Comparison of Exercise Blood Pressure Response in Patients with Coarctation of the Aorta: Surgical Repair vs. Endovascular Stent

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ABSTRACT

Background: Percutaneous stent placement has been shown to be a safe and effective treatment option for patients with coarctation of the aorta. Immediate post-procedural and short term hemodynamic assessments comparing stent placement to surgical correction show equivalency. Little is known about the effects of either treatment modality on blood pressure response during exercise.

Methods: A prospective comparison of hemodynamic response to exercise by treadmill testing in patients at least one year after intervention. Patients included were greater than seven years of age without complex congenital heart disease or single ventricle physiology. Patients underwent standard Bruce Protocol treadmill testing with periodic arm leg blood pressure and metabolic measurements.

Results: 25 patients underwent treadmill testing: 18 with surgical correction, 7 with stent placement. Median age was 13 years (IQR: 11-15.5yrs.). The median arm leg gradient prior to exercise was 12mmHg (IQR: 3-25mmHg) for surgical patients and 16mmHg (IQR: 17.5 - 40mmHg) for stented patients. The median peak exercise arm leg gradient was 28mmHg (IQR:16 - 44mmHg) for surgical patients and 30mmHg (IQR:17.5 - 40mmHg) for stented patients. The median increase in the arm leg gradient with exercise was 16mmHg for surgical patients and 14mmHg for surgical patients. Median Actual VO2Max/Predicted VO2Max was 100% for surgical patients compared to 96% for stented patients.

Conclusions: Few studies have compared surgery and endovascular stenting for coarctation of the aorta, with only one prior study comparing the effects of exercise on blood pressure. Stenting and surgery offer excellent hemodynamic results acutely and at maximal exercise. Stent placement demonstrates equivalent results in blood pressure response during exercise testing when compared to surgical therapy.

BACKGROUND

- Coarctation of the aorta accounts for 4% to 5% of congenital cardiac abnormalities
- Endovascular stent placement as a therapy for coarctation of the aorta was first reported in 1993
- Although endovascular stent therapy and surgical repair are widely used and acutely effective in resolving aortic arch obstruction, longer term assessment of hemodynamic responses to these therapies is needed

OBJECTIVES

The purpose of this study was to compare the hemodynamic and metabolic response to exercise between patients treated with surgical repair vs. endovascular stent placement for coarctation of the aorta

METHODS

- Prospective comparison study of 25 patients with coarctation of the aorta who underwent treadmill exercise testing with metabolic assessment
- 18 with previous surgical correction, 7 with stent placement
- Inclusion criteria
  - Greater than seven years of age and able to participate in exercise testing
  - Diagnosis of Coarctation of the Aorta
- Exclusion criteria
  - Complex congenital heart disease including single ventricle physiology
- Exercise testing with standard Bruce protocol
- Blood pressures measured with standard blood pressure cuffs
- Non-parametric analysis for statistical comparisons

Surgical Repair vs. Endovascular Stent Placement in patients with Coarctation of the Aorta

	Surgical Repair	Endovascular Stent	P-Value
Demographics			
Patients enrolled	18	7	
Gender (% male)	72%	43%	
Height (cm)	155 (136-170)	155 (147-170)	0.57
Weight (kg)	48.6 (33.4-62.5)	53 (43.1-71.9)	0.33
Body Mass Index	19.7 (17.9-22.0)	22.1 (19.9-24.8)	0.12
Hemodynamic Data before and after Exercise Treadmill Testing			
Resting SBP (mmHg)	119 (110-129)	135 (113-138)	0.18
Rest SBP (% tile)	81 (62-93)	97 (79-99)	0.10
Resting DBP (mmHg)	60 (50-66.5)	65 (52-70)	0.42
Rest DBP (% tile)	37 (9-58)	44 (22-63)	0.50
Resting arm-leg SBP gradient (mmHg)	12 (9-22)	16 (3-25)	0.62
Peak Exercise arm-leg SBP gradient (mmHg)	28 (16-44)	30 (18-40)	0.99
Arm-leg change with exercise (mmHg)	16 (4-22)	14 (8-17)	0.80

Statistics described as medians (interquartile range)
SBP – systolic blood pressure, DBP – diastolic blood pressure

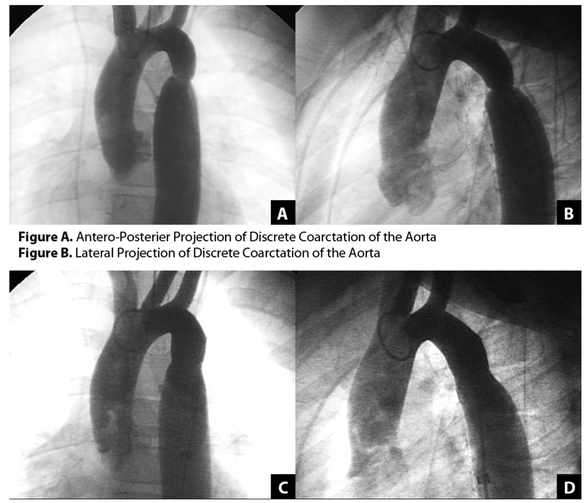

Figure A. Antero-Posterier Projection of Discrete Coarctation of the Aorta
Figure B. Lateral Projection of Discrete Coarctation of the Aorta

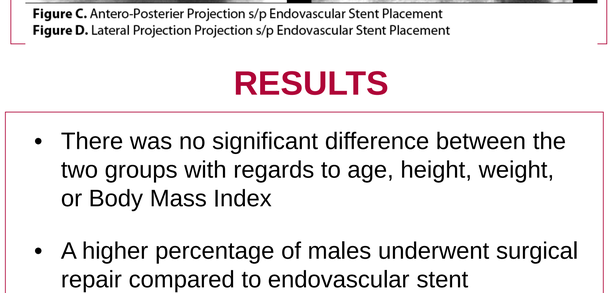

Figure C. Antero-Posterier Projection s/p Endovascular Stent Placement
Figure D. Lateral Projection Projection s/p Endovascular Stent Placement

RESULTS

- There was no significant difference between the two groups with regards to age, height, weight, or Body Mass Index
- A higher percentage of males underwent surgical repair compared to endovascular stent
- Resting systolic and diastolic blood pressure were not statistically different
  - Endovascular stent patients had higher resting systolic and diastolic blood pressures
    - Not statistically significant
- Arm-leg blood pressure gradients at baseline and at peak exercise were not different between groups
- The increase in arm-leg gradient was similar in both groups
- Baseline spirometry, VO_2 Max, VCO_2 Max, Heart Rate Response, Respiratory Rate, or Respiratory Exchange Ratio (RER) Max were not different between the two groups

Spirometry and Metabolic Response to Exercise Treadmill Testing

	Surgical Repair	Endovascular Stent	P-Value
FEV1 (% pred)	90 (77-105)	103 (98-119)	0.08
FVC (% pred)	96 (83-104)	100 (99-124)	0.08
FEV1/FVC (% pred)	85 (81-99)	95 (86-103)	0.18
VO_2 Max	45.0 (35.1-53.6)	43.0 (38.3-47.5)	0.53
VO_2 Max (% pred)	101 (76-122)	99 (89-111)	0.76
VCO_2 Max	2437 (1909-3153)	2547 (1932-4067)	0.97
VCO_2 Max (%pred)	119 (73-124)	104 (101-112)	0.55
Heart Rate at VO_2 Max (% pred)	94 (86-97)	88 (76-101)	0.92
Respiratory Rate at VO_2 Max	53 (50-63)	52 (49-55)	0.41
PET CO_2 Max (% pred)	108 (104-112)	119(105-132)	0.18
PET O_2 Max	93 (88-95)	90 (85-95)	0.66
RER Max	1.13 (1.07-1.21)	1.15 (1.08-1.27)	0.77

CONCLUSIONS

- Primary Surgical Repair and Endovascular Stent placement both offer excellent hemodynamic results
- Arm-leg gradient at rest and after exercise were not different between groups
- Resting systolic blood pressures for both groups were elevated at baseline
- Metabolic performance measurements were not different between the two groups

ACKNOWLEDGEMENTS

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