

*Title:* Persistent growth failure in infants with congenital heart disease (CHD) following cardiac surgery

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*Objective:* Describe growth patterns in neonates with CHD following cardiac surgery.

*Background:* Lack of parenteral or enteral macronutrients for infants requiring vital organ support or surgery can lead to lean-tissue wasting and long term adverse outcomes such as growth failure. Although growth failure has received a considerable amount of attention as a major and potentially modifiable risk factor for increased morbidity, prolonged hospitalization, and impaired neurodevelopment in patients with CHD, particularly hypoplastic left heart syndrome (HLHS), a single variable responsible for growth failure and a close observation of neonates to determine rate of growth following hospital discharge (at 8-12 weeks of age) has not yet been identified.

*Methods:* This study was a retrospective cohort analysis comparing growth, heart failure status, and nutritional intake in patients with CHD following cardiac surgery. Neonates and infants met the inclusion criteria for the study if they had surgery for critical CHD prior to 10 weeks of age. Forty-five patients were weighed at birth, 3-7 weeks, and 8-12 weeks of age. Their weights were converted to z-scores using the WHO growth charts for boys and girls from 0-2 years of age. Interval growth velocity was computed by subtracting the z-score at birth from the 3-7 week z-score and the z-score at 3-7 weeks from the z-score at 8-12 weeks. Patients were also assessed for heart failure at 10-15 weeks of age using the following parameters: treatment with diuretics, ACE inhibitors, and/or digoxin, pre-discharge echocardiogram findings of > moderate LV or RV dysfunction or > moderate AV valve regurgitation), and a brain natriuretic peptide > 100. Mode of nutrition (oral, tube, or breastfeeding) at discharge following surgery and at 10-15 weeks was considered as a potential correlative factor for growth status.

*Results:* Genetic syndrome was found in 6/45 (13.3%). Nearly ½ or 46% of patients were on heart failure medications, and 10/45 (22%) had echocardiographic findings of heart failure. At hospital discharge, the majority (60%) were orally fed, exclusive breast fed (2%), oral and tube (31%), and exclusive tube (37%). At 10-15 weeks, mode of feeding included oral (55%), exclusive breast feeding (21%), oral and tube (13%), exclusive tube feeding (11%). Explorative analysis of data using unpaired t-tests, ANOVA, and Chi-square analysis showed that there was a significant drop in z-score velocity in patients on tube feeding and had >1 indication for heart failure ( $p=$ ). Weight z-scores fell significantly from birth to 3-7 weeks of age and again from 8-12 weeks of age. Growth velocities were significantly slower from birth to 3-7 weeks than from 3-7 weeks to 8-12 weeks ( $p=$ ), indicating that slowing of growth was most marked in the first 3-7 weeks after birth. At 3-7 weeks, the weight of 8 patients dropped >2 SD from their birth weight (BW), 17 dropped 1-2 SD from their BW, and 20 maintained their weight within 1 SD of BW. The average z-score velocity between 3-7 and 8-12 weeks was -0.24, indicating a continuation in decline and lack of catch-up growth during the post-operative time frame. By 8-12 weeks, only 6/45 patients (13.3%) showed catch up growth (improvement in weight z-score by greater than 0.5SD).

*Conclusions:* Neonates and infants with critical CHD demonstrated decreased growth velocity and poor catch-up growth after cardiac surgery. Close monitoring after hospital discharge and further investigation of growth failure in a larger patient sample is necessary in hopes of identifying risk factors for growth failure in patients with CHD following cardiac surgery.