Management of Tachycardia-induced Cardiomyopathy in children

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Objective:

• Persistent tachycardia causes
  elevated ventricular filling pressures
  severe biventricular systolic dysfunction
  reduced cardiac output
  elevated systemic vascular resistance
Associated arrhythmias are:
- atrial fibrillation
- atrial flutter
- atrial tachycardia
- reentrant supraventricular tachycardia
- accessory pathway tachycardia
- frequent ectopic beats
- ventricular tachycardia
• Management and restoration of cardiac function is dependent on control of tachyarrhythmias.

• Here we report a case serial including ten children with tachycardia-induced cardiomyopathy in different types.
• Diagnosed as Tachycardiomyopathy in Baskent University Pediatric Cardiology Department between August 2014-2017

• Ten patient (3 female, 7 male)
• The mean age 10,1±4,3 (min 4- max 15,8)

• Seven of them had no medical problem or tachycardia history but three had prior heart surgery including Senning, TAPVC and VSD correction, respectively.
<table>
<thead>
<tr>
<th>Age/year</th>
<th>Arrhythmia</th>
<th>DC CV</th>
<th>ECMO</th>
<th>Medication</th>
<th>RFA</th>
<th>First EF %</th>
<th>Last EF %</th>
<th>Prior Heart Surgery</th>
<th>Follow-up period month</th>
<th>Evidence for improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,8</td>
<td>VT</td>
<td>+/+</td>
<td>-</td>
<td>Metoprolol</td>
<td>+</td>
<td>47</td>
<td>68</td>
<td>-</td>
<td>23</td>
<td>Increased EF</td>
</tr>
<tr>
<td>11,8</td>
<td>Mahaim acc pathway + AVNRT</td>
<td>+/+</td>
<td>-</td>
<td>Amiodarone</td>
<td>+</td>
<td>42</td>
<td>78</td>
<td>-</td>
<td>16</td>
<td>Increased EF</td>
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<tr>
<td>14,5</td>
<td>VT</td>
<td>+/-</td>
<td>-</td>
<td>Amiodarone</td>
<td>+</td>
<td>44</td>
<td>62</td>
<td>-</td>
<td>22</td>
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<tr>
<td>7,9</td>
<td>AVRT</td>
<td>-</td>
<td>-</td>
<td>Amiodarone</td>
<td>+</td>
<td>38</td>
<td>69</td>
<td>-</td>
<td>11</td>
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<tr>
<td>13</td>
<td>Atrial tachycardia</td>
<td>-</td>
<td>-</td>
<td>None</td>
<td>+</td>
<td>17</td>
<td>37</td>
<td>-</td>
<td>6</td>
<td>Less Incr EF</td>
</tr>
<tr>
<td>14,5</td>
<td>PJRT</td>
<td>-</td>
<td>+</td>
<td>Sotalol</td>
<td>+</td>
<td>10</td>
<td>32</td>
<td>-</td>
<td>1</td>
<td>Less Incr EF</td>
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<tr>
<td>12,3</td>
<td>Atrial tachycardia</td>
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<td>+</td>
<td>Amiodarone</td>
<td>+</td>
<td>18</td>
<td>62</td>
<td>-</td>
<td>27</td>
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<tr>
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<td>+/+</td>
<td>-</td>
<td>Amiodarone</td>
<td>-</td>
<td>32</td>
<td>60</td>
<td>VSD corr</td>
<td>8</td>
<td>Increased EF</td>
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<tr>
<td>4</td>
<td>Atrial tachycardia</td>
<td>+/+</td>
<td>-</td>
<td>Sotalol</td>
<td>-</td>
<td>48</td>
<td>62</td>
<td>Senning</td>
<td>9</td>
<td>Increased EF</td>
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<tr>
<td>5</td>
<td>Atrial tachycardia</td>
<td>+/+</td>
<td>-</td>
<td>Sotalol</td>
<td>-</td>
<td>48</td>
<td>64</td>
<td>TAPVC corr</td>
<td>10</td>
<td>Increased EF</td>
</tr>
</tbody>
</table>
Results

- **EF** 34±14 % (min 10- max 48)
  - FS 19,6± 5,5 % (min 8- max 25)
  - LVEDD 55±12 mm (min 30- max 78)
- After complete recovery
  - **EF** 59±14 (min 32- max 78)
• 12 yo girl (father died 6 year ago)
• ARVD? cardiac MRI normal, but has two different heterozygote desmoplakin mutation
  \[p.P450L\ (c.1349C>T), \ p.A2761T\ (c.8281G>A)\]
• Mahaim tachycardia with right anterolateral accessory pathway and AVNRT were ablated
• 13 yo boy
• Referred for heart transplantation
• But diagnosed atrial tachycardia
• 17% EF with severe congestive heart failure (NYHA Class IV)
• After successful RFA, no arrhythmic medication
• EF was noted 37% after 3 months with better clinical symptoms (NYHA Class I-II).
• 12 yo, boy
• EF was 18%, severe mitral insufficiency
• Diagnosed atrial tachycardia
• Ventricular fibrillation inadvertently developed in the course of ablation, and he needed CPR for a short time
• ECMO was applied
• After 5 days he was supported with a ventricular asist device
• Following a month, second radiofrequency catheter ablation was successfully applied.
• Systolic heart function improved within a week.
• After three months of LVAD EF was noted 56% without any cardiac complaint and pump was successfully removed
A 14.5-year-old boy was diagnosed with myocarditis.

Is it myocarditis?
Diagnosed PJRT
• EF was 10%
• As soon as left ventricle catheterisation VF developed, multiple DF required
• After 2 hours with continuous CPR, ECMO was applied
• He was extubated and inotrope drugs were decreased the following day
• Anaphylactic shock was developed during amiodarone infusion at second day
• Sotalol 80 mg twice a day was applied
• After 7 days on ECMO second radiofrequency catheter ablation was successfully applied
• Ecmo was ended after three days of ablation
• Ten days later EF was 32% and he was discharged from hospital with oral heart failure medication (without any central nervous system sequelae)
Discussion

• The clinical presentation is symptoms of tachycardia and/or HF signs

• It can be difficult to determine whether an arrhythmia is the \text{initiator or consequence} of cardiomyopathy in a patient with tachycardia and HF.

Thus, AIC raises a “chicken or egg” question
Discussion

• No absolute Echo parameters
• Therefore patients in whom arrhythmia-induced cardiomyopathy is suspected should undergo close cardiac monitoring
Management

• To achieve ventricular heart rate control or to restore
• Options for the restoration of sinus rhythm include electrical cardioversion, antiarrhythmic drugs, and catheter ablation of the arrhythmia
• Close follow-up is required even after successful ablation because of the tendency for cardiomyopathy if tachycardia recurs
• In the largest pediatric series of AIC, AET (59%) and permanent junctional reciprocating tachycardia (PJRT; 23%) were the most common arrhythmias represented.

• AET usually occurs without structural heart disease, but has been described after congenital heart disease surgery.
• Previous small reports describe weeks to months for functional recovery and years for reverse remodeling, the median time to recovery in a larger study was <2 months in children.

• Failure to recover should instigate a search for factors--- subclinical arrhythmia recurrence? an underlying cardiomyopathy.
• Sudden cardiac death has been reported in AIC patients following symptom recovery and LVEF normalization (suggesting a greater risk in patients with severe baseline LV dysfunction)
Conclusion

• **AIC has a wide range of clinical manifestations, from asymptomatic tachycardia to cardiomyopathy to end-stage HF**

• Early recognition is critical, and aggressive treatment aimed at controlling or eliminating the arrhythmia results in symptom resolution and recovery of ventricular function
Conclusion

- However, cellular and extracellular ultrastructural changes can persist and can contribute to a rapid decline in cardiac function with arrhythmia recurrence, as well as confer a risk of sudden cardiac death.