Late survival and RV performance in matched children after Norwood: Norwood-BT vs Norwood-Sano

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95th Annual Meeting: American Association for Thoracic Surgery
2015, Seattle, WA
No disclosures
Congenital Heart Surgeons’ Society
N = 692 Neonates
Critical Left Ventricular Outflow Tract Obstruction

2005 – 2014: 21 Institutions
Aortic atresia/critical AS
Ductal-dependent
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N = 692 Neonates
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2005 – 2014: 21 Institutions
Aortic atresia/critical AS
Ductal-dependent

Ross-Konno/Yasui
n = 8

Transplant
n = 5

Aortic Valvotomy
n = 107

Hybrid
n = 110

Norwood
n = 454
Stage-1 Norwood

n = 454

BT (51%)  
n = 232

SANO (49%)  
n = 222

Ohye RG, et al. NEJM, 362;21 May, 2010
BT vs SANO

Difference in survival

Difference in RV dysfunction

Difference in tricuspid regurgitation
Overall survival for all children
n = 454

Survival rates:
- SANO: 71%
- BT: 59%

Statistical significance:
$P < 0.001$
Propensity-Matching

BT vs SANO

100%
Matched Children
n = 338

BT (75%)
n = 169

SANO (74%)
n = 169
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1. Parametric hazard analysis:
   a. Competing end-states
   b. Overall survival
   c. Transplant-free survival
End-states after Norwood
All Matched Children (n=338)
End-states after Norwood
All Matched Children (n=338)

Alive without definitive palliation

Years after Norwood
End-states after Norwood
All Matched Children (n=338)

Alive without definitive palliation

Years after Norwood

%
End-states after Norwood
All Matched Children (n=338)

- Alive without definitive palliation
- Dead
- 2-V
- Fontan
- Transplant

% versus Years after Norwood
End-states after BT (n=169)

Mortality

Death after BT

% of patients who died after BT over the years after Norwood.

42% mortality after 6 years.
End-states after SANO (n=169)

Mortality

Death after BT
42%

Death after SANO
24%

Years after Norwood
End-states after BT (n=169)
Definitive Palliation

Year after Norwood

- Fontan: 49%
- Transplant/BVR: 3%
End-states after **SANO** (n=169)

**Definitive Palliation**

- **Fontan**
  - 54%
  - 49%
- **Transplant/BVR**
  - 10%
  - 3%

Years after Norwood
Overall survival  
$n = 338$

- **SANO**: 70% survival  
- **BT**: 55% survival  
  
$P < 0.001$
Transplant-free survival

$n = 338$

% Survival vs Years after Norwood

SANO

BT

$P = 0.004$
Systemic RV

Ventriculotomy

Ohye RG, et al. NEJM, 362;21 May, 2010
2. Prevalence of RV dysfunction and TR:
   Mixed-model regression analysis of repeated echos
2. Prevalence of RV dysfunction and TR: Mixed-model regression analysis of repeated echos

Reports analyzed from every echo on every patient
N = 2,993 echos
Grades of RV dysfunction and TR

From institutional echo reports

1 = trivial
2 = mild
3 = mild-to-moderate
4 = moderate
5 = moderate-to-severe
6 = severe
Grades of RV dysfunction and TR

From institutional echo reports

1 = trivial
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“Important” RV dysfunction and TR
RV dysfunction after Norwood

2474 echos for 292 children
RV dysfunction after Norwood

BT vs SANO

Early, $P = 0.019$

Late, $P = 0.36$

≥ Moderate RV dysfunction (%)

0 2 4 6

Years after Norwood
Transplant-free survival and RV dysfunction

BT vs SANO

Transplant-free survival: BT vs SANO

Years after Norwood

%
Transplant-free survival and RV dysfunction

BT vs SANO

Transplant-free survival: BT vs SANO
64% vs 53%

RV dysfunction: BT vs SANO

Years after Norwood
Transplant-free survival and RV dysfunction

BT vs SANO

Transplant-free survival:
- BT vs SANO
  - BT: 64%
  - SANO: 53%

Early hazard:

Peak prevalence:

RV dysfunction:

Years after Norwood
Transplant-free survival after stage-2
BT (n=108) vs SANO (n=125)

Survival rates are 81% for BT and 80% for SANO, with a p-value of 0.68.
RV dysfunction after stage-2

BT vs SANO

P = 0.675
Tricuspid regurgitation after Norwood

2423 echos for 288 children
Tricuspid regurgitation after Norwood

BT vs SANO

Early, $P = 0.003$

Late, $P = 0.68$

≥ Moderate TR (%)

Years after Norwood
Summary

For comparable neonates with critical LVOTO undergoing stage-1 Norwood:

1. Overall and transplant-free survival are better after SANO
Summary

For comparable neonates with critical LVOTO undergoing stage-1 Norwood:

1. Overall and transplant-free survival are **better** after SANO
2. Early RV dysfunction and TR are **worse** after BT
Summary

For comparable neonates with critical LVOTO undergoing stage-1 Norwood:

1. Overall and transplant-free survival are better after SANO
2. Early RV dysfunction and TR are worse after BT
3. Late RV dysfunction and TR are similar between groups
Implication

Children undergoing SANO are more likely to be alive at 6 years – irrespective of final physiology

Suggesting that SANO is preferable to BT for stage-1 palliation