Early Rehabilitation Interventions Improve Functional Outcomes in Children After Cardiac Surgery

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Background

- Children with congenital heart disease (CHD) who require surgical interventions are at increased risks for neurodevelopmental deficits.[1,2]
- Early evaluation, intervention, and long term follow up are recommended by the American Heart Association and American Academy of Pediatrics.[1]

Methods

- A single-center retrospective study was conducted to evaluate the effects of early rehabilitative evaluation and intervention in children after cardiac surgery from 8/1/2011 to 7/30/2013
- Patients who were deemed high risk for neurodevelopmental deficits based on AHA guidelines were referred to physical therapy (PT), occupational therapy (OT) and speech therapy (ST) in the postoperative period.
- Rehabilitative services clinicians evaluated patients at time of referral and prior to hospital discharge.
- Developmental evaluations were performed at the Neonatal and Cardiac Intensive Care Follow-up Clinic and/or outpatient rehabilitative services visits.

PT evaluated the following variables:

Normal	• All extremities moving with some variety • Good state regulation • Able to achieve midline • Visual gaze and/or tracking • Good attention
Suspect	• Sporadic movement of extremities overall • Inconsistent ability for state regulation • Able to facilitate occasional midline • Occasional visual gaze and/or tracking • Intermittent attention
Abnormal	• One or more extremities not moving • Inability to achieve state regulation • Cannot tolerate and/or facilitate midline • No visual gaze and/or tracking • Inability to achieve attention
Decreased motor quality	• Monotonous movement patterns • Predictive movement patterns • Decreased motor repertoire with decreased fluidity, smoothness and/or variety of movement.
Decreased motor quantity	• Decreased frequency in movement patterns.
Decreased endurance	• Inability to tolerate therapeutic handling or assisted transitions as expressed by physiologic instability and/or presence of behavior stress signs

Methods

ST evaluated the following variables:

Risk for speech-language delay	• Hearing loss • Time on bypass • Neurological insult • Cyanotic cardiac physiology • Genetic syndrome • Tracheostomy
Aspiration	• Documented aspiration of material below the level of the vocal folds as identified via VFSS or FEES exam during active swallowing
Feeding methods	• Oral feeding (full PO) • Oral feeding with supplemental nutrition • No oral feeding
Feeding strategies	• Change in feeding position • Change in nipple flow • Use of thickened liquid consistency • Use of external pacing • Time limit for oral feeding

OT evaluated the following variables:

Decreased visual tracking	• Inability to visually attend to stimuli • Inability to demonstrate visual regard of item • Inability to track with fluid pursuits to functionally appropriate range
Decreased upper extremity motor skills	• Impaired range of motion, strength and coordination of proximal and distal upper extremity • Asymmetry and poor grading of movement, poor grasp and paucity of upper extremity movement
Decreased state regulation	• Increased stress cues in response to daily, routine activities with poor ability to self soothe or response to imposed calming strategies in a variety of environments

Results

	N (%); Mean (SD)
Female	35/71 (49.3)
Race • White • African American • Asian • Other	 44/71 (61.9) 10/71 (14.1) 2/71 (2.8) 14/71 (19.7)
Weight at surgery (Kg)	5.06 (2.37)
Age at surgery (mos)	4.5 (4 d-4.1 yrs)
CPB time (min)	146 (47.4)
Cross clamp time (min)	92.4 (52.6)
ICU length of stay (days)	27 (4d-5.4 mos)
Genetic abnormalities	46 (23.8) Trisomy 21 (11); 22q deletion (7); Micro deletion (6) VACTERL (3); CHARGE (2)

Table 1: Patient characteristics

- CPB surgery 60/71 (84.5%)
- Single ventricle physiology 12/71 (16.9%)
- Late prematurity <37 weeks GA 16/71 (22.5%)
- Rehabilitative evaluations:
  - PT (70/71), OT (30/71), ST (31/71)
- Early PT/OT/ST abnormalities improved at neurodevelopmental follow up Fig 2-4 (p=.001)
- Risk of speech-language delay remains high (p=.002)

Results

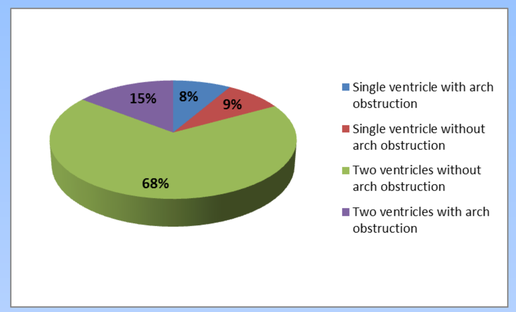

Figure 1: Cardiac physiology

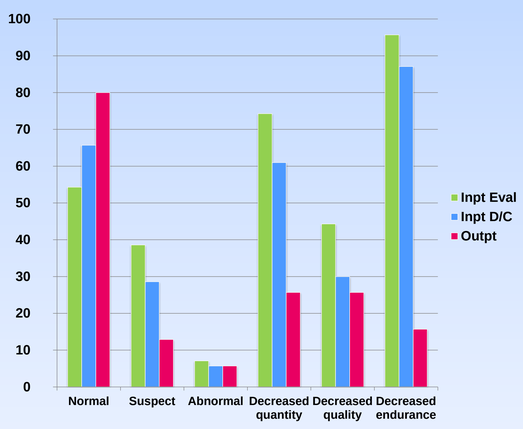

Figure 2: Percentage of patients exhibiting PT variables

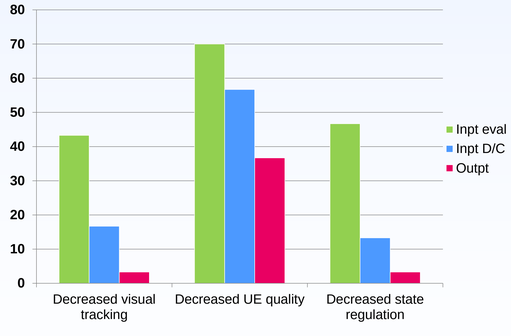

Figure 3: Percentage of patients exhibiting OT variables

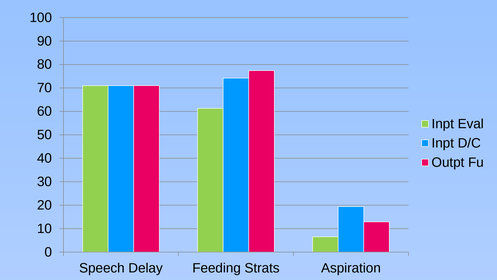

Figure 4a: Percentage of patients exhibiting ST variables

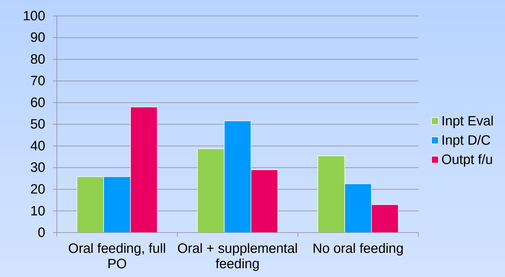

Figure 4b: Mode of feeding by percentage

Conclusion

- Children with CHD exhibit abnormalities in endurance, state regulation, motor quality and quantity, ability to PO feed, and speech-language delay after cardiac surgery.
- Risk of speech-language delay remains significant and requires follow up.
- Early initiation of PT, OT and ST interventions show promising preliminary results of improvement in all remaining areas of potential delay.
- Further studies are needed to track the longitudinal benefits of intervention for this population.

References

[1] Marino, Bradley S., et.al "Neurodevelopmental outcomes in children with congenital heart disease: evaluation and management : A scientific statement from the American Heart Association." *Circulation*. 2012.126.1143-1172.

[2] Limperopoulos, Catherine et.al. "Neurodevelopmental status of newborns and infants with congenital heart defects before and after open heart surgery." *Pediatrics*. 2000. 638-645.