Impact of Respiratory Viral Infection on Outcomes of Congenital Heart Repair Surgery

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Introduction/Significance

- Respiratory viral infections are common in the pediatric population and can range from mild to life-threatening.
- Cardiothoracic surgeons may avoid performing surgery on patients with congenital heart disease with possible concurrent viral respiratory illness.
- Some will test for respiratory viruses during preoperative planning.
- Our hospital began using the FilmArray from BioFire Diagnostics in April 2014, which tests for 17 common viral respiratory pathogens and 3 bacterial respiratory pathogens.
- Previous studies on this topic are limited by small study populations, or a very narrow study focus.
- The impact of these infections on outcomes after congenital heart repair surgery is unclear.

Design and Objectives

The aim of this retrospective cohort study was to compare outcomes after congenital heart repair surgery in patients with positive respiratory viral testing to those with negative testing and to determine if there are significant differences in post-operative hospital course or morbidity.

Study Procedures

Study Population:

- Inclusion criteria:
  - Pediatric patient ≤ 18 years old at time of surgical procedure.
  - Underwent cardiothoracic surgery for repair of congenital heart disease between April 1, 2014 and March 31, 2019.
  - Received FilmArray testing within 4 weeks prior to surgical procedure to 1 week after procedure.
- Exclusion criteria:
  - Premature infants < 28 weeks gestation undergoing PDA ligation in the neonatal period.

Study Procedures (continued)

Data Collected:

Data were collected by review of patient charts.

- Demographic data collected: Age at time of surgery, gender, presence of secondary pulmonary, ENT, or genetic diagnoses, RACHS-1 category of surgical procedure, respiratory symptoms at time of testing, and viral diagnosis if testing was positive.
- Primary outcome: Post-operative ICU length of stay (LOS).
- Secondary outcomes: Post-operative hospital LOS, duration of intubation need for reintubation, total duration of respiratory pressure support, need for increased oxygen supplementation at discharge, 30-day readmission rate after discharge, and 30-day post-operative all-cause mortality.

Analyses

- Numeric data were analyzed using the Wilcoxon Rank Sum test, and are expressed in the following tables as median [25th, 75th percentile]
- Categorical data were analyzed using the Chi-Square or Fisher's Exact Test (noted by * on p-value), and are expressed in the tables as count (%)
- Threshold for determining statistical significance was set at $p < 0.05$.

Results

- 120 patients in study (Table 1), 43 tested positive for respiratory viruses and 77 tested negative. 79 patients had respiratory symptoms at the time of testing, and 41 did not.
- Patients with positive respiratory viral testing were older, had a lower RACHS-1 procedure, and were more likely to have respiratory symptoms than those who tested negative (Table 1).
- Patients with negative respiratory viral testing had longer post-operative ICU LOS, hospital LOS, and duration of post-operative respiratory support (Table 2), compared to positive testing.

Results (continued)

- Absence of respiratory symptoms at the time of testing was associated with a longer post-operative ICU LOS and hospital LOS, compared to symptomatic patients (Table 3).
- Unable to meaningfully analyze combination of FilmArray and symptom status due to very small size of FilmArray positive, asymptomatic group.

Table 1: Patient demographic data

	FilmArray Positive (N=43)	FilmArray Negative (N=77)	p-value
Age at time of surgery (months)	6 [4, 16]	3 [1, 6]	0.0016
Male	27 (63)	47 (61)	0.8499
Secondary Diagnoses			
Pulmonary Only	1 (2)	2 (3)	0.7421*
ENT Only	3 (7)	6 (8)	
Genetic Only	9 (21)	10 (13)	
>1 Secondary Diagnosis	30 (70)	59 (77)	
RACHS-1 category of surgery	2 [2, 3]	3 [2, 3]	0.0146
Respiratory symptoms at time of testing	34 (79)	45 (58)	0.0223
Rhinorrhea/Nasal congestion	8	5	
Cough	16	9	
Increased Secretions	14	17	
Increased work of Breathing/tachypnea	11	20	
Viral diagnosis			
Rhino/enterovirus	30	-	-
Coronaviruses	5	-	-
Respiratory Syncitial Virus	5	-	-
Parainfluenza 3	3	-	-
Human Metapneumovirus	1	-	-
Adenovirus	1	-	-
Influenza B	1	-	-
Co-infections+	3	-	-

+one patient had co-infection of RSV + Rhino/enterovirus, one Rhino/enterovirus + Parainfluenza 3, one Coronavirus HKU1 + Coronavirus OC43; *denotes fishers exact test was used

Table 2: Outcomes by FilmArray testing status

	FilmArray Positive (N=43)	FilmArray Negative (N=77)	p-value
ICU Length of Stay (days)	6 [4, 11]	11 [5,28]	0.0104
Hospital Length of Stay (days)	10 [7, 19]	18 [12, 40]	0.0009
Post-Op Duration of Initial Intubation (days)	1 [0, 3]	3 [1, 7]	0.0234
Total post-op duration prior to final extubation/ Trach Placement (days)	1 [0, 6]	7 [2, 19]	0.0005
Total post-op duration resp pressure support (days)	1 [0, 8]	7 [2, 24]	0.0004
Reintubation Required	6 (14)	23 (30)	0.0508
Increase in Home O2 requirement or home vent settings	1 (2)	10 (13)	0.0947*
Mortality with 30 days	0 (0)	1 (1)	1.0000*
Readmission within 30 days of hospital discharge	6 (14)	15 (19)	0.4448
Respiratory Chief Complaints	3	9	
Respiratory Primary Diagnosis	2	7	

Table 3: Outcomes by respiratory symptom status

	Asymptomatic (N=41)	Symptomatic (N=79)	p-value
ICU Length of Stay (days)	13 [5, 37]	7 [4, 13]	0.0136
Hospital Length of Stay (days)	29 [12, 48]	13 [7, 22]	0.0059
Post-Op Duration of Initial Intubation (days)	3 [0, 9]	1 [1, 5]	0.2679
Total post-op duration prior to final extubation/ Trach Placement (days)	7 [1, 24]	3 [1, 8]	0.1213
Total post-op duration resp pressure support (days)	8 [2, 29]	3 [1, 9]	0.0580
Reintubation Required	11 (26.8)	18 (22.8)	0.6235
Increase in Home O2 requirement or home vent settings	5 (12.2)	6 (7.6)	0.5075*
Mortality with 30 days	0 (0)	1 (1.3)	1.0000*
Readmission within 30 days of hospital discharge	10 (24.4)	11 (13.9)	0.1524

Discussion

- To our knowledge, this is the largest study examining this clinical scenario in congenital heart disease patients, with the most comprehensive panel of viruses included.
- Positive respiratory viral test or presence of symptoms is not predictive of worse outcomes after congenital heart repair surgery.
- Lacking respiratory symptoms or testing negative for a respiratory virus is not a reassuring factor for better post-operative outcomes, there are likely other contributing factors.
- Larger, possibly multicenter studies would be required to determine if there are particular viral pathogens, or a particular combination of respiratory viral status and symptom status that contributes to these post-operative outcomes.

Conclusion

Testing for respiratory viruses should not be a routine part of planning for patients scheduled to undergo congenital heart repair surgery. This would not only reduce unnecessary testing and financial burden on patient families, but also reduce unnecessary delays in definitive treatment for congenital heart disease.