ICD for Primary Prevention of Sudden Cardiac Death

가톨릭 의과대학
오 용 석

Introduction

- Implantable cardioverter defibrillator (ICD) is recommended as the prime therapy for the secondary prevention of SCD.
- However, because only a small percentage of patients who suffer a cardiac arrest survive to benefit from the ICD therapy as secondary prevention, prophylactic use of ICD for primary prevention of SCD becomes an attractive option for high-risk patients.

Risk Stratification for ICD therapy

- SCD incidence : 2 /1000 per year
- Structural heart disease :

1) Myocardial infarction (MI)
2) Congestive heart failure (CHF) : LVEF is the primary factor
3) Signal-averaged electrocardiogram (SAECG)
4) Baseline ventricular arrhythmia,
5) T-wave alternans,
6) Autonomic nerves function,
7) Electrophysiological (EP) testing

Non-invasive evaluation for sudden cardiac death

1. Cardiovascular function

(1) LVEF is the most consistent and powerful predictor of all-cause and cardiac mortality in patients with ischemic and non-ischemic heart diseases.
LVEF < 30–35%

LVEF has relatively low specificity as a predictor of death from arrhythmia.

(2) NYHA functional class

: NYHA classes II and III symptoms are much more likely to die of arrhythmia than NYHA class IV symptoms.

2. Ventricular arrhythmias

- Premature ventricular complexes (PVCs) and non-sustained ventricular tachycardia (NSVT) in normal subjects
- The majority of studies : PVCs did not increase the risk fatal arrhythmia
- In MI, with a depressed LVEF (<30%) predicted a high risk of SCD in a long-term follow-up (after 6 months).

- However, further analysis showed that the length but not the rate of NSVT on 24 h ECG was a predictor of major arrhythmic events in patients with DCMP.
- The incidence of major arrhythmic events during follow-up increased to 10% per year in patients with 10 beat runs of NSVT ($P < 0.05$).

3. Electrocardiographic evaluation for SCD

1) Standard electrocardiography

- Underlying structural heart diseases

  : ventricular hypertrophy, ischemic heart disease

- Congenital abnormalities (e.g. long-QT syndrome, short-QT syndrome (< 300ms), and Brugada syndrome)

- Electrolyte disturbances.

- Prolonged QRS duration (usually .120 ms)

2) QT dispersion, QT variability, and QT dynamicity

- No relationship between QT dispersion or QT variability and patient outcomes.

- Currently has not been clinically useful.

3) Microvolt T-wave alternans

- alternating T-wave amplitude and morphology from beat to beat
- This repolarization abnormality can be associated with re-entrant ventricular arrhythmias.
- Very high negative predictive value for predicting ventricular arrhythmias.
- Positive and negative predictive values of the MTWA test were similar to those of EP testing at 1 year.
- MTWA testing should not be overinterpreted.

4) Signal-averaged electrocardiogram (SAECG)

- Late potential
- The main role of SAECG is its excellent negative predictive value in patients with MI, whereas its positive value is relatively low (<30%)

5) Autonomic function for sudden cardiac death

- Heart rate variability (HRV), baroreflex sensitivity, heart rate turbulence (HRT), and deceleration capacity of heart rate (HR-DC)
- the absence of HRT , useful predictor of all-cause mortality in post-MI patients, but less evidence for sudden death or arrhythmic events.

6) Serum markers

- BNP (brain natriuretic peptide)
- Increased BNP and C-reactive protein were associated with a higher VT incidence.
- BNP is primarily a marker of progressive CHF, which itself may lead to an increased risk of arrhythmic events. Therefore, the role of BNP as a risk stratifier should not be over-estimated at present,

7) Invasive evaluation of sudden cardiac death

- EP testing
- In ischemic heart disease, the inducibility of sustained ventricular tachyarrhythmias during EP testing is a well-established marker of an increased risk of ventricular tachyarrhythmia.
- high number of false-negative

- In conclusion, currently available data do not support routine use of any risk-stratification techniques for selection of patients for ICD therapy.
- More specific means and risk modelling are still needed to identify those patients who will benefit from an ICD.

- *ACC / AHA / HRS 2008 Guideline* -

- Prior MI and heart failure due to either coronary artery disease
- Nonischemic DCM.
- HCM,
- ARVD/C,
- long-QT syndrome.
- In less common conditions (e.g., Brugada syndrome, catecholaminergic polymorphic VT, cardiac sarcoidosis, and LV noncompaction),

1) Coronary artery disease

(1) Prior MI (at least 40 days post infarct)
LVEF < 30% in NYHA functional class I
(MADIT-II criteria)

(2) Prior MI (at least 40 days post infarct)
LVEF < 35% in NYHA functional class II-III
(SCD-HeFT criteria)

(3) Non sustained VT, LVEF < 40% due to prior MI and inducible VT or VF at EPS
(MUSTT)

2) Non-ischemic dilated cardiomyopathy

- Not as simple as with coronary artery disease

(1) LVEF < 35% in NYHA functional class II-III (SCD-HeFT criteria)

(2) Unexplained syncope and significant LV dysfunction

(3) be considered for patients with an LVEF < 35% in NYHA functional class I

3) Hypertrophic Cardiomyopathy (HCM)

- 1/ 500 in general population
- Major risk factor : one or more risk
  - Prior cardiac arrest
  - Spontaneous sustained or nonsustained VT
  - Family History of SCD
  - LV thickness > 30mm
  - Abnormal blood pressure response to exercise (flat or hypotensive)
- Other risk factor
  - Atrial fibrillation, myocardial ischemia, LV outflow obstruction, high-risk mutation, competitive physical exertion.

4) Arrhythmogenic right ventricular dysplasia / cardiomyopathy (ARVD/C)

- A reason for SCD in young individual during exercise
- Risk stratification is not complete
- Higher risk factor : one or more risk factor
  - a previous cardiac arrest
  - Syncope with VT
  - Extensive RV disease or LV involvement
  - Polymorphic VT
  - RV aneurysm (associated with a locus on chromosome lq 42-43)

5) Brugada, PMVT syndromes, Long QT, short QT

(1) Brugada syndrome

- Family history of SCD : controversial
- Syncope and spontaneous ST elevation pattern EKG
- EP test : very high negative predictive value (93%)

(2) Cathecholaminergic Polymorphic VT (PMVT)

- Ventricular tachyarrhythmia relation to physical or emotional stress
- Usually beta blocker response
- With continued exercise, the runs of VT typically increase duration and VT may become sustain, a beat to beat alternating QRS axis changing by 180° (bidirectional VT)
- Recurrence of sustained VT, hemodynamically unstable VT, or syncope with taking beta blocker
- Syncope occurs during taking beta blocker

(3) Long QT, Short syndrome

- Strong family history of SCD

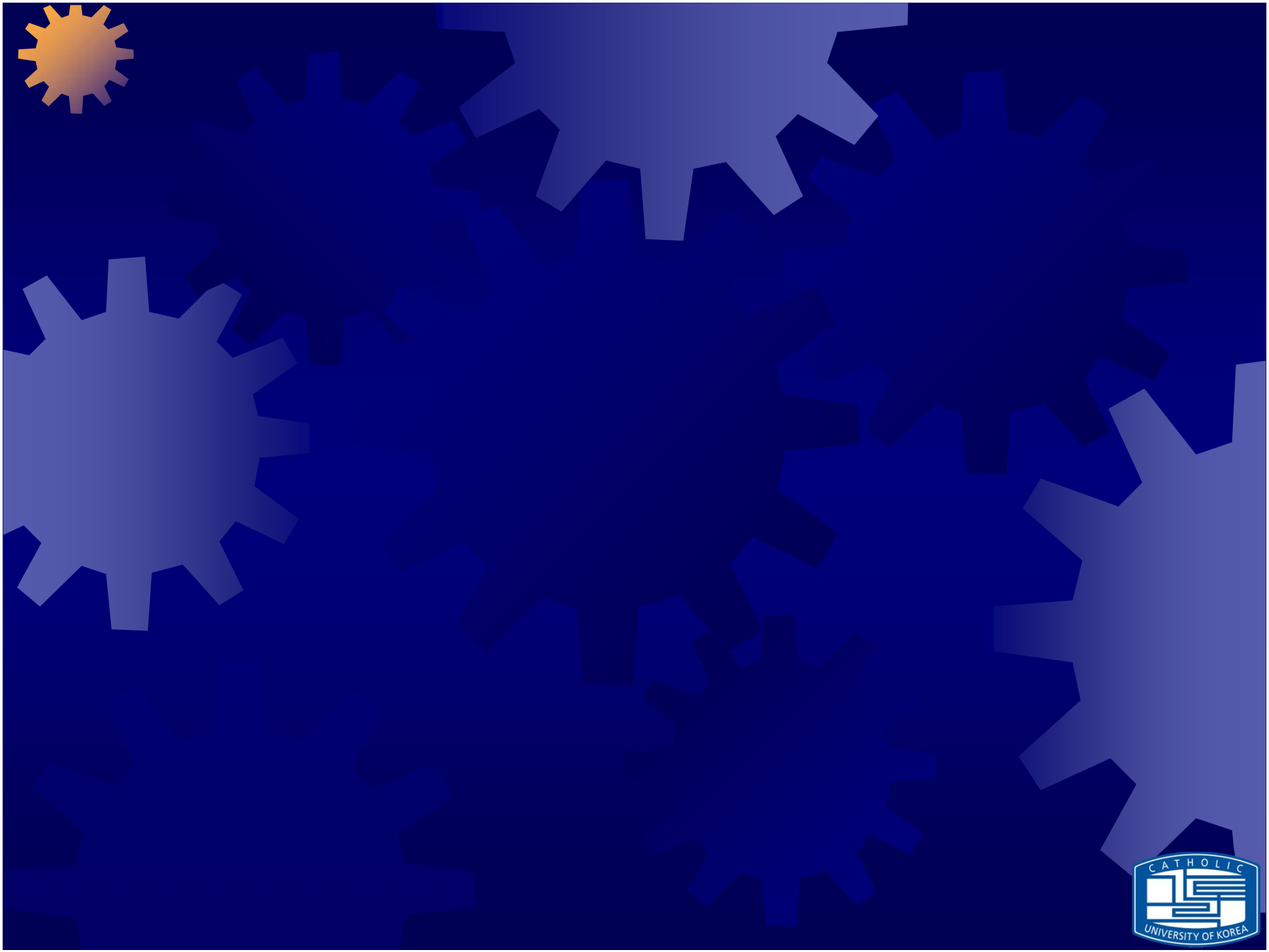
6) Noncompaction of LV

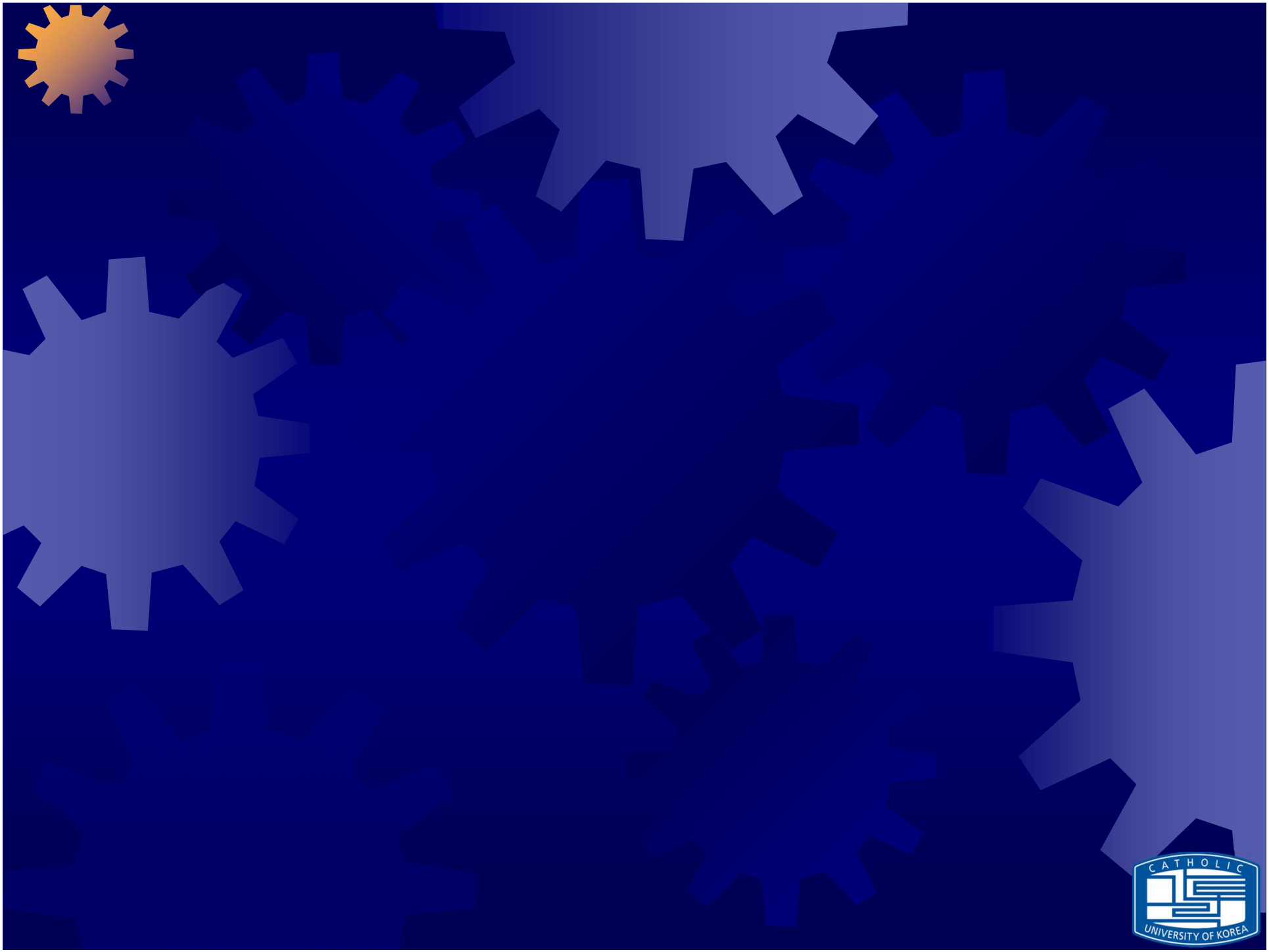
- By CT or MRI
- Even no impairment of systolic function, ventricular arrhythmia is frequent
- Strong family history
- Syncope with ventricular arrhythmia

7) Unexplained Syncope

(1) Inducible into VT, this arrhythmia is presumed to be cause of syncpoe

경청해 주셔서 감사합니다.


CATHOLIC
UNIVERSITY OF KOREA


CATHOLIC
UNIVERSITY OF KOREA