Sarcoidosis and VT
- Air Pollution, Sarcoidosis and Cardiac Death -

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Case

- M/37, cardiac arrest at home, resuscitated by CPR and Defibrillation
- Cardiac enzyme; minimally elevated
Case

- No chest pain when cardiac arrest occurred
- Healthy, well-built
- No family history of sudden cardiac death
Case

- Echocardiography: unremarkable
- CAG: minimal stenosis at RCA
- EP study: no inducible VT or VF
- Epinephrine/Flecainide provocation test: negative
- Cardiac MRI: weak LGE, R/O sarcoidosis or myocarditis

- Chest CT: Negative for sarcoidosis
- ICD was implanted
Sarcoidosis

- Systemic granulomatous disease
- Unknown etiology
- Immunological response to certain antigens
- Environmental factors

- Lung involvement 90%
- Cardiac involvement
  - Isolated or combined
  - Causing AV block VT, HF

Dust & Sarcoidosis

- 4 fold increase of sarcoidosis incidence in rescuers of World Trade Center disaster (2001)
Air Pollution: Global Burden

**Figure 1:** Global map of annual average concentrations of ambient (outdoor) fine particulate matter (PM$_{2.5}$) in $\mu g/m^3$.
Air Pollution: Global Burden

4.2 million deaths every year as a result of exposure to ambient (outdoor) air pollution

3.8 million deaths every year as a result of household exposure to smoke from dirty cookstoves and fuels

91% of the world’s population lives in places where air quality exceeds WHO guideline limits

Ambient air pollution

- Health impacts
- Pollutants
- Interventions and tools
- Guidelines
- Policy and progress
- Outreach and advocacy

Household air pollution

- Health impacts
- Pollutants
- Interventions and tools
- Guidelines
- Policy and progress
- Outreach and advocacy

Campaigns

BreatheLife is a joint campaign led by the World Health Organization (WHO) and the Climate & Clean Air Coalition (CCAC) to mobilize cities and individuals to protect our health and planet from the effects of air pollution.

Campaign website
Infographics
Videos
Air Pollutants

• Gases
  • CO₂, SOₓ, NOₓ, CO, VOC (Volatile organic compounds), NH₃

• Particulate matter
  • PM₁₀
  • PM₂.₅
  • Ultrafine materials

• Toxic metals; lead, mercury
• Smog
• Ground level ozone (O₃)
Air Pollutants and Cardiovascular Disease

Particulate matter air pollution and cardiovascular disease, Circulation 2010;121:2331-78.
Air Pollutants and Cardiovascular Disease

- Annual increases of 10 μg/m³ in PM10 and 5 μg/m³ in PM2.5 were associated with increased risks of myocardial infarction of 12% and 13%, respectively.

- There is a ‘Gap’ between total cardiac death and myocardial ischemia – NOT all cardiac death can be explained by ischemic events.

ESCAPE project, meta-analysis, 11 European countries, BMJ. 2014; 348: f7412.
- The risk of ventricular arrhythmias was associated with increased levels of air pollution in the preceding 2 h exposure period. The strongest association was seen for PM10.
- Positive association between heart failure hospitalization or heart failure mortality, and all gaseous and particulate air pollutants except ozone
Air Pollution and Heart Failure

- Additional analyses by outcome, study design, age, and geographical location. There was no change in effect direction across all pollutants in these analyses.
Prevalence of Sarcoidosis in Korea

- **Patient Number**

<table>
<thead>
<tr>
<th>Year</th>
<th>Patient Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1,384</td>
</tr>
<tr>
<td>2011</td>
<td>1,608</td>
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<tr>
<td>2012</td>
<td>1,811</td>
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<tr>
<td>2013</td>
<td>2,006</td>
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<td>2014</td>
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<td>2015</td>
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<td>2016</td>
<td>2,647</td>
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<tr>
<td>2017</td>
<td>2,815</td>
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<td>2018</td>
<td>3,189</td>
</tr>
</tbody>
</table>

Health Insurance Review & Assessment Service 2019
The prevalence of sarcoidosis was high in regions with metal industry and intense agriculture. Air quality is associated with prevalence of sarcoidosis.
Ventricular Tachycardia in Cardiac Sarcoidosis

- Ventricular tachycardia due to
  - Inflammatory change associated with granuloma
  - Scar change
  - Electrophysiological mechanisms
    - Early afterdepolarization
    - Phase 2 and 3 reentry
    - Scar-related

- SCD is often the first manifestation of CS
Diagnosis of Cardiac Sarcoidosis

Unexplained Mobitz II or 3rd degree AV block in adults aged < 60 years

High resolution CT chest
Advanced cardiac Imaging (CMR or FDG-PET)

1. CT scan suggestive of pulmonary sarcoidosis
2. CMR or FDG-PET suggestive of CS

One or more of 1-2

Positive – High probability of CS

Biopsy
Extra-cardiac if feasible, otherwise Guided EMB* to confirm diagnosis

Negative – Consider further biopsy and/or interval repeat imaging (especially if cardiac deterioration in follow-up)

Neither of 1-2

Negative – Low probability
Consider alternative diagnosis

2014 HRS Expert Consensus Statement
Difficulties in Diagnosis of CS

• Isolated cardiac sarcoidosis
• Low diagnostic yield of myocardial biopsy
  • Patch distribution
  • Tissue obtained in blind manner
• Imaging studies are helpful but NOT pathognomonic
Improving Diagnosis Rate

• Understanding various myocardial involvement pattern

<table>
<thead>
<tr>
<th>Clinical data</th>
<th>Guide</th>
<th>Pathology Images</th>
<th>Involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-year-old man; sudden death while driving a bus</td>
<td></td>
<td></td>
<td>Epicardial ✓ Multifocal ✓ Septal ✓ RV free wall ✓</td>
</tr>
<tr>
<td>Age and sex unknown; sudden death</td>
<td></td>
<td></td>
<td>Epicardial ✓ Multifocal ✓ Septal ✓ RV free wall ✓</td>
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<tr>
<td>53-year-old man; heart transplantation due to cardiac sarcoidosis</td>
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<td>Epicardial ✓ Multifocal ✓ Septal ✓ RV free wall ✓</td>
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<tr>
<td>53-year-old man; end-stage heart failure due to cardiac sarcoidosis, died of hemorrhagic shock</td>
<td></td>
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<td>Epicardial ✓ Multifocal ✓ Septal ✓ RV free wall ✓</td>
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Improving Diagnostic Accuracy

- FDG uptake with maximum intensity projection (MIP) image; additional image sets are recommended
- CT fusion image
- Bull’s eye map display
- Oblique tomography
Air Pollution, Sarcoidosis and Cardiac Death

- Air pollution is very important health burden.
- Direct linkage between air pollution and sarcoidosis with resulting cardiac death is unclear, but sarcoidosis might be increasing as air pollution is getting worse and sarcoidosis could cause cardiac death.
- Many cases of Sarcoidosis might be underdiagnosed because of poor yield of current diagnostic tools.
- We should keep in mind that sarcoidosis could be probable diagnosis for sudden cardiac death of unknown cause.
Thank you for your attention