Mechanical Circulatory Support in Pediatric Myocarditis: Utilization and Patient Outcomes

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BACKGROUND

- Myocarditis is a common cause of heart failure in children
- There is significant variability in clinical presentation, severity, etiology, and clinical course of pediatric myocarditis
- The most severe cases may cause low cardiac output syndrome requiring mechanical circulatory support (MCS)
- Use of MCS, MCS strategies and MCS outcomes in pediatric myocarditis have not been well described

AIMS

The study aims to describe:

- The frequency of MCS use in pediatric patients with myocarditis and types of support used
- Outcomes of patients who receive MCS and how outcomes compare between strategies
- Trends in MCS in pediatric myocarditis over time

METHODS

- Study Design: Retrospective cohort study
- Data Source: Kids' Inpatient Database (KID), a nationally representative administrative sample of discharge data from patients under 21 years
- Inclusion Criteria:
  - Admission in 2003, 2006, 2009, 2012 or 2016
  - Diagnosis of myocarditis by ICD-9 or 10 code
- Exposure:
  - Mechanical circulatory support
    - Extracorporeal membrane oxygenation (ECMO) including ECPR vs non- ECPR
    - Durable ventricular assist device (VAD)
    - Temporary ventricular assist device
    - Combination MCS (ECMO+VAD or durable VAD+temporary VAD)
- Outcomes:
  - Primary Outcome: Mortality
  - Secondary Outcomes: Transplant, stroke, arrhythmia, and renal failure

RESULTS

Table 1. Patient demographics and clinical characteristics

	All Myocarditis Admissions n=5661	Any MCS n=424 (7.5%)	No MCS n=5237 (92.5%)	p-value
Age				
<1 year	915 (16.2)	108 (25.5)	807 (15.4)	<0.0001*
1-5 years	937 (16.5)	115 (27.1)	822 (15.7)	
6-12 years	955 (16.9)	88 (20.8)	867 (16.6)	
13-18 years	2854 (50.4)	112 (26.4)	2742 (52.4)	
Sex				
F	1984 (35.1)	217 (51.2)	1767 (33.8)	<0.0001
M	3663 (64.7)	207 (48.8)	3456 (66.1)	
Race				
White	2358 (41.7)	142 (40.7)	2216 (49.9)	0.0084
Non-white	2432 (42.9)	206 (59.0)	2225 (50.1)	
Primary Payer				
Government	2400 (44.4)	198 (51.5)	2202 (43.8)	<0.0001
Private	2830 (52.3)	179 (46.6)	2652 (52.8)	
Other	178 (3.3)	8 (2.1)	170 (3.4)	
Location of Patient				
Urban	4773 (85.6)	354 (86.1)	4419 (85.5)	0.084
Rural	806 (14.4)	57 (13.9)	749 (14.5)	
Number of Complex Chronic Conditions (CCCs)**				
0	2042 (36.1)	27 (6.4)	2016 (38.5)	<0.0001
1	2616 (46.2)	216 (50.9)	2399 (45.8)	
2	1003 (17.7)	181 (42.7)	822 (15.7)	

p-values compare probability of MCS use by age, sex, race, primary payer, location of patient and number of CCCs
*MCS use in patients 13-18 years vs <13 years
**Excludes cardiovascular CCC

Figure 1. Use of mechanical circulatory support in pediatric myocarditis

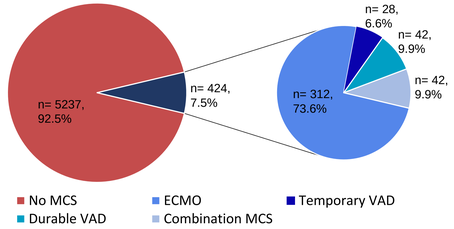


Figure 2. Trends in incidence and mortality in pediatric myocarditis

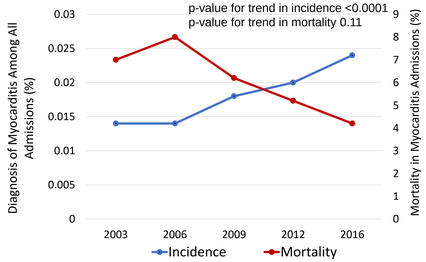
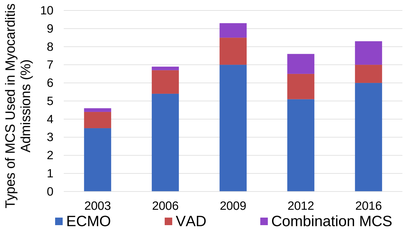
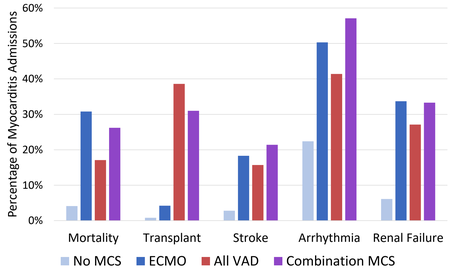


Figure 3. Trends over time in MCS use in pediatric myocarditis



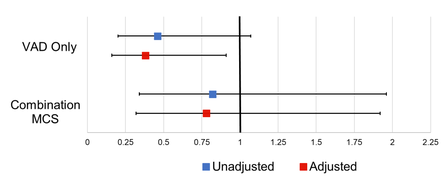
p-value for trend in combination MCS = 0.18

Figure 4. Morbidity and mortality in pediatric myocarditis



p-value for probability of each individual outcome (mortality, transplant, stroke, arrhythmia and renal failure) in MCS vs no MCS < 0.0001
p-value for mortality in VAD or Combo vs ECMO alone = 0.11
p-value for transplant in VAD or Combo vs ECMO alone <0.0001

Figure 5. Odds of death based on MCS strategy compared to non-ECPR ECMO



Multivariable analysis adjusted for age, sex, race and number of CCCs.

LIMITATIONS

- Given the limited clinical granularity in an administrative dataset, there may remain residual unmeasured confounding, particularly related to severity of illness leading to confounding by indication
- Transition of ICD-9 to ICD-10 during the study period may lead to misclassification of exposures or trends in diagnosis unrelated to incidence of disease

CONCLUSIONS

- In a nationwide cohort, MCS is used in 1 in 13 pediatric myocarditis admissions, with ECMO remaining the most common modality used
- The diagnosis of pediatric myocarditis is increasing over time and there is a trend towards decline in mortality
- Patients who receive MCS have higher morbidity and mortality than those who do not
- After adjustment, patients who receive VAD as compared to non-ECPR ECMO have a significantly lower risk of death during admission
- Further study is required to determine how MCS strategies are selected and the effect on individual outcomes

DISCLOSURES

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