An Eight Year Experience With The Ross Procedure

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Abstract and Introduction

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Background: The Ross Procedure has gained wider acceptance as a first time procedure for AVR in young patients. We report on our first 117 Ross Procedures. **Methods:** Data was compiled from the STS database, chart reviews, patient questionnaires and the Ross Registry. The cusum method was used to analyze the "learning curve". **Results:** Three patients (2.6%) died, from heparin induced thrombocytopenia, pulmonary embolism, and MI. Complications included reoperation for bleeding: 5 (4.3%); transient renal failure requiring dialysis: 2 (1.7%); heart block requiring PPM: 2 (1.7%). There were no strokes. Six patients (5.1%) were readmitted within 30 days; 2 for delayed tamponade and 4 for atrial fibrillation. Four patients have undergone autograft reoperation, 2 required mechanical AVR, 2 repairs of an annular false aneurysm. One patient required pulmonary homograft replacement. Follow-up echo data showed 7 patients (6.0%) had AI=2+ and one (0.9%) had AI=3-4+. Questionnaire response (88%) revealed 90% of patients experienced no significant limitations in activities of daily living (ADL).

The learning curve dropped below 180 minutes perfusion time at 35 patients. In the last 82 patients, there were no autograft reoperations, 2 (1.7%) reoperations for bleeding, and only 4 (3.4%) had AI >1+ on follow-up echo. **Conclusion:** The Ross Procedure carries a low morbidity and mortality, has few autograft or homograft failures in the first 5 years and no limitation to ADL for the patients. Once a surgeon has surpassed the learning curve, the Ross Procedure should be considered the primary operation for young patients with aortic valve disease.

The Ross Procedure has gained wider acceptance as a first time procedure for AVR in young patients. Because of perceived technical difficulties, concerns remain about operative morbidity and mortality as well as early pulmonary and aortograft function.We report on our first 117 patients undergoing the Ross Procedure.

Methods

- Data was extracted from our STS certified database
- Supplementary data was obtained by chart reviews and from the Ross Registry
- Patient questionnaires were used to assess limitations in ADL activity
- A 1:1 match was obtained for the Ross patients and aortic valve replacements during the corresponding time period
- The data was then analyzed using chi-square or t-tests as appropriate to compare risk factors and outcomes from the two techniques
- The cusum method was used to analyze the "learning curve".

Results

Ross - AVR Pre-op Risk Factors After Matching

Matched On :Age ± 20,CVD,CHF

Category	*AVR(117)* N	%	*Ross(117)* N	%	*p-value*
Female	31	26.5	31	26.5	NS
Smoker	27	23.1	22	18.8	NS
Fam Hx	24	20.5	45	38.8	0.002
Diabetes	9	7.7	7	6.0	NS
Hypercholesterolemia	17	14.5	27	23.1	NS
Renal Failure	5	4.3	3	2.6	NS
Dialysis	3	3.6	0	0	NS
Hypertension	34	29.1	41	35.0	NS
CVA	5	4.3	0	0	0.02
Lung Disease	Distribution not different				NS
Immunosuppresion Meds	1	0.9	1	0.9	NS
PVD	2	1.7	0	0	NS
Cerebral Vasc Dis	1	0.9	1	0.9	NS
Previous CAB	1	0.9	0	0	NS
Previous Valve	12	10.3	8	6.8	NS
MI	5	4.3	1	0.9	NS
MI When	Distribution not different				NS
CHF	19	16.2	19	16.2	NS
Cardiogenic Shock	2	1.7	0	0	NS
Resuscitation	1	0.9	0	0	NS
Status					NS
Elective	97	82.9	106	91.4	
Urgent	18	15.4	10	8.6	
Emergent	1	0.9	0	0	
Salvage	1	0.9	0	0	
IABP	5	4.3	2	1.7	NS
Intraop IABP Usage	5	100	2	100	NS
Arrhythmia	12	10.3	3	2.6	0.02
Valve Dis- Aortic Stenosis	64	54.7	54	46.2	NS
Valve Dis- Mitral Stenosis	2	1.7	0	0	NS
Valve Dis- Aortic Insufficiency					NS
0	31	26.5	29	24.8	
1	5	4.3	3	2.6	
2	9	7.7	4	3.4	
3	22	18.8	21	18.0	
4	49	41.9	60	51.3	
5	1	0.9	0	0	
Valve Dis- Mitral Insufficiency	Distribution not different				NS
Valve Dis- Tricuspid Insufficiency	Distribution not different				NS
Valve Dis- Pulmonic Insufficiency	Distribution not different				NS

Continuous Variables

Age	45.5 ± 9.9	42.7 ± 11.8	NS
EF	52.6 ± 11.6	56.0 ± 9.4	0.02

Complications: AVR vs Ross

Matched On: Age ± 20, CVD,CHF (117 patients each group)

Factor	AVR N	%	Ross N	%	p-Value
Mortality Rate	5	4.3	3	3.1	NS
Overall Complication Rate	44	37.6	44	37.6	NS
Tamponade	1	0.9	2	1.7	NS
A Fib	19	16.2	22	18.8	NS
Cardiac Arrest	2	1.7	2	1.7	NS
Blood Products	51	44	63	53.9	NS
Coma (24 hr)	2	1.7	1	0.9	NS
Renal Failure	4	3.4	7	6	NS
Dialysis Required	1	0.9	2	1.7	NS
GI Disorder	0	0	0	0	NS
IABP Use (Intraop or Postop)	5	4.3	2	1.7	NS
Intraop	5	100	2	100	
Postop	0	0	0	0	
MI	1	0.9	1	0.9	NS
Infection	4	3.4	0	0	0.04
Coagulopathy	5	4.3	3	3.8	NS
Reop Valve Dysfunction	0	0	0	0	NS
MultiSystem	0	0	0	0	NS
Pneumonia	2	1.7	0	0	NS
Re-op Bleeding	7	6	5	4.3	NS
Readmit in 30 day	5	6.2	6	6.3	NS
Septicemia	1	0.9	0	0	NS
Sternal Deep Infection	1	0.9	0	0	NS
Stroke- Perm	1	0.9	0	0	NS
Stroke- Transient	1	0.9	1	0.9	NS
Heart Block	1	0.9	2	1.7	NS

Continuous Variables (ANOVA)

Xclamp Time (min)	84.3 ± 37.3	157.2 ± 24.1	<0.001
Perfusion Time (min)	117.6 ± 56.9	188.6 ± 28.3	<0.001
ICU LOS (days)	2.4 ± 3.7	1.7± 2.1	NS (0.09)
LOS (days)	7.1± 6.4	5.8 ± 3.2	0.05

Mortality =3 (2.6%)
- 1 - heparin induced thrombocytopenia
- 1 - pulmonary embolism
- 1 - myocardial infarction

Results (cont'd)

Complications
- 5 - reoperation for bleeding (4.3%)
- 2 - transient renal failure requiring dialysis (1.7%)
- 2 - heart block requiring permanent pacemaker(1.7%)
- 0 - stroke
- 6 - readmitted within 30 days (5.1%)
  - 2 for delayed tamponade
  - 4 for atrial fibrillation.
- 4 - needed autograft reoperation (3.4%)
  - 2 required mechanical AVR
  - 2 repairs of an annular false aneurysm
- 1 - pulmonary homograft replacement (0.9%)

Follow-up echo data
- 7 - had AI=2+ (6.0%)
- 1 - had AI=3-4+ (0.9%)

Questionnaire response (88%) revealed 90% of patients experienced no significant limitations in activities of daily living (ADL).

For the Ross procedure, the learning curve dropped below 180 minutes perfusion time at 35 patients (cusum). After that time, in the last 82 patients the results improved further:
- 0 - autograft reoperations,
- 2 - reoperations for bleeding (1.7%)
- 4 - had AI >1+ on follow-up echo (3.4%)

Summary

- The Ross Procedure carries a low morbidity and mortality
- Few autograft or homograft failures were observed in the first 5 years
- Patients reported they had no significant imitations to ADL
- The learning curve comprises about 35 patients
- Once a surgeon has surpassed the learning curve, the Ross procedure should be considered the primary operation for young patients with aortic valve disease.