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Frequent PVCs may contribute to ongoing or deteriorating LV dysfunction.

PVC in children

**Primary** event vs. **Secondary** phenomenon

- Cardiomyopathy
- Arrhythmia

**BENIGN**
PVC in children

① PVCs are frequent in neonates, infants, and children.
② The prevalence of PVCs in healthy children varies with age. In older children and young adults, the incidence increases
③ Nearly 20% of the neonates have uncomplicated ventricular ectopy consisting of uniform PVCs or couplets.
④ This decreases to 10% of toddlers and school-age children and increases to 20%–30% of the normal adolescents.
PVC in children

① In otherwise normal adolescent boys, although some ventricular ectopy is common, less than 5% will have more than 50 beats per 24 hours and less than 2% will have multiform PVCs, couplets, or nonsustained VT on 24-hour monitoring.

② Ventricular extrasystoles (VEs) are common in children without structural heart disease and are usually associated with a benign clinical course, even though the reduction or disappearance of ectopy may take over 10 years.

③ PVCs disappeared in 28% of the patients after a follow-up of 72±32 months.

PVC IN CHILDREN

PVC are generally considered **benign** in the absence of symptoms and/or left ventricular (LV) dysfunction.

Different or same as in adults?

- Clinical course
- Effect on ventricular function
- According to onset age
## Differences btw Normal & CHD

<table>
<thead>
<tr>
<th>NORMAL HEART</th>
<th>CONGENITAL HEART</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Levocardia</strong></td>
<td>Levo/meso/dextro</td>
</tr>
<tr>
<td>Intracardiac</td>
<td>Intracardiac</td>
</tr>
<tr>
<td>◦ 4chamber</td>
<td>◦ 4 possible</td>
</tr>
<tr>
<td>◦ concordant</td>
<td>◦ anytype</td>
</tr>
<tr>
<td>◦ normal</td>
<td>◦ 1-2 inlet/1-2 outlet</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Conduction</th>
<th>Normal or abnormal</th>
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<tbody>
<tr>
<td>Extracardiac</td>
<td>Aorta/PV/PV/SV</td>
</tr>
</tbody>
</table>

**Growing & development**

**Etiology & comorbidity**
WHAT effects according to the age of onset?

- Fetal
- Neonate & infant
- Children & adolescent
- Adult
PVC induced CMP

Definition
- caused by PVCs and reversible upon suppression of the PVCs.
- either having an abnormal left ventricular ejection fraction (LVEF) which improved by at least 15% or 10% or normalization of LVEF>50% after an effective ablation procedure.
PVC induced cardiomyopathy can be induced in children with PVCs?

Yes

Several small studies have come so far.
The influence of premature ventricular contractions on left ventricular function in asymptomatic children without structural heart disease: an echocardiographic evaluation.


BACKGROUND: Isolated monomorphic premature ventricular contractions (PVCs) are not uncommon in the pediatric population. The degree of cardiac dysfunction caused by PVCs in children without structural heart disease is unknown.

PURPOSE: To investigate the influence of PVCs on echocardiographic left ventricular (LV) systolic function in children without structural heart disease.

METHODS: Forty asymptomatic children with isolated monomorphic PVCs without structural heart disease were selected. The median age was 6 years, range of 3-12 years. The following subgroups were compared: frequent vs. infrequent PVCs (> or < or = 10/min); short vs. long coupling interval (RR'/RR ratio < or = or > 0.6); and short vs. long QT interval (QT < or = or > 400 ms). Using echocardiography the left ventricular ejection fraction (LVEF in percentage) and cardiac index (CI in L/min/m2) were measured for both normal sinus beats (SB-LVEF and CI), PVCs (PVC-LVEF and CI) and the average LVEF and CI were calculated. All values were expressed as means +/- SD.

RESULTS: In all children LV dimensions and the SB-LVEF and CI were within normal limits. The PVC-LVEF (48 +/- 5) and PVC-CI (1.57 +/- 0.19) were significantly decreased and the average CI was 2.41 +/- 0.29. In 27 pts with > 10 PVCs/min the average LVEF and CI decreased to 53 +/- 5 and 2.08 +/- 0.24 respectively. In 16 pts with PVCs and a short coupling interval (RR'/RR < or = 0.6) the PVC-LVEF and PVC-CI was 43 +/- 0.03 and 1.50 +/- 0.14, which was significantly lower than in 24 pts with a long coupling interval (58 +/- 4, 1.88 +/- 0.11). In 11 pts with a prolonged QT interval (> 400 ms) the PVC-LVEF and PVC-CI was significantly lower than in the 29 children with a shorter QT interval, 41 +/- 5 vs. 55 +/- 4 and 1.46 +/- 0.13 vs. 1.86 +/- 0.15 respectively (all p < 0.01).

CONCLUSION: In asymptomatic children with isolated monomorphic PVCs the average ejection fraction and cardiac output is markedly reduced if PVCs are frequent (> 10/min), have a short coupling interval or a prolonged QT interval.
Frequent VPBs were defined as an ectopy burden of 5% or more in 24 h.

28 patients (17 boys, age 13.3 ± 5.9 years, and 11 girls, age 13 ± 5.2 years) with frequent VPBs.

The echocardiograms of four patients (2 boys, 14%) showed cardiomyopathy.

Cardiac function normalized in all four patients, with spontaneous resolution of the VPBs (2 patients) or with antiarrhythmic therapy (2 patients).

During a follow-up period of 2.7 ± 2.3 years, 32% of the patients without cardiomyopathy showed a marked spontaneous improvement in arrhythmia burden.

Most of the patients showed VPBs with a left bundle branch block (LBBB) and inferior axis morphology.
Of the 36 patients with sequential echocardiograms,
① 32 (88%) remained normal,
② 3 (9%) had abnormal echocardiograms which normalized,
③ 1 (3%) had progressive left ventricular dysfunction.

On sequential Holter data (n = 48),
① 54% showed stable or decreased VE,
② 40% showed resolution,
③ 6% showed worsening.

*Echo, echocardiogram; F, female; M, male.*
① A total of 36 children met the study criteria (premature ventricular contractions comprising at least 20% of rhythm on 24-hour);
② seven patients (19.4%, 95% CI 6.2–32.6%) met the criteria for cardiomyopathy, mostly at initial presentation.
③ Ectopy decreased to <10% of beats without intervention in 16.7% (95% CI 4.3–29.1%) of the patients
In conclusion, there was no significant relation between VPC burden or VPC characteristics and LV systolic function in this pediatric population with structurally normal hearts.

But?

- 31 (25%) of 123 pts underwent follow-up Holter monitoring between 6 and 36 months.
- Median follow-up was 13 months (IQR 11 to 17).
- Twenty-four of the 31 patients (77%) had decreases in VPC burden from initial to follow-up Holter monitoring without intervention.
- The median VPC burden in this group decreased from 17% to 5% (p < 0.002)
PVC induced CMP

MECHANISMS

① Promotion of ventricular dyssynchrony;
② Increased oxygen consumption;
③ Autonomic dysregulation
④ Impaired contractility with altered intracellular calcium currents.

CONSIDERATION IN CHILDREN

① Effect on growing heart
② Developing autonomic nervous system
③ Effect on congenital heart disease
Risk Factors for PVC CMP

**IN ADULTS**

1. high PVC frequency
2. epicardial PVC location,
3. duration of PVC exposure,
4. increased QRS width
5. Interpolated PVCs, nonsustained VT burden, short PVC coupling interval
6. male gender,
7. absence of circadian fluctuation of the PVC burden,
8. asymptomatic status.

**IN CHILDREN**

??
Major findings of our study are that LV dysfunction was present in 8% of all children, which normalized after successful therapy. Presence of LV dysfunction was significantly associated with a higher burden of PVCs, the presence of couplets, and VTs.
Natural history of ventricular premature contractions in children with a structurally normal heart: does origin matter?

Gertie C.M. Beaufort-Krol, Sebastiaan S.P. Dijkstra, and Margreet Th.E. Bink-Boelkens*

Conclusion
① there is a difference in the natural history between PVC–LBBB and PVC–RBBB in children with an anatomically normal heart.
② Premature ventricular contraction with right bundle branch block disappears during childhood. Follow-up of these children seems not necessary.
③ Premature ventricular contraction with left bundle branch block does not disappear and, therefore, it may be necessary to follow these children even during adulthood.
① A 15% prevalence of mild LV systolic dysfunction, with no severe PVC-induced cardiomyopathy;
② No significant association between PVC burden and LV size or function;
③ A strong association between PVC coupling interval and LV dysfunction, with a cut off value <365 ms yielding the greatest discriminatory potential; and
④ A benign disease course in most patients that was characterized by a major reduction in PVC burden over time.
SUMMARY

① PVCs in children may contribute ventricular dysfunction – In a cohort of children with frequent PVCs and asymptomatic ventricular tachycardia (VT), LV dysfunction was present in 8% - 19.4% of the children.

② That LV dysfunction was reversible by reducing the amount of ectopy, either by medication or catheter ablation.

③ Risk factors are not well investigated in children unlike in adults
   ➢ PVC burden
   ➢ Coupling interval
   ➢ Type – PVC LBBB
   ➢ QRS duration ? QT interval ?
   ➢ the prevalence of VTs, and ventricular couplets

④ Children with frequent PVCs and asymptomatic VT should be followed regularly. If LV dysfunction develops, medication or ablation is indicated to reduce the amount of ectopy.

⑤ So far, PVC effect on growing heart has not been known.
Thank you