Arrhythmia Review Course 4

Wide QRS Tachycardia

프로그램 디렉터: 임홍의
연사: 김성수, 권창희, 임우현, 최영
CASE 1.

• F/69

• DOE, Dizziness, Palpitations (onset: several hours ago)

• Past Hx: HTN, DM

• V/S: 120/70-150-20-36.4°C
ECG after adenosine 6mg IV
Q. 가장 가능성이 높은 심전도 진단은?

1. Ventricular tachycardia

2. SVT with ventricular pre-excitation: anti-dromic AVRT

3. SVT with preexisting bundle branch block

4. SVT with aberrancy
VT / SVT DDx

Sensitivity: 98.7%, Specificity: 96.5%

AV dissociation → YES → VT

Concordance through precordial leads → YES → VT

R to S interval > 100ms in any of V1 to V6 → YES → VT

Morphology criteria for RBBB or LBBB QRS → YES → VT

SVT

Brugada et al, Circulation 1991;83:1649-1659
Wide QRS tachycardia (RBBB morphology)

VT, RBBB morphology
QRS width >140ms
Positive concordance
V1: qR, R, RR’ (R>R’)?
V6: RS (R<S), rS?

SVT with RBBB
QRS width <140ms
V1: RsR’,RR’(R<R’)
V6: R/S >1
Wide QRS tachycardia (LBBB morphology)

**VT, LBBB morphology**
- QRS width >160ms
- Negative concordance
  - V1: Flat r, slow S, Nadir sign
  - V6: any q (Q)

**SVT with LBBB**
- QRS width <160ms
- V1: tiny rS, QS
- V6: no Q
Typical AVNRT with RBBB
Case 2.

- 46/M

- **C/C:** Palpitations (onset: 30 minutes ago)

- **P/I:** 내원 30분 전부터 sudden onset palpitation, dizziness 발생하여 응급실 내원

- **P/Hx.:** HTN/DM

- **V/S:** 130/80-216-20-36.5°C
ECG at ER
Q. 가장 가능성의 높은 심전도 진단은?

1. SVT with aberrancy
2. Ventricular tachycardia from right ventricle
3. Ventricular tachycardia from epicardium
4. WPW with SVT
### VT vs. SVT

<table>
<thead>
<tr>
<th>Absence of an RS complex in all precordial leads</th>
<th>The longest R to S interval &gt;100 ms in any precordial lead</th>
<th>AV dissociation</th>
<th>Classical criteria for VT present both in lead V1–2 and V6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

#### VT diagnosed | SVT diagnosed

### Classical, Wellens, criteria favouring VT

AV dissociation, capture or fusion beats, negative or positive concordance, tachycardia QRS more narrow than sinus QRS

<table>
<thead>
<tr>
<th>RBBB configuration</th>
<th>LBBB configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>QRS width &gt;140 ms, left axis</td>
<td>QRS width &gt;160 ms, right axis</td>
</tr>
</tbody>
</table>
| QR, R, RSr’ complex in V1 | (A) Initial R in V1 >30 ms  
(B) Slurring or notching of the downstroke of the S-wave in V1–2  
(C) Begin QRS-nadir S-wave >70 ms in V1–2 |
| qR in V1 | R in V1 | Rabbit ear in V1 |
| RS <1 in V6 | QS in V6 |
| Any Q in V6 | Any Q in V6 |
Heart rate: 176회/мин

Heart rate: 210회/мин
Coumel’s law

- Ipsilateral BBB produces prolonged tachycardia cycle length of AVRT
Final diagnosis

Atrioventricular reentry tachycardia with aberrancy
Case 3.

M/26; palpitation

- C/C: palpitation & chest pain

- V/S: BP 100/60, HR 244, RR 23, BT 36.4, SPO2 98
Initial ECG at ER
Spontaneous Termination
Q. 가장 가능성이 높은 심전도 진단은?

1. Ventricular tachycardia

2. SVT with ventricular pre-excitation: anti-dromic AVRT

3. SVT with preexisting bundle branch block

4. SVT with aberrancy
Q. 가장 가능성이 높은 심전도 진단은?

1. Ventricular tachycardia
2. SVT with ventricular pre-excitation: anti-dromic AVRT
3. SVT with preexisting bundle branch block
4. SVT with aberrancy
Anti-dromic AVRT in WPW
Case 4

• M/65
• HT
• 2년 전 PAF 진단받고 타병원에서 flecainide 50mg bid 복용 중.
• 최근 AF 조절되지 않아 flecainide 100mg bid로 증량.

• C.C: 흉통 및 두근거림
• BP 76/48 mmHg, HR 184 bpm
ECG at ER
ECG after DC cardioversion
ECG after 2 days
2D-Echo: EF=65%, no RWMA
Q. 가장 가능성이 높은 심전도 진단은?

1. Idiopathic VT
2. SVT with Aberrancy
3. Anti-dromic SVT
4. Ic Flutter d/t use-dependency of antiarrhythmic drug
ECG at ER
Use-dependency of class IC AADs

- Binding to open-state Na+ channels >> binding to closed Na+ channels

- More effective in myocardial cells at faster HR

- AF with rapid ventricular response → Class IC → Atrial flutter with 1:1 conduction & wide QRS complex

- Class IC AADs should be administered with AV nodal blockers!
Treatment of Ic flutter

• **Acute management**
  – Stop IC AAD
  – Rate control & consider DC cardioversion

• **Long-term management**
  – AF/AFL ablation
  – Change to other class AAD (e.g. Class III AAD)
CASE 5.

• F/39

• Syncope (1 min)

• Past Hx: none

• V/S: 90/60-152-20-36.9°C
ECG at ER
Adenosine 6mg, 12mg IV
ECG after Isoptine 5mg/IV
Q. 가장 가능성 높은 심전도 진단은?

1. Ventricular tachycardia from left ventricle
2. SVT with ventricular pre-excitation: anti-dromic AVRT
3. SVT with preexisting bundle branch block
4. SVT with aberrancy
AV dissociation

QRS > P

Sup Axis

qR

R/S < 1
Idiopathic LV fascicular VT

RBBB + sup. Axis + LAD
Idiopathic LV fascicular VT

- Verapamil-sensitive VT
- In structurally normal heart
- ECG : Monomorphc QRS, RBBB, Superior axis
- Mechanism : Reentry
- Treatment : Verapamil or RFCA
# VT originating papillary muscle muscle

<table>
<thead>
<tr>
<th></th>
<th>PM VT</th>
<th>Fascicular VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manifestation of arrhythmia</td>
<td>Sustained VT&lt;PVC or non-sustained VT</td>
<td>T&lt;</td>
</tr>
<tr>
<td>Mechanism</td>
<td>Abnormal automaticity or triggered activity</td>
<td></td>
</tr>
<tr>
<td>ECG during arrhythmia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QRS morphology</td>
<td>RBBB</td>
<td></td>
</tr>
<tr>
<td>QRS duration</td>
<td>Longer</td>
<td></td>
</tr>
<tr>
<td>V1</td>
<td>qR or R</td>
<td></td>
</tr>
<tr>
<td>Q wave in limb leads</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>Response to verapamil</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>Induction mode during EPS</td>
<td>Spontaneously or during an infusion of isoproterenol or epinephrine</td>
<td></td>
</tr>
<tr>
<td>Recurrence rate after RFCA</td>
<td>Relatively high</td>
<td></td>
</tr>
<tr>
<td>High frequency potential preceeding the earliest local ventricular electrogram</td>
<td>(-)</td>
<td></td>
</tr>
</tbody>
</table>
EPS: VT induction

AV dissoication
RFCA: left Post. Fascicle
Case 6.

M/9

• C/C: palpitation & chest pain
• V/S: BP 105/26, HR 220, RR 23, BT 36.4, SPO2 98
Initial ECG at ER
ECG after amiodarone infusion
Q. 가장 가능성이 높은 심전도 진단은?

1. SVT with aberrancy
2. LV outflow tract VT
3. RV outflow tract VT
4. WPW with AF
Wide QRS tachycardia 의 진단은?

1. SVT with aberrancy
2. LV outflow tract VT
3. RV outflow tract VT
4. WPW with AF
Differential diagnosis of wide QRS tachycardia

Absence of RS in all precordial leads?
- Yes → VT
- No → RS interval (beginning of the R wave to the deepest part of the S wave) > 100 ms in any precordial lead?
  - Yes → VT
  - No → AV dissociation?
    - Yes → VT
    - No → Apply the following conventional criteria

RBBB morphology
- V1 Monophasic R
  - VT
- V1 or V6 Triphasic QRS
  - VT

LBBB morphology
- V1 or V2 Monophasic R > 30 ms or > 60 ms to nadir S, or notched S
  - VT

Brugada algorithm for the differential diagnosis of WCTs

*Circulation* 1991; 83: 1649–1659
### Tachycardia with a LBBB-like QRS

<table>
<thead>
<tr>
<th>Lead</th>
<th>SVT</th>
<th>VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead $V_1$ or $V_2$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R $&gt;$ 30 m sec.</td>
<td>VT</td>
<td>VT</td>
</tr>
<tr>
<td>$&gt;$ 60 m sec to nadir of S</td>
<td>VT</td>
<td>VT</td>
</tr>
<tr>
<td>Notched S</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small R</td>
<td>Broad R</td>
</tr>
<tr>
<td></td>
<td>Fast descent</td>
<td>Slow descent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$&gt;$ 60 ms</td>
</tr>
</tbody>
</table>

### Tachycardia with a RBBB-like QRS

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<tr>
<th>Lead</th>
<th>SVT</th>
<th>VT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead $V_1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monophasic R</td>
<td>VT</td>
<td>VT</td>
</tr>
<tr>
<td>QR or RS</td>
<td>VT</td>
<td>VT</td>
</tr>
<tr>
<td>Triphasic</td>
<td>SVT</td>
<td>VT</td>
</tr>
<tr>
<td></td>
<td>rSR pattern</td>
<td>Monophasic R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>qR (or RS)</td>
</tr>
<tr>
<td>Lead $V_6$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R to S ratio $&lt;$ 1</td>
<td>VT</td>
<td>VT</td>
</tr>
<tr>
<td>QR or RS</td>
<td>VT</td>
<td>Triphasic</td>
</tr>
<tr>
<td>Monophasic R</td>
<td>VT</td>
<td>SVT</td>
</tr>
<tr>
<td>Triphasic</td>
<td></td>
<td>R/S $&lt;$ 1</td>
</tr>
<tr>
<td>R to S ratio $&gt;$ 1</td>
<td>SVT</td>
<td>QS pattern</td>
</tr>
</tbody>
</table>
Brugada algorithm for the differential diagnosis of WCTs

Absence of RS in all precordial leads?
- Yes → VT
- No

RS interval (beginning of the R wave to the deepest part of the S wave) > 100 ms in any precordial lead?
- Yes → VT
- No

AV dissociation?
- Yes → VT
- No

Apply the following conventional criteria

RBBB morphology
- V1 Monophasic R → VT
- V1 or V6 Triphasic QRS

LBBB morphology
- V1 or V2 Monophasic R > 30 ms or > 60 ms to nadir S, or notched S → VT
- SVT

Circulation 1991; 83: 1649–1659
New algorithm using only lead aVR

Vereckei algorithm for the differential diagnosis of wide QRS tachycardia based on the aVR lead

Heart Rhythm 2008; 5: 89–98

56msec > 40msec
Anatomy of normal heart

The right ventricular outflow tract is leftward in the body, in comparison with the left ventricular outflow tract. The right ventricular outflow tract lies anterior to the left ventricular outflow tract.

## Diagnostic criteria

<table>
<thead>
<tr>
<th>RVOT source</th>
<th>LBBB pattern; R-wave transition after V3; tall R in leads II, III, aVF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septal</td>
<td>Absence of notching in leads II, III, aVF; precordial transition &lt;V4</td>
</tr>
<tr>
<td>Free wall</td>
<td>Presence of notching in leads II, III, aVF; precordial transition ≥V4</td>
</tr>
<tr>
<td>Coronary cusps</td>
<td>Strongly inferior axis; precordial transition earlier than in NSR</td>
</tr>
<tr>
<td>LCC</td>
<td>m or w pattern in V1</td>
</tr>
<tr>
<td>RCC</td>
<td>QS or rS pattern in V1</td>
</tr>
<tr>
<td>Aortomitral continuity</td>
<td>RBBB, inferior axis, qR pattern in V1</td>
</tr>
<tr>
<td>LV summit</td>
<td>Inferior axis, delayed upstroke in lead II, QS in lead I, R/S ratio in V2&lt;1</td>
</tr>
</tbody>
</table>
ECG morphology of outflow tract ventricular arrhythmias
RVOT vs. LVOT VT

RVOT tachycardia

LVOT tachycardia
EPS and RFCA

VT induction by RAP (320 msec) under isoproterenol infusion (1ucg/min)
Activation mapping

RVOT posteroseptum

Preceding to the onset of QRS by 43msec
Successful ablation

4 seconds
Case 7

- **71/M**

- **C/C:** chest pain (onset: 3 days ago)

- **P/I:** 내원 3일 전부터 intermitent chest pain 발생하였다가 내원 당일부터 증상 악화되어 응급실로 내원함.

- **P/Hx:** HTN/DM

- **V/S:** 100/60 – **201** – 30 – 36.1°C
ECG at ER
ECG after cardioversion
Q. 가장 가능성이 높은 심전도 진단은?

1. SVT with Aberrancy
2. Ventricular tachycardia from right ventricle
3. Ventricular tachycardia from epicardium
4. WPW with SVT
Assessing the origin of VT
Epicardial VT - ECG criteria

• Pseudo-delta >34ms

• Intrinsic deflection time >85ms

• Shorted RS complex duration >121ms
Absence of q wave

Presence of q wave

IDT: 112 ms

QRS: 206 ms

Pseudo-delta: 56 ms

MDI: 103 ms / 206 ms: 0.5

Shortest RS: 157 ms
Apical superior LV:
- Q wave lead I

Basal superior LV:
- Q wave lead I
- No Q wave leads II-III-aVF

Apical inferior LV:
- Q wave II-III-aVF
- aVR/aVL<1

Basal inferior LV:
- Q wave leads II-III-aVF
- aVR/aVL<1

LV EPICARDIUM

LV ENDOCARDIUM

LV APEX:
- Q wave lead V2

LV apex:
- Q wave lead V2
Epicardial VT – LV basal anterolateral wall
Epicardial VT – LV basal inferior wall

Endocardial VT with similar origin
Treatment

- IV amiodarone/esmolol infusion
- Coronary angiography: normal
- 2D ECHO.: LVEF 40%, Global hypokinesia
- ECMO support
- Radiofrequency catheter ablation
Activation – LV endo/epicardium
Ablation site

RAO view

LAO view
Epicardial ablation

• Indication
  – Previous failure of endocardial ablation
  – Predictive ECG criteria
  – Chagas disease
  – Epicardial scar on MRI for myocarditis sequelae/NICM/HCMP..
  – ARVC
  – Brugada syndrome
Case 8

- M/75
- DCM (EF=25%), PAF
- 4YA, ICD implantation for primary prevention
- C.C: Dizziness, palpitation
- V/S 92/68 mmHg, HR 140 bpm
- Medication
  - Carvedilol SR 16mg qd, valsartan 80mg bid, spironolactone 12.5mg qd, amiodarone 100mg qd
  - Pradaxa 110mg bid, pitavastatin 2mg qd
ECG in ER

DEVICE(Ver): MAC2000 (1.1)  0.56-150Hz  60Hz
REST ECG : 4 X 2.5s + 1 Rhythm
25mm/s, 10mm/mV
Q. 가장 가능성이 높은 심전도 진단은?

1. Ventricular tachycardia from right ventricle

2. Ventricular tachycardia from left ventricle

3. SVT with aberrancy conduction

4. SVT with WPW syndrome: anti-dromic AVRT
ECG in ER
ECG after DC cardioversion
2 distinct patterns of myocardial scarring in patients with NICM
VT in structural heart disease

• **Fast VT vs. Slow VT**

• **In this patient, slow VT (HR 141 bpm) developed**
  – Below VT detection rate (148 bpm) → no therapy delivered

• **Treatment of slow VT**
  – **Medical treatment**
    • Optimal HF management
    • BB, AAD (amiodarone)
  – **Sustained slow VT** → ATP (anti-tachycardia pacing) therapy only
  – **Short lasting slow VT** → monitor only
  – **If intractable** → consider VT ablation
CASE 9.

- M/43
- Chest pain (30 minutes ago)
- Past Hx: HTN, DM (3 Years on Med)
- Social Hx: Current smoker (15PYs)
- V/S: 70/60-100-20-36.9°C
ECG at ER
문제. 가장 가능성이 높은 심전도 진단은?

1. Ventricular tachycardia
2. SVT with ventricular preexcitation
3. Atrial flutter with preexisting bundle branch block
4. Accelerated idioventricular rhythm
응급 관상동맥 조영술
응급 관상동맥 중재술

4.0*12mm Xience Alpine
Kissing Balloon 3.5mm LAD, 2.5mm LCX
ECG at discharge
Accelerated Idioventricular Rhythm (AIVR)

- May result from accelerated ventricular focus that is faster than the prevailing sinus rate and takes over or can occur as escape rhythm (generally with 3rd degree AVN block)
- Usually 60-100 bpm (differentiates from VT)
- Regular wide QRS
- Associated with post-MI (especially inferior wall MI), reperfusion tx, digoxin toxicity, or after a PVC
- Usually self limited, rarely see progression to VT/VF
Acute LM occlusion

“Acute circumferential subendocardial ischemia”:

- ST ↓ ≥ 1 mm in 6 or more leads (most prominent in V4-5)
- ST ↑ in aVR ≥ 1 mm
- ST ↑ in aVR ≥ V1
  - ST deviation in V6 > V1
  - STEMI equivalent

The combination of acute ischemia in the LAD and CX region results in a frontal ST deviation vector pointing toward aVR and a horizontal ST deviation vector directed away from the posterior wall.

*Am Heart J 2010;160:995-1003*
*J Electrocardiol 2008;41:626–9*
*The ECG in Emergenciy Decision Making. Saunders 2006*
Case 10

- F/77
- H/O stroke (2014.5)
- DM, HT, dyslipidemia
- Angina, 1VD, s/p PCI (2017.7)
- Dizziness d/t AF c SVR → PM 거부

- C.C: repeated loss of consciousness with seizure-like activity (1DA)

- Medication
  - Apixaban 2.5mg bid, aspirin 100mg qd, telmisartan 80mg qd, rosvustatin 10mg qd
  - Novomix (7:3) 16-8 unit, gemigliptin 50mg qd, metformin 500mg qd
ECG 4 months ago
ECG at ER
Q. 가장 의심되는 원인은?

1. Vasovagal syncope
2. Sudden asystole
3. Tachy-brady syndrome
4. Bradycardia-dependent polymorphic VT (TdP)
Telemetry ECG rhythm during LOC
Torsades de Pointes (TdP)

- Polymorphic VT with
  - Prolonged QT interval during sinus rhythm
  - QRS complexes twisting around the isoelectric baseline
- Etiology
  - Congenital
  - Acquired (drugs or electrolyte abnormalities)
  - Initiation: a long – short ventricular cycle length
- Treatment
  - D/C QT prolongation drugs, correction of electrolyte abnormalities
  - IV Magnesium sulfate 2g (x2)
  - Atrial or ventricular overdrive pacing > 90bpm, or isoproterenol
Treatment
Case 11.

• M/76
• c/c: sudden collapse

• P/I: small bowel infarction 에 의한 pneumoperitoneum 으로 small bowel resection 시행 후 POD #9 째 새벽 e-tube 물고 saturation 감소하면서 sudden collapse 발생, wide QRS tachycardia 소견 보여 CPR and defibrillation 후 회복됨.

• P/Hx:
  – PeAF
  – h/o CVA -> NR (Plavix PO)
  – DM
  – HTN
Initial ECG at ER
Rhythm strip at patient’s event
Rhythm strip at patient’s event
ECG after defibrillation
Laboratory results

- Hb 10.1 g/dL
- BUN/Cr 36/1.3 mg/dL, K 3.9 mmol/L
- Mg ionized 0.57 mmol/L (0.45~0.6)
- CK-MB <0.7 ng/ml (~6.6)
  - Post-OP (POD #2) CK-MB 26
- Hs-TnI 978 ng/L (~20.7)
  - Post-OP (POD #2) hs-TnI 10001
Q. 가장 가능성 높은 심전도 진단은?

1. Monomorphic VT

2. Polymorphic VT with ischemia

3. Bidirectional VT

4. Torsades de pointes in long QT
진단은?

1. Monomorphomic VT
2. Polymorphic VT with ischemia
3. Bidirectional VT
4. Torsades de pointes in long QT
Morphology of Ventricular Arrhythmias

Ventricular tachycardia

Monomorphic VT

Polymorphic VT

Bidirectional VT

Torsades de pointes

Ventricular flutter

Ventricular fibrillation

2017 VA/SCD Guideline
Echocardiography

Newly developed RWMA at LCX territory
Coronary angiography
Figure 5. Treatment of Recurrent VA in Patients With Ischemic Heart Disease or NICM

1. **ICD with VT/VF recurrent arrhythmia**
   - **Polymorphic VT/VF**
     - **Consider reversible causes**
       - Drug, electrolyte induced: Treat for QT prolongation, discontinue offending medication, correct electrolytes (Class I)
       - Ischemia: Revascularize (Class I)
       - No reversible causes: Amiodarone (Class I)
     - **Sustained monomorphic VT**
       - Catheter ablation as first-line therapy (Class IIb)
       - Amiodarone or sotalol (Class I)

2. **Arrhythmia not controlled**
   - IHD with frequent VT or VT storm
     - Yes: Catheter ablation (Class I)
     - No: Catheter ablation (Class IIa)
   - NICM
     - Catheter ablation (Class IIa)

*Colors correspond to Class of Recommendation in Table 1.*
Case 12

- 70/M

- C/C: Dizziness, Palpitations (onset: several hours ago)

- P/I: 내원 당일 피부 미용팩을 미숫가루로 오인하고 복용 후 심계항진을 동반한 의식소실을 주소로 타병원에서 수 차례 Cardioversion 및 amiodarone 정주하였으나 반응 없어 응급 전원됨.

- P/Hx: HTN

- V/S: 90/50-193-28-36.4°C
ECG at ER
ECG at ER
Q. 가장 적절한 치료 방법은?

1. Adenosine 투여

2. 반복적인 Cardioversion

3. Quinidine 정주

4. Extracorporeal circulation (ECMO)
Bidirectional VT

• Usually caused by drug toxicity (digitalis, aconite)

• Other etiologies: myocarditis, MI, cardiac tumor, cardiac channelopathies

• Triggered activity arising alternately from the left fascicle

• Alternating left- and right- axis deviation
Electrical storm

• **Definition**
  – $\geq 3$ recurrent episodes of sustained (>30초) VT/VF or appropriate ICD shock during 24 hours

• **Initial evaluation**
  – Accurate diagnosis of clinical arrhythmia
  – Assess underlying structural heart disease
  – Identify reversible factors: ischemia, electrolyte imbalance, worsening heart failure, hyperthyroidism, drug, infection..
Electrical storm

• Treatment
  – Amiodarone/beta-blocker
  – Lidocaine (amiodarone에 보조적으로, 주로 ischemia와 동반될 때)
  – Sedation/general anesthesia
  – Refractory VT with hemodynamic compromise: percutaneous hemodynamic support (ECMO/IABP)
  – TdP: magnesium, replace potassium, isoproterenol, overdrive pacing..
  – Refractory monomorphic VT: RFCA
Extracorporeal Circulating System
Extracorporeal circulation 12시간 후 심전도
Extracorporeal circulation 48시간 후 심전도
Case 13.

- M/46

- C/C: dyspnea & edema

- V/S: BP 131/77, HR 122, RR 28, BT 36.6, SPO2 99
Initial ECG at ER

QRS 59
T -78

konkuk - konkuk (500-00-01)

- ABNORMAL ECG -

Not confirmed

Device: 01  Speed: 25 mm/sec  Limb: 10 mm/mV  Chest: 10 mm/mV

E 60- 0.5-150 Hz W  PH090A  P?
Holter monitoring

<table>
<thead>
<tr>
<th>Venticular Events</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Beats</td>
<td>68966</td>
</tr>
<tr>
<td>Couplets</td>
<td>1698</td>
</tr>
<tr>
<td>Triplet</td>
<td>960</td>
</tr>
<tr>
<td>Bigeminny Runs</td>
<td>68</td>
</tr>
<tr>
<td>Trigeminny Runs</td>
<td>19</td>
</tr>
<tr>
<td>Longest</td>
<td>76 beats at 03:00:32-2</td>
</tr>
<tr>
<td>Min Rate</td>
<td>42 BPM</td>
</tr>
<tr>
<td>V Tach Runs</td>
<td>6262</td>
</tr>
<tr>
<td>Max Rate</td>
<td>207 BPM</td>
</tr>
<tr>
<td>Max VE/Minute</td>
<td>104 beats at 01:50:00-2</td>
</tr>
<tr>
<td>Max VE/Hour</td>
<td>5269 beats at 05:00:00-2</td>
</tr>
<tr>
<td>Mean VE/Hour</td>
<td>4330.7</td>
</tr>
<tr>
<td>VE/1000</td>
<td>777.6</td>
</tr>
</tbody>
</table>
Echocardiography

LVE (LVEDD/ESD = 63/47mm), LV EF = 35%
Q. 가장 가능성이 높은 심전도 진단은?

1. PVC induced cardiomyopathy
2. DCMP with frequent PVCs & VT
3. AF with RBBB aberrancy
4. AF with WPW
진단은?

1. PVC induced cardiomyopathy
2. DCMP with frequent PVCs & VT
3. AF with RBBB aberrancy
4. AF with WPW
# AF with WPW vs. AF with BBB

<table>
<thead>
<tr>
<th>공통점</th>
<th>WPW with AF</th>
<th>AF with BBB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregularly irregular, Wide QRS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>차이점</td>
<td>Variable QRS morphology</td>
<td>Monoform QRS</td>
</tr>
<tr>
<td>QRS polarity – As delta wave</td>
<td>QRS polarity – As BBB</td>
<td></td>
</tr>
</tbody>
</table>
# Treatment of WPW with AF

<table>
<thead>
<tr>
<th>Class</th>
<th>Management</th>
</tr>
</thead>
</table>
| **I**  | B Catheter ablation of the accessory pathway  
- syncope secondary to a rapid heart rate  
- a short bypass tract refractory period  
B Immediate DC cardioversion (hemodynamic instability)  
C IV procainamide or ibutilide (without hemodynamic instability)  |
| IIa    | B IV flecainide |
| IIb    | B IV quinidine, disopyramide or amiodarone |
| III    | B IV digitalis or non-dihydropyridine CCB |

* Braunwald’s Heart Disease 10th*
EPS and RFCA
EPS and RFCA

Delta (+)
EPS and RFCA
EPS and RFCA

Ablation precedes to the onset of QRS by 16msec
ECG after RFCA
FU echocardiography after 2 months

LVE (LVEDD/ESD = 55/38mm), LV EF = 46%
Case 14

• M/10
• 8세 경부터 달리기 후 의식소실

• 1 년 전에는 학교에서 화장실 가던 중 친구들을 따라가며 뛰어가다가 갑자기 심계항진과 어지러움증 느껴고 쓰러진 적 있음.

• 자전거를 타고 언덕을 오르고 나서 가슴이 두근거리고 나서 기절 한 적이 있음.
Q. 가장 가능성이 높은 심전도 진단은?

1. Idiopathic VT

2. Torsades de pointes (TdP)

3. Ventricular fibrillation

4. AF with WPW syndrome

5. Catecholaminergic polymorphic VT
Catecholaminergic polymorphic VT

PVC; Premature ventricular contraction

alternating QRS morphologies

→ Bidirectional VT
Catecholaminergic polymorphic VT

• Clinical presentation:
  – VT/VF during emotional or physical stress

• ECG:
  – Polymorphic VT with continuously varying QRS
  – Bidirectional tachycardia

• Genetics:
  – Cardiac ryanodine receptor (RyR2) gene mutation

• Treatment:
  – Beta-blocker (+ verapamil or flecainide) ICD
Catecholaminergic polymorphic VT

• 유전자 검사
  – RYR2 gene
  – p.Glu2636Lys (c.7906G>A)
  – NM_001035.2
  – novel mutation 확인됨

• 치료
  – beta blocker 단독 치료를 하다가 syncope 재발하여
    left cardiac sympathetic denervation surgery 를 함( 12세 ),
  – 2011 년부터 beta blocker + flecainide 병용요법을 하고 있음,
  – 그 후로 8 년 간 증상이 없음, 현재 20 세
Case 15

- M/54
- No medical history
- C.C: Palpitation / 1hrs
  - 오후 7시경 귀가 중 갑자기 가슴이 빨리 뛰며 머리 아프고 어지러워 응급실 내원함
  - 1st event
- V/S: BP 110/70 mmHg, PR 228bpm
ECG in ER
Q. 응급실에서 가장 먼저 해 볼 수 있는 방법은?

1. Adenosine 투여
2. 즉각적인 Cardioversion
3. Amiodarone 정주
4. Carotid sinus massage
After adenosine 6mg IV
Atrial flutter

Atrial flutter, 2:1 conduction

Atrial flutter, 4:1 conduction

- Atrial rhythm is regular (about 300 bpm)
- Ventricular rate may be regular or irregular due to varying conduction down AV node (3:1, 4:1 or 3:2 conduction...)
- Commonly see 2:1 block with V rate 150 bpm
- Usually see inverted “p” waves or F waves in leads II, III, aVF in typical atrial flutter because atrial activation starts inferiorly and heads upward
Rate-dependent bundle branch block

- Wide QRS complex appears only at the certain heart rate (Critical heart rate)
- Prolongation of the refractory period in cells of the conductive system.
- Slowed and delayed conduction within the bundle of His, right or left bundle branch
  (Often in the Right bundle, which generally has a longer refractory period)
- Associated with HTN, previous MI, CAD, m

1. Tachycardia dependent BBB
2. Exercise induced BBB (LBBB > RBBB)

Ashman's phenomenon Long preceding R-R interval following by a short cycle ("rate-related bundle branch block")
Thank you for your attentions!

Korea University Cardiovascular Center