
Physical Examination

• This is generally less informative than the history

• Primarily useful in identifying abuse or trauma and in describing patients' overall appearance, a targeted physical examination can nonetheless help to identify a life-threatening problem
**Musculoskeletal**

- Most cases of adolescent chest pain have musculoskeletal origins.
- Precise mechanism leading to chest pain is unknown.
- Unclear attribution to inflammation of the intercostal muscles, costal cartilage, or costal joints.
- Sharp and well localized, without associated symptoms.

### Common Causes of Chest Pain in Adolescents

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idiopathic</td>
<td>21</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>16</td>
</tr>
<tr>
<td>Cough</td>
<td>10</td>
</tr>
<tr>
<td>Costochondritis</td>
<td>9</td>
</tr>
<tr>
<td>Psychogenic</td>
<td>9</td>
</tr>
<tr>
<td>Asthma</td>
<td>7</td>
</tr>
<tr>
<td>Trauma</td>
<td>5</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>4</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>4</td>
</tr>
<tr>
<td>Cardiac disorders</td>
<td>4</td>
</tr>
<tr>
<td>Sickle cell crisis</td>
<td>2</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>9</td>
</tr>
</tbody>
</table>
Pulmonary Conditions

• A history of identifiable illness and additional symptoms (e.g., fever, cough, fatigue, chills) usually accompanies pulmonary causes of chest pain

• Pain on inhalation is fairly typical of pleuritic chest pain

• Potentially life-threatening pulmonary causes of chest pain include pneumothorax and pneumomediastinum
  • Cocaine insufflation can cause both
GI Disorders

- Gastroesophageal reflux disease, peptic ulcer disease, esophagitis, and esophageal spasm can all cause chest pain, although these are less common in adolescents than in adults.
- Can mimic cardiac angina.
Substance Abuse

- Several drugs of abuse, particularly sympathomimetics (e.g., amphetamines, stimulants, cocaine) can cause chest pain.
- Cocaine-related chest pain can resemble a myocardial infarction, both clinically and on ECG.
Psychogenic Conditions

- Adolescent girls more likely than male to present with chest pain of psychogenic origin
- Psychogenic pain has no clearly identifiable or contributing organic etiology
  - Usually associated with stressful events
  - Pain is nonetheless real and should be taken seriously
  - Panic disorder
    - Approximately 30% of young patients who present with chest pain may have panic disorder
    - Hyperventilation is often associated with panic disorders, and can lead to lightheadedness
    - Can lead to social morbidity
- Depression
Cardiac

- Although chest pain associated with potentially life-threatening cardiac disorders is rare in adolescents, it is essential to rule out such conditions.
- Cardiac-related pain tends to be intermittent, associated with exertion, and longer than 10 to 15 minutes in duration, and covers a broad area of the precordium.
- Dizziness, sweating, nausea, syncope, and palpitations.
- Ischemic heart disease is very rare in adolescents. Sometimes associated with a history congenital heart disorder, long-standing hypertension, profound hyperlipidemia, Marfan syndrome, or arteritis.
- Cardiac inflammatory conditions, MVP, Dysrhythmias, etc.
Figure. Distribution of cardiovascular causes of sudden death in 1435 young competitive athletes. From the Minneapolis Heart Institute Foundation Registry, 1980 to 2005. ARVC indicates arrhythmo-
# Cardiac Evaluation

**TABLE 1. Cardiac Disorders Leading to Pediatric Chest Pain**

<table>
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<tr>
<th>Category</th>
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</tr>
</thead>
</table>
| **Coronary artery disease—Ischemia/Infarction** | • Anomalous coronary arteries  
• Coronary arteritis (Kawasaki disease)  
• Long-standing diabetes mellitus |
| **Arrhythmia**                  | • Supraventricular tachycardia  
• Ventricular tachycardia          |
| **Structural abnormalities**    | • Hypertrophic cardiomyopathy  
• Severe pulmonic stenosis  
• Aortic valve stenosis  
• Mitral valve prolapse           |
| **Infection**                   | • Pericarditis  
• Myocarditis                     |
Normal coronary anatomy

Diagram showing different aspects of the coronary anatomy, including labels for various coronary arteries and structures.
Coronary Physiology

Myocardial Oxygen Supply and Demand (Ardehali, Ports)
Anomalies of Coronary Artery Origin

- Origin of one or more coronary arteries from the pulmonary artery
- Anomalous origin of one or more coronary arteries from the aorta
- Origin of coronary arteries from a single coronary ostium
- Ostial anomalies
Left Coronary Artery from the Right Coronary Sinus

- Left main coronary artery may take one of 4 different courses
  - Anterior to the pulmonary artery
  - Posterior to the aorta
  - In the interventricular septum beneath the right ventricular infundibulum
  - Between the aorta and pulmonary artery
- Can be intramural or non-intramural
- In the study of 126,595 angiography patients, seen in 0.047% of patients
• A: Left circumflex coronary artery arising from the right coronary artery.
• B: Left main coronary artery arising from the right sinus of Valsalva (posterior course).
• C: Left main coronary artery arising from the right sinus of Valsalva (anterior course).
• D: Left main coronary artery arising from the right sinus of Valsalva (interventricular septal course).
• E: Left main coronary artery arising from the right sinus of Valsalva, and with a course between the two great arteries. Note the oblique origin of left main coronary artery (LMCA).
• F: Separate origin of the left anterior descending coronary artery from the right sinus of Valsalva.
Left Coronary from Right Coronary Sinus- Intramural course
Right coronary artery from the left coronary sinus
Right coronary artery from the left coronary sinus

- Controversial variant
- In the study of 126,595 angiography patients, seen in 0.17% of patients (6 times that of left coronary artery from right sinus)
- While sudden cardiac death is considered less likely, up to $1/4^{th}$ of patients with anomalous right coronary from the left sinus of Valsalva found at autopsy died suddenly, and $1/3^{rd}$ of the died from cardiac causes
Figure. Distribution of cardiovascular causes of sudden death in 1435 young competitive athletes. From the Minneapolis Heart Institute Foundation Registry, 1980 to 2005. ARVC indicates arrhythmogenic right ventricular cardiomyopathy.
Hypertrophic Cardiomyopathy

- The most common familial heart disease characterized by substantial heterogeneity with respect to presentation, phenotypic expression, clinical course and genetic substrate.
- The most common cause of sudden death in the young, including competitive athletes.
Hank Gathers, 23y, Basketball all-star of Loyola Marymount University collapsed on court, 1990.

Thomas Herrion, 23y, Offensive lineman for San Francisco 49ers collapsed in locker room, 2005.


90% to 95% with abnormal ECG in HCM probands.
Echocardiography
Reflection of Inflections in Hypertrophic Cardiomyopathy

• CW Doppler tracing through the LVOT of a patient with gradient of 64 mmHg
• Inflection point (arrow) marks the beginning of mitral-septal contact
## Genetic Testing

<table>
<thead>
<tr>
<th>Gene</th>
<th>Locus</th>
<th>Protein</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Myofilament HCM</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TTN</td>
<td>2q24.3</td>
<td>Titin</td>
<td>&lt;1</td>
</tr>
<tr>
<td><strong>MYH7</strong></td>
<td>14q11.2-q12</td>
<td>Beta-myosin heavy chain</td>
<td>15-25</td>
</tr>
<tr>
<td><strong>MYH6</strong></td>
<td>14q11.2-q12</td>
<td>Alpha-myosin heavy chain</td>
<td>&lt;1</td>
</tr>
<tr>
<td><strong>MYL2</strong></td>
<td>12q23-q24.3</td>
<td>Ventricular regulatory myosin light chain</td>
<td>&lt;2</td>
</tr>
<tr>
<td><strong>MYL3</strong></td>
<td>3p21.2-p21.3</td>
<td>Ventricular essential myosin light chain</td>
<td>&lt;1</td>
</tr>
<tr>
<td><strong>MYBPC3</strong></td>
<td>11p11.2</td>
<td>Cardiac myosin-binding protein C</td>
<td>15-25</td>
</tr>
<tr>
<td>TNNT2</td>
<td>1q32</td>
<td>Cardiac troponin T</td>
<td>&lt;5</td>
</tr>
<tr>
<td>TNNI3</td>
<td>19p13.4</td>
<td>Cardiac troponin I</td>
<td>&lt;5</td>
</tr>
<tr>
<td>TPM1</td>
<td>15q22.1</td>
<td>Alpha-tropomyosin</td>
<td>&lt;5</td>
</tr>
<tr>
<td>ACTC</td>
<td>15q14</td>
<td>Alpha-cardiac actin</td>
<td>&lt;1</td>
</tr>
<tr>
<td>TNNC1</td>
<td>3p21.3-p14.3</td>
<td>Cardiac troponin C</td>
<td>&lt;1</td>
</tr>
<tr>
<td><strong>Z-disc HCM</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBD3</td>
<td>10q22.2-q23.3</td>
<td>LIM binding domain 3 (alias: ZASP)</td>
<td>1-5</td>
</tr>
<tr>
<td>CSRP3</td>
<td>11p15.1</td>
<td>Muscle LIM protein</td>
<td>&lt;1</td>
</tr>
<tr>
<td>TCAP</td>
<td>17q12-q21.1</td>
<td>Telethonin</td>
<td>&lt;1</td>
</tr>
<tr>
<td>VCL</td>
<td>10q22.1-q23</td>
<td>Vinculin/metavinculin</td>
<td>&lt;1</td>
</tr>
<tr>
<td>ACTN2</td>
<td>1q42-q43</td>
<td>Alpha-actinin 2</td>
<td>&lt;1</td>
</tr>
<tr>
<td>MYOZ2</td>
<td>4q26-q27</td>
<td>Myozenin 2</td>
<td>&lt;1</td>
</tr>
<tr>
<td><strong>Calcium-handling HCM</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JPH2</td>
<td>20q12</td>
<td>Junctophilin-2</td>
<td>&lt;1</td>
</tr>
<tr>
<td>PLN</td>
<td>6q22.1</td>
<td>Phospholamban</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>
Relation between LV thickness and risk of SCD

![Graph showing incidence of sudden death per 1000 person-years versus maximal left-ventricular-wall thickness.](image)

N = 480

Electrocardiogram
Clincal Screening in Families

- **History, Physical, ECG and Echo**
  - *< 12 years old* (Optional unless)
    - Malignant family hx of premature HCM death
    - Competitive athlete (intense training program)
    - Symptoms or other clinical signs of LVH
  - *12 to 18-21 years old*
    - Every 12-18 months
  - *> 18-21 years old*
    - Every 5 years
APPRIOPRIATE USE CRITERIA

ACC/AAP/AHA/ASE/HRS/
SCAI/SCCT/SCMR/SOPE

2014 Appropriate Use Criteria for
Initial Transthoracic Echocardiography
in Outpatient Pediatric Cardiology

A Report of the American College of Cardiology Appropriate Use Criteria Task Force,
American Academy of Pediatrics, American Heart Association, American Society of
Echocardiography, Heart Rhythm Society, Society for Cardiovascular Angiography and
Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular
Magnetic Resonance, and Society of Pediatric Echocardiography
Cardiac Evaluation

8. Flow Diagrams for Common Patient Symptoms

![Flow Diagram: Chest Pain Evaluation](image)

**Figure 3: Chest Pain**

Each indication is preceded with a number sign. The rating of A, M, or R is then followed by the median score in parenthesis for that particular indication. *See Discussion section. Abbreviations: A = Appropriate; M = May Be Appropriate; R = Rarely Appropriate; ECG = Electrocardiogram.
Treatment

• It is important for clinicians to communicate openly with patients and their parents, and to elicit concerns and expectations regarding laboratory tests and diagnostic procedures.
• Sometimes, clinicians' simple affirmation that patients' complaints are real does much to alleviate the stress component of the pain, and may be therapeutic.
Treatment

• Although true cardiac or other serious pathology is rare, chest pain should never be dismissed casually.
• Treat the underlying cause if identified
• Proper referrals only if necessary
• Establish a trusting therapeutic relationship, and encourage continuing communication with clinicians
Reference