EKG Conferences – 2013 - 2014

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Electrocardiography of Shortness of Breath
73 y.o. female with recurrent breast carcinoma. Presented with sudden SOB.
Incidence of Pericardial Effusion in Patients Presenting to the Emergency Department with Unexplained Dyspnea

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Abstract. Objective: To evaluate the frequency of pericardial effusion in patients presenting to the emergency department (ED) with unexplained, new-onset dyspnea. Methods: This prospective observational study took place at an urban community hospital ED with a residency program and an annual census of 65,000 visits. Patients presenting between May 1999 and January 2000 with new-onset dyspnea were eligible if they lacked any pulmonary, infectious, hematological, traumatic, psychiatric, cardiovascular, or neuromuscular explanation for their dyspnea after ED evaluation. Patients received a focused echocardiogram by certified emergency physicians. Data were recorded on standardized data sheets and studies were taped for review. Effusions were categorized as small when the fluid stripe measured less than 10 mm. Moderate-sized effusions measured 10 to 15 mm. Large effusions measured more than 15 mm. Results: One hundred three patients were enrolled. Median age was 56 years (IQR 44, 95% CI = 32 to 67). Fourteen patients (13.6%, 95% CI = 8% to 23%) had effusions. Four had large effusions that explained their dyspnea and were admitted to cardiology; two of these effusions were hemorrhagic, and two were viral in origin. Seven patients with small effusions were treated conservatively at home. Three patients had moderate-sized effusions; all were admitted but treated conservatively. Conclusions: While limited by small numbers, these preliminary data suggest that patients with unexplained dyspnea should be checked for pericardial effusion when bedside ED ultrasound is available. Key words: ultrasound; emergency ultrasonography; pericardial effusion; echocardiography; emergency echocardiography; emergency medicine. ACADEMIC EMERGENCY MEDICINE 2001; 8:1143–1146
EKG signs of Pericardial Effusion

• **Low Voltage**
  - < 5 mm in all limb leads
  - < 10 mm in all precordial leads
  - Poor correlation between voltage & size of effusion

• **Electrical alternans**
  - Cyclic (beat-to-beat) variation in amplitude of QRS
  - Mechanism: Swinging of heart in fluid-filled pericardium

• **Total electrical alternans (P & QRS)** – rare
  - Virtually diagnostic of tamponade
  - Has been associated with malignant effusion
Other causes of electrical alternans

• Supraventricular tachycardias
• Severe left heart failure
• Deep inspirations
  – Typically, without low voltage
Case

• 52 year-old man with recent diagnosis of small cell lung carcinoma. Has complained of increasing shortness of breath.
• Marked tachypnea. BP = 110/90. Obvious jugular venous pressure elevation.
Other causes of *low voltage*

**Infiltrative myocardial diseases**
- Myocarditis
- Amyloid
- Myxedema
  - Effusion
  - Fibrin deposit (insulating effect)

**Extra-cardiac diseases**
- Emphysema
- Pneumothorax
- Obesity
- Pleural effusion
EKG and Pericardial Effusion

- Low voltage is not highly specific or sensitive for pericardial effusion
  - But low voltage is often the first clue
- Other clinical lessons:
  - Not all cancer patients with SOB have a PE
  - Pericardial effusion is a leading cause of unexplained, new-onset SOB
• 54 y.o. man with no significant prior medical history, presented with new-onset shortness of breath.
  – Progressive fatigue & weakness over the past month.
  – SOB increasing in the past 2-3 days
  – Marked exertional dyspnea at grocery store

• Examination:
  – BP: 112/65; RR: 30. Moderate respiratory distress
  – Cardiac: Tachycardia; distant heart sounds
  – Lungs: Decreased breath sounds especially at left base; also rales heart left mid lung field.
Common Clinical Findings

• Tachycardia
• Hypotension or relative hypotension
• Beck’s triad
  – Distant heart sounds (Often normal if effusion is posterior)
  – Low BP
  – Elevated JVP (May be absent if patient volume contracted)
• Predominantly left-sided pleural effusion
• Ewarts sign
  – Patch of dullness to percussion, bronchial breath sounds and egophony below tip of left scapula
  – Compression of base of left lung by large posterior effusion
Suspect Effusion/Tamponade

• Dyspnea that is otherwise unexplained
• Penetrating trauma to chest or abdomen
• Hypotension accompanied/preceded by:
  – Chest pain or pleurisy (even *with* friction rub)
  – Cardiac surgery
  – Cancer
  – Renal failure
• Enlarged cardiac silhouette w/ clear lungs
70 y.o. female with dizziness + SOB
SBP = 60
EKG Findings of Pulmonary Embolus

• Even though
  – Not sensitive or specific
  – Exact contribution to clinical decision tools (Wells, Geneva, d-dimer) not known

• **Often an early clue to proper diagnosis**

• Abnormal in most patients
  – (80%) if sinus tachycardia is included
45 y.o. female with dizziness & shortness of breath
Same patient – 2 days later - after thrombolytic therapy
EKG Clues to Pulmonary Embolus

- Sinus tachycardia
- Right axis deviation
- S$_1$Q$_3$T$_3$
- Atrial fib, flutter, PACs

- T-wave inversions in right precordium
  - Most common (after sinus tachycardia):
  - New rSR’ (complete or incomplete RBBB)
  - Combined T-wave inversions or ST-segment depressions in anterior and inferior leads

**Associated with** more severe PA pressure elevations, RV dysfunction, extensive vascular obstruction and mortality.
CXR in Pulmonary Embolism

- Normal
- **Classic combination**
  - Elevated diaphragm (volume loss)
  - Blunting of costophrenic angle (pleural effusion)
- Sub-segmental atelectasis
- Hamptons hump
- Infiltrate (basal, wedge-shaped, pleural-based)
- Westermark's sign
  - Zone of avascularity
- Prominent pulmonary outflow tract and PA cutoff
70 year old man with SOB
• 35 year old female is 2 weeks s/p vaginal delivery at 32 weeks. Presents with intermittent SOB while visiting her newborn in NICU. Said she was “anxious” and “unable to calm down.”

• Differential diagnosis of SOB in pregnancy – ?
25-JUL-1972 (35 yr)  
Female  Caucasian  
Vent. rate  105 BPM  
PR interval  120 ms  
QRS duration  96 ms  
QT/QTc  404/534 ms  
P-R-T axes  62 3 -5  

Sinus tachycardia  
T wave abnormality, consider anterior ischemia  
Abnormal ECG  
When compared with ECG of 23-APR-2008 20:07,  
Criteria for Inferior infarct are no longer Present  
T wave inversion now evident in anterior leads  
QT has lengthened

Technician: CECILY MARRERO-HUNT  
Test ind: SOB  

Referred by: MICHAEL YARON  
Confirmed by: ERNESTO SALCED
• 57 year old female with left lower extremity pain and swelling, accompanied by SOB

• Examination:
  – Well-appearing, alert with mild respiratory distress
  – Pulse oximetry = 90% on 5L O₂
  – Signs of DVT in left leg

• CTPE: Extensive clot R and L main pulmonary arteries, extending into lower lobes
• 62 year old female with shortness of breath and near-syncopal episode
• Alert, slightly tachypneic
• SBP = 102/58. Right-sided S₃. Bilateral rales.
Sinus tachycardia
Left atrial enlargement
ST & T wave abnormality, consider inferior ischemia
Abnormal ECG
When compared with ECG of 08-MAR-91 19:01,
Non-specific change in ST segment in inferior leads
ST now depressed in lateral leads
T wave inversion now evident in inferior leads
Baseline EKG 2 weeks earlier

<table>
<thead>
<tr>
<th>Date</th>
<th>Vent. rate</th>
<th>PR interval</th>
<th>QRS duration</th>
<th>QT/QTc</th>
<th>P-R-T axes</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-MAY-1928 (62 yr)</td>
<td>94 BPM</td>
<td>160 ms</td>
<td>88 ms</td>
<td>332/415 ms</td>
<td>35 46 37</td>
</tr>
</tbody>
</table>

Normal sinus rhythm
Nonspecific ST-T abnormality
No previous ECGs available

Technician ID: 0
Med: Unknown

Referred by: Confirmed By: JOANN LINDENFELD
Emphysema

- Peri-bronchial destruction of alveolar walls
  - Loss of alveolar attachments
  - Collapse of distal airways
  - Enlargement of air spaces distal to terminal bronchioles

- Plus more airway obstruction (luminal narrowing due to mucus, inflammation)
65 y.o. man with SOB, cough
Plate 1

**Right Atrial Enlargement**

Arrows indicate major atrial electrical vectors

**Left Atrial Enlargement**
EKG Signs of COPD

• Signs of chronic cor pulmonale
  – Right Axis Deviation
  – Right ventricular enlargement
    • Prominent R-wave in V1 (tall R, rSR’, qR)
    • Abnormal S-waves in V5, V6
  – P-pulmonale
    • Leads II, III, aVF: Peaked, “gothic” P-waves (> 2.5 boxes)
    • Inferior (rightward) P-wave axis

• Low voltage
  – Lead 1 sign

• Poor R-wave progression
29 y.o. man with chronic lung disease (cystic fibrosis)
Poor R-wave Progression

- Hyper-aeration of the lungs
- Inferior displacement ("vertical") heart
  - Descent of the diaphragm
  - Heart shifts lower and toward midline
- R.V. hypertrophy and clockwise rotation of the heart (LV moves more posteriorly)
- Differential diagnosis includes old anterior infarction
F. Summary of cardiac electrical activity

- SA node
- Atrial depolarization vector
- AV node (pause in conduction)
- Common bundle of His
- Left and right bundle branches
- Septal depolarization vector
- Late ventricular depolarization vector
- Repolarization vector
- Apical and early left ventricular depolarization vector
Mechanism of MAT

• In atrial tissue
  – Not typical atrial “automaticity”
  – Triggered electrical activity
    • “Secondary” or “after-” or “late” depolarizations
    • A depolarization that is triggered by the after-depolarizations (secondary oscillations of the membrane potential) in phase 4 of preceding beat
  – Possibly due to intracellular Ca++ overload or catecholamine excess
Multifocal Atrial tachycardia

- HR >100
- Visible P-waves
- Iso-electric baseline
  - At least 3 morphologies & 3 PR intervals
- Similar to:
  - Sinus tach + multiple PACs
  - Chaotic atrial rhythm
- Often mistaken for AF

- Closely associated with:
  - Decompensated COPD
  - Decompensated CHF
  - Other hypoxic states
  - Theophylline toxicity

- Treatment (?)
  - Underlying clinical state
  - Beta-blockers (some efficacy in RCTs)
  - Possibly magnesium
  - Calcium channel blockers – weak evidence
  - Digitalis – usually makes it worse
  - Cardioversion - ineffective
Shortness of Breath

REVIEW TRACINGS
57 year old man, walking at DIA and suddenly “slumped over.” Recovered before EMS arrival. Also reported several episodes of exertion-related chest tightness, several days earlier while in Mexico. + dizziness, SOB. Stable, comfortable, joking.
• 64 yo woman was found in cardio-respiratory arrest. Had been seen earlier the same day and started on bactrim. Recent history of laryngitis, URI.
After Resuscitation
• 52 year old man presented with shortness of breath and general weakness.

• Initial BP 118/84. RR = 18. No respiratory distress.
1-AUG-1949 (52 yr)

Male Caucasian

Vent. rate 128 BPM Sinus tachycardia
PR interval 126 ms Otherwise normal ECG
QRS duration 72 ms
QT/QTc 282/411 ms
P-R-T axes 59 34 45

When compared with ECG of 17-JUL-2002 14:36,
No significant change was found

Technician: BRIGETTE SWANSON

Referred by: ABBOTT
Confirmed By: JOHN WEIL, M.D.
• 72 year old man, history of hypertension, presented with 5-6 days of watery diarrhea and weakness. Noted shortness of breath on the morning of admission. In ED had persistent hypotension that responded to IV fluids. Treated with antibiotics (possible sepsis).
31 year old man presents with cough and SOB
• 75 year old woman is 1 month s/p aortic valve replacement. Hx rhuematic aortic and mitral valvular disease. Presented with acute shortness of breath, marked tachypnea.

• Vital signs (?). Clear lungs but + Ewarts sign. Normal heart sounds.
67 y.o. retired cardiologist, history of diabetes. SOB for several weeks, worse this AM and had near-syncope in shower. “Had undergone “extensive work-up 1 week ago for his SOB.”
3 days later, just prior to discharge