

# Post-Operative Ectopic Atrial Tachycardia in Congenital Heart Disease

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## BACKGROUND

- ❖ Arrhythmias are common after congenital cardiac surgery<sup>1-4</sup>
- ❖ Ectopic atrial tachycardia (EAT) is a common post-operative tachyarrhythmia with a reported incidence of 8-15%<sup>5-6</sup>
- ❖ Prior risk factors for EAT in smaller studies included younger age and weight, longer cardiopulmonary bypass (CPB) times, and certain congenital diagnoses<sup>5-9</sup>

## OBJECTIVES

- ❖ Identify risk factors for the development of EAT in patients <1 year of age undergoing congenital cardiac surgery
- ❖ Evaluate natural history of post-operative EAT including time to onset and treatment regimen

## PATIENTS AND METHODS

- ❖ Patients <1 year of age undergoing congenital cardiac surgery at Children's Hospital Los Angeles between 2007 and 2020 were studied.
- ❖ Rhythm diagnoses were made by pediatric electrophysiologist, pediatric cardiologist, or cardiac critical care physician at time of care with ECGs evaluated for confirmation during data collection
- ❖ 129 patients were identified as having EAT out of 5,243 operations (2.5%)
- ❖ Baseline characteristics, primary diagnoses, intra-operative parameters, and surgical procedures were compared.
- ❖ Chi-squared analysis was used for comparing those with and without EAT as well as univariate and multivariate model regression for categories with significant differences.
- ❖ Continuous variables reported as mean  $\pm$  standard deviation or median (interquartile range)

There are no disclosures to report.

## RESULTS

Table 1: Baseline Characteristics

|                          | EAT<br>(n=129)*   | Non-EAT<br>(n=5243)* | P value |
|--------------------------|-------------------|----------------------|---------|
| Gestational age (wks)    | 37.9 $\pm$ 1.8    | 37.1 $\pm$ 3.7       | <0.01   |
| Birth weight (kg)        | 3.0 $\pm$ 0.6     | 2.9 $\pm$ 0.8        | <0.01   |
| Weight at surgery (kg)   | 3.3 (IQR 2.9-3.8) | 4.2 (IQR 3.2-6.3)    | <0.01   |
| Age at surgery (days)    | 7 (3-21)          | 85 (9-198)           | <0.01   |
| Genetic syndrome (any)   | 35 (27.1%)        | 1161 (22.1%)         | 0.18    |
| Heterotaxy (asplenia)    | 9 (7.0%)          | 147 (2.7%)           | <0.01   |
| Heterotaxy (polysplenia) | 0 (0.0%)          | 41 (0.8%)            | 0.31    |
| DiGeorge syndrome        | 10 (7.7%)         | 159 (3.0%)           | <0.01   |
| Male gender              | 77 (60.0%)        | 2881 (55.0%)         | 0.29    |

Table 2: Surgical Factors

|                   | EAT<br>(n=129) | Non-EAT<br>(n=5243) | P Value |
|-------------------|----------------|---------------------|---------|
| STAT category     | 3.9 $\pm$ 0.9  | 2.8 $\pm$ 1.3       | <0.01   |
| CPB (min)         | 64 (IQR 47-91) | 59 (IQR 43-84)      | 0.01    |
| Cross clamp (min) | 25 (1-61)      | 32 (2-54)           | 0.39    |
| DHCA (min)        | 15 (0-37)      | 0 (0-3)             | <0.01   |
| TAPVC repair      | 24 (9.7%)      | 224                 | <0.01   |
| IAA repair        | 6 (7.1%)       | 78                  | <0.01   |
| ASO               | 21 (6.5%)      | 299                 | <0.01   |
| Norwood procedure | 23 (5.7%)      | 402                 | <0.01   |
| TOF repair        | 4 (0.9%)       | 425                 | 0.02    |
| PDA closure       | 2 (0.7%)       | 275                 | 0.03    |
| VSD repair        | 1 (0.2%)       | 514                 | <0.01   |
| Glenn procedure   | 0 (0.0%)       | 376                 | <0.01   |

Percentages represent EAT frequency for each surgical intervention  
Additional surgical procedures were included in analysis but were not significantly different between cohorts.  
ASO Arterial switch operation; DHCA Deep hypothermic circulatory arrest; IAA Interrupted aortic arch; PDA Patent ductus arteriosus; TAPVC Total anomalous pulmonary venous connection; TOF Tetralogy of Fallot; VSD Ventricular septal defect

Table 3: Univariate and Multivariate Analysis

|                       | Univariate<br>Odds Ratio | 95% CI      | Multivariate<br>Odds Ratio | 95% CI             | P Value      |
|-----------------------|--------------------------|-------------|----------------------------|--------------------|--------------|
| Gestational age (wks) | 1.10                     | 1.02-1.18   | 1.01                       | 0.90-1.13          | NS           |
| Birth weight (kg)     | 1.33                     | 1.03-1.73   | 1.13                       | 0.64-2.01          | NS           |
| Op age (days)         | 0.99                     | 0.985-0.991 | 0.99                       | 0.985-1.001        | NS           |
| Weight (kg)           | 0.01                     | 0.003-0.046 | 0.93                       | 0.61-1.42          | NS           |
| DiGeorge              | 2.69                     | 1.38-5.22   | <b>2.37</b>                | <b>1.09-5.16</b>   | <b>0.03</b>  |
| Asplenia              | 2.60                     | 1.30-5.22   | 2.12                       | 0.99-4.57          | NS           |
| CPB (10 min)          | 1.10                     | 1.06-1.14   | <b>1.08</b>                | <b>1.002-1.168</b> | <b>0.045</b> |
| Cross clamp (10 min)  | 1.07                     | 1.02-1.12   | 1.03                       | 0.93-1.13          | NS           |
| DHCA (10 min)         | 1.33                     | 1.23-1.43   | 1.08                       | 0.98-1.21          | NS           |
| STAT $\geq$ 4         | 6.14                     | 4.03-9.74   | <b>2.14</b>                | <b>1.03-4.44</b>   | <b>0.04</b>  |
| TAPVC repair          | 5.12                     | 3.22-8.14   | <b>2.83</b>                | <b>1.52-5.24</b>   | <b>0.01</b>  |
| IAA repair            | 3.23                     | 1.38-7.55   | 1.004                      | 0.35-2.91          | NS           |
| Norwood               | 2.61                     | 1.65-4.15   | 1.51                       | 0.82-2.78          | NS           |
| ASO                   | 2.05                     | 1.03-4.10   | 1.56                       | 0.55-4.44          | NS           |
| TOF repair            | 0.36                     | 0.13-0.99   | 2.01                       | 0.64-6.30          | NS           |
| PDA closure           | 0.28                     | 0.07-1.16   | -                          | -                  | -            |
| VSD repair            | 0.07                     | 0.01-0.52   | 0.62                       | 0.08-4.94          | NS           |

Table 4: EAT Characteristics

|                                   |               |
|-----------------------------------|---------------|
| Time to EAT onset (days)          | 9 (IQR 5-14)  |
| Time to treatment (days)          | 10 (7-16)     |
| EAT rate at diagnosis (bpm)       | 218 (200-240) |
| Peak EAT rate (bpm)               | 220 (200-250) |
| <b>Antiarrhythmic (Initial)</b>   |               |
| Propranolol                       | 72 (55.8%)    |
| Amiodarone                        | 24 (18.6%)    |
| Esmolol                           | 8 (6.2%)      |
| Digoxin                           | 4 (3.1%)      |
| Flecainide                        | 1 (0.8%)      |
| Procainamide                      | 1 (0.8%)      |
| <b>Antiarrhythmic (Discharge)</b> |               |
| Propranolol                       | 70 (54.3%)    |
| Flecainide                        | 6 (4.7%)      |
| Amiodarone                        | 5 (3.9%)      |
| Digoxin                           | 2 (1.6%)      |

## DISCUSSION

- ❖ In this large cohort of infants undergoing congenital cardiac surgery, post-operative EAT was identified in 129/5243, an incidence of 2.5%.
- ❖ Patients who developed EAT were younger and weighed less at time of surgery
- ❖ Patients with DiGeorge syndrome or asplenic heterotaxy were more likely to develop EAT, but only DiGeorge syndrome remained a risk factor in multivariate analysis.
- ❖ Increased STAT (the Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery) category, longer CPB times, and longer DHCA times were associated with developing EAT. STAT  $\geq$  4 and longer CPB times remained significant in multivariate analysis.
- ❖ A number of congenital cardiac surgeries were associated with development of EAT (table 2), but only TAPVC repair remained significant in multivariate analysis
- ❖ Median post-op time to EAT onset was 9 days with post-op time to antiarrhythmic treatment initiation at 10 days
- ❖ Propranolol and amiodarone were commonly used to manage EAT with propranolol being the most common discharge antiarrhythmic drug

## CONCLUSIONS

- ❖ DiGeorge syndrome, longer CPB times, higher STAT categories, and TAPVC repair were all independent risk factors for development of post-operative EAT with TAPVC repair the strongest independent risk factor.
- ❖ Onset of post-operative EAT occurred a median of 9 days after congenital cardiac surgery.

## LIMITATIONS

- ❖ Study design (including search by billing codes and medication usage) may have biased towards treated (and therefore more clinically significant) EAT patients
- ❖ Diagnosis of EAT made by treating physicians with ECG confirmation not available in every patient

## REFERENCES

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