Transcatheter Aortic Valve Implantation (TAVI) – The Time Has Come

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Hong Kong SAR

Queen Elizabeth Hospital
HA Convention 2012
Introduction

• Aortic Stenosis – most common valvular heart disease in the elderly
• 4.6% in adults $\geq 75$ years of age
• Once symptomatic, average survival 2-3 years with high risk of sudden death
• Surgical AVR is the standard treatment
• TAVI emerges as a viable alternative in inoperable or high risk elderly patients
Aortic Stenosis is Life-Threatening and May Progress Rapidly

Treatment Options and Timing Matters

“Survival after onset of symptoms is 50% at two years and 20% at five years.”

“Surgical intervention [for severe AS] should be performed promptly once even .... minor symptoms occur.”
CoreValve®

Edwards Sapien™

CoreValve® Transcatheter Procedure

Balloon catheter threaded through sheath and into heart

CoreValve placed into position over the diseased aortic valve

CoreValve in place, procedure completed

Figure 1

Figure 2

Figure 3

Experimental Device in the United States and Limited by Federal Law to Investigational Use.
TAVI Program in QEH

• New program in KC Cluster
• Extremely high-risk procedure
• Multi-disciplinary Heart Team formed in 2009: Cardiologists, Cardiothoracic surgeons, Cardiac Anaesthesiologists, Radiologists, Cardiac nurses
• CoreValve Greater China Study – approved by KCC Ethics Committee 9 Sep 2010 (funded by research fund and QEH charitable trust fund)
• Didactic lectures & Simulator Training: Jan 2010 - Medtronic TAVI Training Center, Switzerland
• Case Observation: April 2010 - Mercy Hospital, New Zealand
• Further Training in high volume TAVI centre: Oct 2011 - Rigshospital, Copenhagen, Denmark
Potential Adverse Events

- **Access site complications** (i.e., pain, bleeding, hematoma, pseudo aneurysm, etc.)
- Acute coronary closure
- Acute Myocardial Infarction
- **Atrio-ventricular node block**
- **Death**
- Embolization
- Emergent Balloon Valvuloplasty
- Emergent PCI
- Emergent Surgery (i.e., coronary artery bypass, heart valve replacement)
- Myocardial Ischemia
- Mitral valve insufficiency
- **Perforation of the myocardium or vessel**
- **Stroke**
- Thrombosis
- Tamponade
- Ventricular arrhythmias
The Multidisciplinary Heart Team

- Research Coordinators
- Administrators
- Echocardiographer/Imaging Specialists
- Nurse Practitioners & Physician Assistants
- Heart Failure Specialist
- Dietary & Rehabilitation Specialists
- Interventional Cardiologist
- Cardiac Surgeon
- Anesthesiologist
- Social Workers

The Patient with severe AS

Queen Elizabeth Hospital
Patient Flow

HA/Private Hospitals
QEH Physicians / Surgeons Overseas

QEH TAVI Referral Centre

Initial assessment by cardiologists + Echo

TEE
Coro angio +/- PCI
CT angio

Heart Team final decision → workup for TAVI/SAVR

Independent assessment by cardiac surgeons

Pre-TAVI case review

TAVI Day

QEH TAVI Conference (debriefing)
Follow-up Schedule

- FU 1 month and then every 2-3 months
- Plavix for 3 months
- Aspirin for life
- Echo at 1, 6, 12 months and then yearly
- 6 min walk test at 1, 6, 12 months
- NYHA Functional Class assessment
- Risk factors control
HK Experience

• 22 CoreValve cases (no Edwards valve yet)
  – QEH 14, HK Adventist 3, PWH 5

• QEH Registry - 14 CoreValve patients (since 6 Dec 2010):
  – 7 males and 7 females
  – Mean age 80.9±2.7 years
  – 2 bicuspid AV
  – Procedural success rate 100%
  – In-hospital mortality 0%
  – 30-day mortality 0%
QEH Registry

- 9 small CoreValve devices (26mm), 4 medium (29mm) and 1 large (31mm)
- 1 subclavian vascular complication treated with stent graft
- No iliac/femoral vascular complication
- All femoral wounds closed with Prostar/Proglide x 2
- One patient has PCI to LAD done before TAVI, returned for NSTEMI and with redo-PCI done, died 3 months after TAVI because of acute coronary stent thrombosis
- All 14 patients have functionally normal CoreValve with trivial to mild AR
QEH Registry

- Pre-dilatation of the native aortic valve was done in all the 14 patients and post-dilatation in 3 patients
- Aortic valve area improved from $0.72 \pm 0.19 \text{cm}^2$ to $2.04 \pm 0.36 \text{cm}^2$
- Mean gradient across the aortic valve decreased from $54.3 \pm 12.0 \text{mmHg}$ to $9.7 \pm 3.4 \text{mmHg}$
- 2 permanent pacemaker implantation (both with pre-existing SSS/slow AF) (14.3%)
- Improve NYHA Functional Class 1.25
CoreValve Asia Registry

- Malaysia – 18
- Thailand – 13
- HK (Lee) – 12
- Taiwan – 11
- Singapore – 9
- Korea – 9
- HK (Lam) – 2
- Total: 74
## QEH Registry vs. Asia Registry

<table>
<thead>
<tr>
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<th>QEH Registry</th>
<th>Asia Registry</th>
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<tbody>
<tr>
<td>Number of patients</td>
<td>14</td>
<td>74</td>
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<tr>
<td>Age, years</td>
<td>80.9</td>
<td>79.1</td>
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<tr>
<td>Females, %</td>
<td>50</td>
<td>42</td>
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<td>Log EuroSCORE, %</td>
<td>12.3</td>
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<tr>
<td>Mean pressure gradient, mmHg</td>
<td>54.3</td>
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<tr>
<td>Aortic Valve Area, cm²</td>
<td>0.72</td>
<td>0.7</td>
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<tr>
<td>LVEF, %</td>
<td>58.4</td>
<td>40</td>
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<tr>
<td>Route</td>
<td>Transfemoral 13 Subclavian 1</td>
<td>Transfemoral 71 Subclavian 3</td>
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<tr>
<td>CoreValve size</td>
<td>26mm – 9 29mm – 4 31mm – 1</td>
<td>26mm – 51 29mm – 22 31mm – 1</td>
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<td>Asia Registry</td>
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<tr>
<td>--------------------------------</td>
<td>--------------</td>
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<tr>
<td>Procedural Success, %</td>
<td>100</td>
<td>98.6</td>
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<td>30-day mortality, %</td>
<td>0</td>
<td>1.4</td>
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<tr>
<td>Stroke, %</td>
<td>0</td>
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<td>Permanent Pacemaker, %</td>
<td>14.3</td>
<td>13.5</td>
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<tr>
<td>Vascular Complications, %</td>
<td>7.1</td>
<td>6.8</td>
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<tr>
<td>NYHA at 30 days</td>
<td>2.6 → 1.3</td>
<td>2.6 → 1.5</td>
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<tr>
<td>MPG at 30 days, mmHg</td>
<td>9.7</td>
<td>9.7</td>
</tr>
<tr>
<td>AVA at 30 days, cm²</td>
<td>2.0</td>
<td>1.9</td>
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<tr>
<td>LVEF at 30 days, %</td>
<td>61.5</td>
<td>42</td>
</tr>
</tbody>
</table>
30-Day All-Cause Mortality

2. Meredith. VARC-adjudicated Outcomes in Inoperable and High Risk AS Patients. TCT 2010, Washington, DC.
30-Day Stroke Rate

2. Meredith. VARC-adjudicated Outcomes in Inoperable and High Risk AS Patients. TCT 2010, Washington, DC.
Pacemaker Implantation Rates Across Studies

Vascular Complications

1. Meredith I.T. 12 Month Results from ANZ CoreValve TAV Study. Presented at: TCT 2011.
5. Ruiz C.E. Weighted meta-analysis of CoreValve® Outcomes. Presented at: EuroPCR 2011 (analysis sponsored by Medtronic, Inc.).
Mean Gradient & Valve Area

QEH Registry

The PARTNER Trial

CoreValve ADVANCE Study
QEH | Symptom Status (NYHA Class)

Baseline:
- Class III: 57%
- Class II: 43%

30 days:
- Class III: 30%
- Class II: 70%
- Class I: 22%

6 months:
- Class III: 22%
- Class I: 78%
Conclusions

• TAVI – rapid adoption worldwide as a viable treatment option for inoperable or high-risk symptomatic severe AS patients

• Intrinsic high risk procedure for high risk patients

• Multi-disciplinary team approach

• Promising short- and intermediate-term outcome results in Hong Kong

• Long-term outcomes meticulously monitored
Clinical Governance & Credentialing

Expert Panel on TAVI → TAVI Implementation WG
- Technology Assessment
- Lay down service model – TAVI team
- Formulate referral protocol for all HA hospitals
- Indications & Contraindications of TAVI
- HA TAVI Registry & Audit
- Credentialing - Formal training of the TAVI team & training centre
- Referral network
- Presentation to Medical Device Advisory Committee
- HA Mechanism for Safe Introduction of New Procedures (HAMSINP)
- Apply for Samaritan Fund support
Key to Success

Patient Selection
Procedural details
Multi-disciplinary TAVI Heart Team
Thank you!
Backup Slides
Patient Inclusion Criteria

1. Documented severe aortic valve stenosis

2. Access vessel diameter >6 mm as defined pre procedure via angiographic measure

3. Aortic valve annulus diameter >=20 mm and <= 27 mm as defined pre procedure by echocardiographic measure

4. Ascending aorta diameter <= 43 mm at the sino-tubular junction

5. Native aortic valve disease, defined as valve stenosis with an aortic valve area <1cm2 (<0.6cm2 /m2) as defined pre procedure by echocardiographic measure
Patient Inclusion Criteria (Con’t)

6. Age $\geq 80$ years Or
   Surgical risk calculated with logistic EuroSCORE $\geq 20\%$, Or
   Age $\geq 65$ years with one or two (but not more than 2) of the following criteria:
   - Cirrhosis of the liver (Child class A or B)
   - Pulmonary insufficiency: VMS $< 1$ liter
   - Previous cardiac surgery (CABG, valvular surgery)
   - Porcelain aorta
   - Pulmonary hypertension $> 60$ mmHg and high probability of cardiac surgery for other than valve replacement
   - Recurrent pulmonary embolus
   - Right ventricular insufficiency
   - Thoracic burning sequelae contraindicating open chest surgery
   - History of mediastinum radiotherapy
   - Severe connective tissue disease resulting in a contraindication to surgery
   - Cachexia (clinical impression)
**Patient Exclusion Criteria**

1. Known hypersensitivity or contraindication to aspirin, heparin, ticlopidine, clopidogrel, nitinol, porcine products, or contrast media which cannot be adequately pre-medicated

2. Any sepsis, including active endocarditis

3. Recent myocardial infarction (<30 days)

4. Any left ventricular or atrial thrombus as determined pre procedure by echocardiography

5. Uncontrolled atrial fibrillation

6. Mitral or tricuspid valvular insufficiency (> grade II)

7. Previous aortic valve replacement (mechanical valve or stented bioprosthetic valve)

8. Evolutive or recent CVA (cerebrovascular accident), (<3 months)
Patient Exclusion Criteria (Con’t)

9. Femoral, iliac or aortic vascular condition (e.g. stenosis, tortuosity), that make impossible insertion and endovascular access to the aortic valve

10. Symptomatic carotid or vertebral arteries narrowing (> 70%) disease

11. Abdominal or thoracic aortic aneurysm

12. Bleeding diathesis or coagulopathy, or patient will refuse blood transfusion

13. Progressive disease with life expectancy less than one year

14. Creatinine clearance < 20 ml/min

15. Active gastritis or known peptic ulcer disease

16. Pregnancy
Please affix patient’s label here
(with ID number)

Queen Elizabeth Hospital
Transcatheter Aortic Valve Implantation (TAVI)
Referral Form

Patient’s contact number: ______________________
Name of referring doctor: ______________________
Name of referring unit and hospital: ______________________
Contact number of referring doctor: Tel: ____________ Fax: ____________

Patient must be symptomatic, with severe aortic stenosis who has an elevated surgical risk for open heart surgery before consideration for TAVI.

Symptoms:
Aortic valve area (cm²): ____________ Mean Gradient across aortic valve (mmHg): ____________
Mobility: (unaided / with aids / with assistance) ____________

Inclusion Criteria:
1. Documented severe aortic valve stenosis. Native aortic valve disease, defined as valve stenosis with an aortic valve area <1cm² (<0.6cm²/m²), mean gradient across aortic valve =40mmHg as defined pre procedure by echocardiographic measure.
2. Aortic valve annulus diameter ≥20 mm and ≤ 31 mm as defined pre-procedure by echocardiographic measure.
3. Patients with age ≥ 80 years Or
   Patients with surgical risk calculated with logistic EuroSCORE ≥ 20 %, Or
   Patients with Age ≥ 65 years with one or two (but not more than 2) of the following criteria:
   - Carotid stenosis (Child class A or B).
   - Pulmonary insufficiency: NEMS ≤ 1 liter.
   - Previous cardiac surgery (CABG, valve surgery).
   - Porcelain aorta.
   - Pulmonary hypertension, RVSP > 60 mmHg and high probability of cardiac surgery for other than valve replacement.
   - Recurrent pulmonary embolus.
   - Right ventricular insufficiency.
   - Thoracic burning sensation contraindicating open chest surgery.
   - History of mediastinum radiotherapy.
   - Severe connective tissue disease resulting in a contraindication to surgery.
   - Cocaine (clinical impression).

Exclusion Criteria:
1. Known hypersensitivity or contraindication to aspirin, heparin, ticlopidine, clopidogrel, nitinol, porcine products, or contrast media which cannot be adequately pre-medicated.
2. Any sepsis, including active endocarditis.
3. Recent myocardial infarction (<30 days).
4. Any left ventricular or atrial thrombus as determined pre-procedure by echocardiography.
5. Uncontrolled atrial fibrillation.
6. Severe mitral valve insufficiency (grade III).
7. Previous aortic valve replacement (mechanical valve or stented bioprosthetic valve).
8. Evolved or recent CVA (cerebrovascular accident) (<3 months).
9. Symptomatic carotid or vertebral arteries narrowing (>70%) disease.
10. Bleeding diathesis or coagulopathy, or patient will refuse blood transfusions.
11. Progressive disease with life expectancy less than one year.
12. Creatinine clearance < 20 ml/min.
13. Active gastritis or known peptic ulcer disease.
Pre-procedure management

- Reserve CCU bed for post-operative care
- Consult anesthetist (Remark: TAVI, Attention: Dr. D. Fok)
- Routine blood test, e.g. CBP, R/LFT, CK, LDH, INR/APTT/PT, CRP, HbsAg (Urgent), T/S
- 12-lead full ECG
- CXR
- Echo, date: ________________
- Coronary angiogram, date: ______________
- CT aortogram, date ________________
- Reserve 4 unit PC on the date of procedure
- Aspirin 80/160 mg daily for one week/300 mg loading on date of procedure + Clopidogrel 75 mg daily for one week/300 mg loading on date of procedure
- Antibiotic cover: ________________
- Stop Warfarin before procedure with INR < 1.5 on date of procedure
- Stop AV blocker (i.e. B-blocker, Ca channel blocker, digoxin) at least 2-3 days before procedure
- Consent (Major consent and study consent)
- Neurological observations with documentation of 4 limbs power
- Foley to BSB
- HB in situ
- MRSA screening
- Dental consultation if under general anaesthesia
- 6 mins walk test by physiotherapist
- NIHSS score by OT
- CT brain if history of stroke/TIA
Performing TAVI – step by step

• In cath. lab. / Hybrid OT
• GA
• Temporary pacing via R internal jugular vein
• TEE guidance
• L femoral artery puncture, 6F sheath
• R femoral artery puncture, 6F → 18F sheath
• 5,000u heparin
• Prostar / Proglide x 2
• Cross AV (AL1 with straight wire)
• Exchange for Amplatz superstiff GW
• Nucleus balloon dilatation under rapid ventricular pacing
• CoreValve implantation with repeated aortogram
• Post-dilatation if needed
• Closure of R femoral wound
• Final angiogram of RFA
Post-procedure management

Day 0
- Echocardiogram Day 0, Day 1 and on discharge
- Restrict right/ left lower limb until sheath removal
- Hourly BP/P, pedal pulse (radial pulse if using subclavian approach), Sao2, Temperature, RR, neurological observation (GCS) and urine output
- H’stix Q4H
- Oxygen therapy if SaO2 < 94%
- Cardiac monitoring
- Defibrillator standby, pads attached to patient
- 12- lead ECG
- CXR
- Check temporary pacing wound and setting (threshold output:____, sensitivity: _____, Current setting: pacing rate:____, output:______, sensitivity:______)
- Assess wound site for any hematoma or oozing Q1H
- Blood x R/LFT, CK, LDH, CBP, INR and CRP 6 hours after procedure, then daily monitoring
- Follow anesthetist’s order
- Medication:
  - If warfarin is not indicated:
    i. First 6 months post-PAVR, give clopidogrel 75mg daily and aspirin 80mg daily.
    ii. After first 6 months, administer aspirin 80mg daily only.
  - If warfarin is indicated:
    i. First 6 months post-PAVR, administer warfarin and clopidogrel.
    ii. After first 6 months, administer warfarin and aspirin.
- Antibiotic therapy if required
- Resume own medication
Day 1 to 5

- BP/P, pedal pulse, Sao2, Temperature, RR, neurological observation (GCS), urine output and vascular site at least Q4H
- +/- H’stix
- Continue temporary pacing monitoring for 2 days
- 12-lead ECG and blood x R/LFT, CK, LDH, INR, CBP and CRP
- Echocardiogram on discharge
- Cardiac monitoring
- Defibrillator standby
- Off Foley/ paul’s tube if patient ambulated
- Physiotherapy + 6 min walk test
- Valve serial number card to patient upon discharge
- Plavix duration card to patient upon discharge
Credentialed

- TAVI procedure will only be done in centres with on-site cardiac surgical support
- Each dedicated TAVI centre should set up a TAVI Heart Team comprising of cardiologists, cardiac surgeons, cardiac anaesthesiologists and cardiac nurses
- Formal training of the TAVI Heart Team
  - Didactic theoretical training
  - Simulator training
  - A visit to an experienced centre to observe TAVI cases
- The first 10-15 cases will be supported by a proctor
- Patient outcomes will be closely monitored
- Set up HA TAVI Registry for future auditing
- Establish a TAVI training centre (including simulator training) for staff and personnel in the related field
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Medtronic CoreValve</th>
<th>Edwards Sapien</th>
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<tbody>
<tr>
<td>Valve size (mm)</td>
<td>26, 29, 31</td>
<td>20, 23, 26</td>
</tr>
<tr>
<td>Treatable annulus size (mm)</td>
<td>20 - 29</td>
<td>18 – 25</td>
</tr>
<tr>
<td>Tissue type</td>
<td>Porcine Pericardium</td>
<td>Bovine Pericardium</td>
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<tr>
<td>Frame material</td>
<td>Nitinol</td>
<td>Cobalt Chromium</td>
</tr>
<tr>
<td>Delivery profile</td>
<td>18F</td>
<td>18 – 24F</td>
</tr>
<tr>
<td>Delivery mechanism</td>
<td>Self-expanding</td>
<td>Balloon expandable</td>
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## Baseline CoreValve Patient Characteristics

### National Registries

<table>
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<tr>
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<th>ANZ Registry(^1)</th>
<th>Italian Registry(^2)</th>
<th>UK Registry(^3)</th>
<th>Belgian Registry(^4)</th>
<th>Brazilian Registry(^5)</th>
<th>Spanish Registry(^6)</th>
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<tbody>
<tr>
<td>N</td>
<td>362</td>
<td>772</td>
<td>452</td>
<td>297</td>
<td>198</td>
<td>108</td>
</tr>
<tr>
<td>Age, years</td>
<td>84 ± 6</td>
<td>82 ± 6</td>
<td>81.3 ± 7.4</td>
<td>83 ± 6</td>
<td>82.2</td>
<td>78.6 ± 6.7</td>
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<tr>
<td>Female, %</td>
<td>46</td>
<td>56</td>
<td>48</td>
<td>54</td>
<td>55</td>
<td>54.6</td>
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<tr>
<td>Logistic EuroSCORE, %</td>
<td>18 ± 11</td>
<td>22.9 ± 13.5</td>
<td>18.1</td>
<td>24 ± 15</td>
<td>21.4</td>
<td>16 ± 13.9</td>
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<td>NYHA class III and IV, %</td>
<td>78</td>
<td>70.6</td>
<td>73.9</td>
<td>80</td>
<td>83.5</td>
<td>58.4</td>
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<tr>
<td>LVEF, %</td>
<td>58 ± 11</td>
<td>51 ± 13</td>
<td>–</td>
<td>57 ± 15</td>
<td>–</td>
<td>–</td>
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<tr>
<td>Mean pressure gradient, mm Hg</td>
<td>51 ± 15</td>
<td>52 ± 17</td>
<td>–</td>
<td>47 ± 16</td>
<td>–</td>
<td>55 ± 14.3</td>
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<tr>
<td>Aortic valve area, cm(^2)</td>
<td>0.7 ± 0.2</td>
<td>–</td>
<td>–</td>
<td>0.63 ± 0.14</td>
<td>–</td>
<td>0.63 ± 0.2</td>
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2-Year and 3-Year Survival Rates

2-Year Survival

- **Belgian**
  - 80 patients, n=45

- **UK**
  - 76.1 patients, n=452

3-Year Survival

- **Italian**
  - 65.1 patients, n=181

3. Tamburino C. Italian CoreValve Registry. Presented at TCT 2011.
1-Year Survival Rates Across Clinical Trials

1. Meredith I.T. 12 Month Results from ANZ CoreValve TAV Study. Presented at: TCT 2011.
5. Ruiz C.E. Weighted meta-analysis of CoreValve® Outcomes. Presented at: EuroPCR 2011 (analysis sponsored by Medtronic, Inc.).
All Cause Mortality (ITT)
Crossover Patients Followed

HR [95% CI] = 0.57 [0.44, 0.75]  
p (log rank) < 0.0001

Δ at 1 yr = 20.0%  
NNT = 5.0 pts

Δ at 2 yr = 24.3%  
NNT = 4.1 pts

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<th>Months</th>
<th>Standard Rx</th>
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<tr>
<td>0</td>
<td>0%</td>
<td>0%</td>
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<tr>
<td>6</td>
<td>6%</td>
<td>20%</td>
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<tr>
<td>12</td>
<td>32%</td>
<td>43%</td>
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<tr>
<td>18</td>
<td>50.7%</td>
<td>30.7%</td>
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<tr>
<td>24</td>
<td>67.6%</td>
<td>43.3%</td>
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Numbers at Risk

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