Arrhythmia Review Course 1

Basic Interpretation of Arrhythmia

프로그램 디렉터: 이만영
연사: 곽재진, 황종민, 백용수, 김태석
37/F, Refer for abnormal ECG finding
37/F, same patient, Our hospital ECG
ECG calibration marker

1. Standard calibration: 10 mm/mV, 25 mm/s

2. 10 mm/mV, 50 mm/s

3. 20 mm/mV, 25 mm/s

4. 5 mm/mV, 25 mm/s

5. 10-5 mm/mV, 25 mm/s: decrease the amplitude of precordial lead or limb lead deflections only.

Alan Davies, Alwyn Scott, Starting to Read ECGs, 2014
20/M, Dizziness and palpitation
위 환자의 진단은?

1. Ventricular Tachycardia
2. WPW with AF
3. PSVT with aberrant conduction
4. Torsades de pointes
5. Motion artifact
20/M, Dizziness and palpitation
35/M, Left posterior fascicular block?
35/M, same patient, Normal ECG
Lead reversal: left arm / right ram
16/M, ECG abnormality
Dextrocardia
Dextrocardia with situs inversus

- First description of situs inversus in 1606 (H. Fabricius)
- First description of dextrocardia in 1643 (M. A. Severino)

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Fig. 1: A resting standard 12-lead electrocardiogram of a 22-year-old Nigerian man. He had a heart rate of 73 beats per minute, inversion of P-waves in leads I, aVL, and aVR, dominant S-waves in leads I and V1 to V3, isoelectric R-waves progression in chest leads, low voltage QRS axis in V4 to V6, and right axis. Flattened T-waves in V4 to V6 and dVR and inverted T-waves in lead I and AVL.

Fig. 2: A resting standard 12-lead electrocardiogram of a 22-year-old Nigerian man with the electrocardiogram electrodes reversed. The electrocardiogram electrodes were reversed by placing the chest electrodes in a mirror-image position on the right side of his chest and reversing the left and right limb leads. All the previous changes (Fig. 1) were reversed and a normal electrocardiographic pattern of a young adult man occurred.

Fig. 3: Chest X-ray (posterior anterior view) of a 22-year-old Nigerian man showing dextrocardia, with the cardiac apex pointing to the right. His aortic arch was located on the right. His stomach bubble was located below his right hemidiaphragm. His hepatic opacity was located below his left hemidiaphragm. His trachea was slightly deviated to the left.
Dextrocardia

<table>
<thead>
<tr>
<th>Atria</th>
<th>Situs Solitus</th>
<th>Situs Inversus</th>
<th>Situs Solitus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventricles</td>
<td>D-Loop</td>
<td>L-Loop</td>
<td>L-Loop</td>
</tr>
<tr>
<td>Great Arteries</td>
<td>Solitus</td>
<td>Inversus</td>
<td>L-Transposition</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Dextroposition</td>
<td>Mirror-image Dextrocardia</td>
<td>Congenitally Corrected TGA</td>
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</table>

Mirror image dextrocardia

Normal heart and circulation

https://www.rch.org.au/cardiology/parent_info/Mirror_Image_Dextrocardia/
https://ecg-educator.blogspot.com/2016/08/dextrocardia_43.html
50/F, intermittent palpitation
71/M, Sx(-)
APC

Conducted APC

Non conducted APC

360

340

A
AVN
V

RP'

RP'
Three Destinies of APC

- **Refractory period**
  - **LBB**
  - **RBB**

- **Excitable period**
  - **APC with aberrancy**
  - **Non-conducted APC**
  - **APC with normal conduction**
48/F, chest discomfort
APC with aberrant conduction, PVC
Atrial Premature Contraction (APC)

- **No therapy is required** for APCs in the asymptomatic individual. For patients with symptomatic APBs, simple reassurance regarding the benign nature of APBs is frequently adequate to alleviate symptoms. In addition, patients should be counselled to avoid or minimize potential APB precipitants (smoking, caffeine intake, alcohol intake, stress).

- For patients with ongoing symptomatic APBs following efforts to minimize potential APB precipitants we suggest a trial of **medical therapy with β-Blockers** or class IC antiarrhythmic drugs (e.g. flecainide, propafenone).

- When APCs are symptomatic and documented to trigger AF, they may be a target for catheter ablation, particularly in patients with concern for cardiomyopathy due to frequent APBs or those with persistent APBs and symptoms in spite of medical therapy.
45/F, Chest discomfort
Next day

* T wave + PAC
# T wave only
Flecainide 사용 후
M/57 Palpitation, chest discomfort
M/57 Palpitation, chest discomfort

NSR -> A.fib

NSR -> Paroxysmal A.fib

Sustained A.fib (Palpitation)

A.fib -> NSR (Palpitation)
AF catheter ablation

LSPV trigger
52/F, Palpitation
Outflow Tract PVC/VT
(심실유출로 기원 심실조기수축/심실빈맥)

- LBBB morphology
- Precordial transition
  - Sinus: RV & LV simultaneously activation transition V3 or 4
  - LVOT: early transition ≤V2 (earlier than sinus)
  - RVOT: late transition ≥V4
  - (later than sinus)
  - Transition at V3 (both sinus and VT): need more information

- Inferior axis
  - (+) on II, III, aVF

- Frequent PVC
- Exercise test로 유발 (25-50%)
- Catheter ablation
53/M, Exertional Chest pain
PHx none, smoker +
53/M, Exertional Chest pain
Stage 1
53/M, Exertional Chest pain

Stage 2
53/M, Exertional Chest pain
Stage 3
53/M, Exertional Chest pain
Stage 4
53/M, Exertional Chest pain
Recovery
53/M, Exertional Chest pain
TTE: No RWMA, CAG: CAOD
Treadmil exercise testing

- To aid in establishing the diagnosis of CAD, determining functional capacity, and estimating prognosis (Sensitivity: approximately 68% and specificity: 77% for CAD)
- Approximately 75% to 80% of the diagnostic information on exercise-induced ST-segment depression in patients with a normal resting ECG is contained in leads V₄ to V₆

**ACC/AHA Guidelines: Risk Assessment and Prognosis in Patients with Symptoms or Prior History of Coronary Artery Disease**

<table>
<thead>
<tr>
<th>CLASS</th>
<th>INDICATION</th>
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| I     | 1 Patients undergoing initial evaluation with suspected or known CAD, including those with complete right bundle (indicated) branch block or less than 1 mm of resting ST-segment depression (specific exceptions noted below in class IIb)  
2 Patients with suspected or known CAD, previously evaluated, now presenting with significant change in clinical status  
3 Low-risk unstable angina patients 8 to 12 hr after presentation who have been free of active ischemic or heart failure symptoms  
4 Intermediate-risk unstable angina patients 2 to 3 days after presentation who have been free of active ischemic or heart failure symptoms |
| IIa   | Intermediate-risk unstable angina patients who have initial cardiac markers that are normal, a repeat ECG without significant change, and cardiac markers 6 to 12 hr after onset of symptoms that are normal and no other evidence of ischemia during observation |
| IIb   | 1 Patients with the following resting electrocardiographic abnormalities:  
  - Preexcitation (Wolff-Parkinson-White) syndrome  
  - Electronically paced ventricular rhythm  
  - 1 mm or more of resting ST-segment depression  
  - Complete left bundle branch block or any interventricular conduction defect with QRS duration > 120 msec  
  2 Patients with stable clinical course who undergo periodic monitoring to guide treatment |
| III   | 1 Patients with severe comorbidity likely to limit life expectancy and/or candidacy for revascularization  
  2 High-risk unstable angina patients |
ECG during TMT

• PQ 점이 기준. 연속하는 3개 이상의 박동에서
  • ST depression
    • 수평형 또는 하강형일 경우에는 J점 후 60-80ms 점에서 ≥ 1.0 mm
    • 상승형일 때는 J점 후 80 ms 점에서 ≥ 1.5 mm
    • 안정 시에 ST절 하강이 이미 있는 경우에는 추가로 1 mm 이상 하강해야 양성 으로 판정
    • LV를 바라보고 있는 lead V4-6, II/III/aVF 에서 ST depression 이 나타나게 되고, aVR에서 ST elevation 이 나타나게 된다.

• ST elevation
  • Q 파가 없는 유도에서 1 mm 이상이면 양성
TMT – normal response

Rest

Exercise

Computer

Normal

Rapid upsloping

V5

V5

V5

2.5

2.3

-0.3

2.1

2.5

2.3
TMT – normal response

- ST80 displacement (Top number)
  - magnitude of ST-segment displacement 80 milliseconds after the J point relative to the PQ junction

- ST-segment slope measurement (Bottom number)
  - ST-segment slope at a fixed time point after the J point to the ST80 measurement
TMT – may suggest ischemia

Minor ST depression

Slow upsloping

$V_5$

$0.7$

$-2.3$

$1.4$
TMT – myocardial ischemia

Horizontal

Downsloping

V6
TMT – myocardial ischemia

- ST80 displacement (Top number)
  - depression - 1.0 mm (0.1mV) or more

- ST-segment slope measurement (Bottom number)
  - ≤ - 1.0 mV/sec (slow or downsloping)
42/M, Chest pain
Acute Pericarditis

Irritation of the pericardium causes a net positivity in pericarditis.
# Acute Pericarditis

<table>
<thead>
<tr>
<th></th>
<th>Acute Pericarditis</th>
<th>AMI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ST segment</strong></td>
<td>Upward concavity(∪) Not localizing</td>
<td>Upward convexity(∩) localizing</td>
</tr>
<tr>
<td><strong>Reciprocal change</strong></td>
<td>Unremarkable</td>
<td>Characteristic</td>
</tr>
<tr>
<td><strong>QRS complex</strong></td>
<td>Insignificant change</td>
<td>Pathologic Q wave Notching and loss of R-wave amplitude</td>
</tr>
<tr>
<td><strong>T wave</strong></td>
<td>After several days, the ST segments return to normal, and <em>only then, or even later</em>, do the T waves become inverted.</td>
<td>T-wave inversions are usually seen within hours <em>before</em> the ST segments have become isoelectric.</td>
</tr>
<tr>
<td><strong>Morphology</strong></td>
<td><img src="image" alt="Morphology" /></td>
<td><img src="image" alt="Morphology" /></td>
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</table>
46/M, 수술 전 심전도 이상으로 의뢰
Apical hypertrophic cardiomyopathy

Giant T wave inservion
Echocardiography

Apical HCMP
Strain vs. Infarction/Ischemia

- Strain Pattern
- Infarction
- Badness!
- Ischemia
M/83 Dyspnea, PAF, ESRD c HD, HTN, DM...

HR 58 bpm, QTc 594 ms, amiodarone 50 mg qd, K 3.0 mmol/L, Ca\(^{2+}\) 1.05 mmol/L
M/83 Dyspnea, PAF, ESRD c HD, HTN, DM...

2일 후, HR 72 bpm, QTc 466 ms, amiodarone 50 mg qd, K 3.4 mmol/L, Ca^{2+} 1.13 mmol/L
## Acquired Prolongation of QT Interval

### Electrolyte abnormalities:
- Hypokalemia
- Hypomagnesemia
- Hypocalcemia

### Cardiac conditions:
- Myocardial ischemia and infarction
- Myocarditis
- Marked bradycardia
- Stress cardiomyopathy

### Endocrine disorders:
- Hypothyroidism
- Hyperparathyroidism
- Pheochromocytoma
- Hyperaldosteronism

### Intracranial disorders:
- Subarachnoid hemorrhage
- Thalamic hematoma
- Cerebrovascular accident
- Encephalitis

### Nutritional disorders:
- Anorexia nervosa, Starvation
- Liquid protein diets
- Gastroplasty and ileojejunal bypass
- Celiac disease

### Antiarrhythmic drugs
- **Class IA:** Quinidine, disopyramide, procainamide
- **Class III:** Sotalol, amiodarone, ibutilide, dofetilide

### Antibiotics
- **Macrolides:** Erythromycin, clarithromycin, azithromycin
- **Fluroquinolones:** Levofloxacin, moxifloxacin, gatifloxacin, Trimethoprim-sulfamethoxazole
- Clindamycin, Pentamidine, Chloroquine
- Antifungals: Ketoconazole, itraconazole

### Antipsychotics
- Haloperidol, phenothiazines, thioridazine, trifluoperazine, sertindole, zimeldine, ziprasidone
- Tricyclic and tetracyclic antidepressants

### Antihistamines (histamine 1-receptor antagonists)
- Terfenadine, astemizole, diphenhydramine, hydroxyzine

### Cholinergic antagonists:
- Cisapride, organophosphates

### Others:
- Citrate (massive blood transfusions)
- Cocaine
- Methadone
- Fluoxetine (in conjunction with other drugs that prolong QT)

[Harrison’s Internal Medicine 20th Edition]
57/M, General weakness, Lethargy
2 hours later...
## ECG Changes in Hyperkalemia

<table>
<thead>
<tr>
<th>ECG Changes</th>
<th>K⁺ level</th>
</tr>
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<tbody>
<tr>
<td>Tall, peaked T wave</td>
<td>5.7 mEq/L</td>
</tr>
<tr>
<td>Decreased P amplitude</td>
<td>7 mEq/L</td>
</tr>
<tr>
<td>PR prolongation, Loss of P wave, QRS widening</td>
<td>&gt; 8 mEq/L</td>
</tr>
<tr>
<td>Sine wave → arrest</td>
<td>&gt; 10 mEq/L</td>
</tr>
</tbody>
</table>

**Serum potassium levels**

- A. normal (3.5 - 5.0 mEq/L)
- B. about 7.0 mEq/L
- C. 8.0 - 9.0 mEq/L
- D. >10.0 mEq/L

**Changes in the ECG in lead II caused by hyperkalemia**
62/F, ER visit for palpitation and dyspnea
- PAF, Pilsicainide (Sunrhythm) 150 mg bid
62/F, ER visit for palpitation and dyspnea
- After IV adenosine
62/F, ER visit for palpitation and dyspnea

- Atrial Flutter
62/F, ER visit for palpitation and dyspnea
- After DCCV
Class Ic antiarrhythmic drugs

- Primarily block Na\(^+\) channels
- Inhibits phase 0 depolarization
- Minimal effect on repolarization
- Slow binding and dissociation from the receptor
Class Ic & Use-dependency

- Na⁺ channel blocker
  - Rate elevation (AF → AFL)
  - Progression of conduction delay → QRS widening

- Class Ic
- AF에 사용 시 ventricular rate acceleration ; Digoxin, BB, non-DHP CCB 등을 병용 투여
69/M, fatigue, lethargy, and visual aberration
Drug effect of digitalis on ECG

"Scooping" of ST-T wave complex

QT shortening
Digitalis Intoxication

Salvador Dali, 1904-1989