

Perfect Match: Evaluating Cardiac Volumes for Optimizing Donor to Recipient Match for Pediatric Heart Transplant Recipients

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Background

- United Network for Organ Sharing (UNOS), heart transplants performed 10,157 for patients under the age of 18
- The number of patients each year that are listed for heart transplantation outnumber the available donors
- Methods for matching recipients to donors needs to be evaluated
- Accurately assess the recipients needs & improve the quality of organ transplantation

Methods

- 300 CT scans from UIHC pediatric patients with no heart disease were used for virtual reconstruction
- Virtual reconstructions were then trimmed to represent the anatomy that would be transplanted and measured Total Cardiac Volume (TCV)
- Data collected was then used to generate predictive models for evaluating TCV

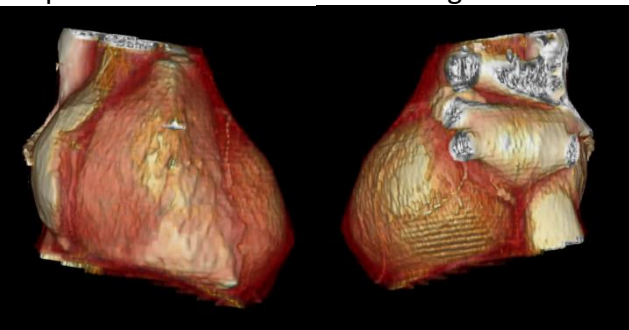


Figure 1 shows the virtual reconstructions used

Results

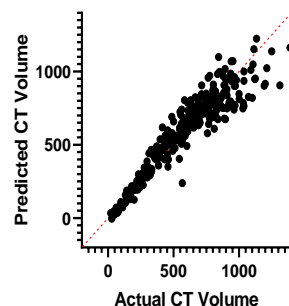
Table 1. shows the demographic breakdown of the normal anatomy cohort

Mean Demographics	Male (N=168)	Female (N=132)
Age (years)	11.91 (0.06-20.98)	13.37 (0.02-20.89)
Height (cm)	145.3 (37.5-199.3)	141.6 (54-182)
Weight (kg)	52.06 (1.05-152.6)	54.8 (3.15-248.5)
BSA (m ²)	1.415 (0.1046-2.801)	1.425 (0.2174-3.285)
BMI (kg/m ²)	21.55 (2.003-116.5)	23.79 (10.8-101.7)
CT Volume (ml)	607.5 (20-1390)	549.7 (43-1212)

Conclusions

- Body Surface Area (BSA) is a strong predictor of patient Total Cardiac Volume
- The different physical variables can be combined to form a strong predictive model for younger patients and patients with lower TCV values
- Reconstructive modeling using advanced imaging software allows for accurate assessment of patient volume and geometry
- Future goals: Evaluate how these models might be used to improve outcomes in patients undergoing heart transplants with and without congenital heart defects
- Grow the available library of normal cardiac anatomies to further develop an accurate model for non-invasive predictions of total cardiac volume

Actual vs Predicted plot: Model 4 Using Age, BSA, and BMI



$$TCV = \beta_0 + \beta_1(Age) + \beta_2(Height) + \beta_3(Weight)$$

$$TCV = \beta_0 + \beta_1(Age) + \beta_2(BSA)$$

$$TCV = \beta_0 + \beta_1(Age) + \beta_2(BMI)$$

$$TCV = \beta_0 + \beta_1(Age) + \beta_2(BSA) + \beta_3(BMI)$$

Figure 2. shows the plot of the predicted TCV using the last equation below versus the actual calculated value using the virtual software ($R^2 = 0.8911$)

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