Cardiothoracic Anesthesia Update 2014-2015

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University of Colorado Hospital

Disclosures

• None relevant to this talk
• Editor in Chief for Seminars in Cardiothoracic and Vascular Anesthesia

Topics:

• Cardiac Evaluation for the perioperative period
• Risk prediction and outcomes in cardiac surgery
• Aortic surgery – TEVAR
• TAVR: Advances in anesthetic management
• Management of Ischemic Mitral Regurgitation

The 2014 ACC/AHA Guidelines for Perioperative Cardiovascular Evaluation (Noncardiac Surgery)
Mr Thomas is a 65 year old male scheduled for tumor debulking and resection of colonic mass for suspected colon cancer, referred for evaluation of heart murmur, arrhythmia, HTN, TIA, and diabetes. No other PMHx.

What is the urgency of the surgery?
A) Elective
B) Time sensitive
C) Urgent
D) Emergent

Case

Mr Thomas is a 65 year old male scheduled for tumor debulking and resection of colonic mass for suspected colon cancer, referred for evaluation of heart murmur, arrhythmia, HTN, TIA, and diabetes. No other PMHx.

Does he need preoperative cardiac risk assessment?
A) Yes
B) No

Who Needs Preoperative Cardiac Risk Assessment?

Known CAD:
- History of MI
- Angina-type chest pain relieved with NTG
- EKG with pathological Q waves
- Abnormal non-invasive cardiac stress test or coronary angiogram
- Prior coronary intervention or CABG

Risk Factors for CAD:
- Age >55
- Diabetes
- Stroke (CVA/TIA)
- Heart failure
- Moderate-severe valvular disease
- Significant arrhythmia

Case

Mr Thomas is a 65 year old male scheduled for tumor debulking and resection of colonic mass for suspected colon cancer, referred for evaluation of heart murmur, arrhythmia, HTN, TIA, and diabetes. No other PMHx.

What is the risk of the surgery?
A) Low
B) Elevated
C) Intermediate
D) High

Urgency of Surgery

There is a new sense of urgency:
- Emergent: Life or limb threat if no surgery <6 hours
- Urgent: Life or limb threat if no surgery within 6-24 hours
- Time Sensitive: Delay of surgery for >6 weeks will negatively affect outcome
- Elective: Surgery could be delayed up to 1 year without harm
Low Risk for Surgery

- Procedural Risk <1% mortality:
  - Herniorrhaphy
  - Breast surgery
  - Superficial / Derm procedures
  - Cosmetic surgery
  - Ophthalmologic surgery
  - Dental / oral surgery
  - Endoscopic / angiographic

- Patient Risk Factors: no unstable cardiac conditions:
  - Recent MI (<1-6 months)
  - Class III-IV angina (<6 METs)
  - Decompensated HF <1 week
  - Unstable arrhythmia
  - Severe-critical valvular disease

Cardiac Risk Stratification: RCRI Criteria

<table>
<thead>
<tr>
<th>ROC Curves</th>
<th>Validation Set, N=1422</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Goldman (0.70)</td>
</tr>
<tr>
<td></td>
<td>Detsky (0.58)</td>
</tr>
<tr>
<td></td>
<td>ASA (0.71)</td>
</tr>
<tr>
<td></td>
<td>RCRI (0.81)</td>
</tr>
</tbody>
</table>

Risk of Surgery

A new risk emerges:

- Risk: combined surgical and patient risk factors to predict major adverse cardiac event (MACE) = ACS, MI, HF, unstable arrhythmia, death
  - Low: <1% MACE
  - Elevated >2% MACE

- Simplified risk assessment reflects management decisions:
  - Low risk: no intervention
  - Elevated risk: optimize or cancel

- For greater accuracy, use validated clinical risk predictors

Revised Cardiac Risk Index (RCRI) Criteria

- Compensated CHF = OR 4.3
- Known coronary artery disease = OR 3.8:
  - angina or CP with NTG
  - remote MI >3-6 months
  - EKG: pathological Q waves
  - abnormal stress test
  - abnormal cardiac cath
  - prior CABG or PCI
- Hx TIA or CVA = OR 3
- Intra-abdominal or high risk surgery = OR 2.6
- DM requiring insulin = OR 1
- Renal insufficiency, Cr >2 = OR 0.9

Revised Cardiac Risk Index (RCRI)

<table>
<thead>
<tr>
<th>RCRI = &lt;1% mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 RCRI = &lt;1% mortality</td>
</tr>
<tr>
<td>1-2 RCRI = 2-7% mortality</td>
</tr>
<tr>
<td>3-4 RCRI = 9-18% mortality</td>
</tr>
<tr>
<td>&gt;5 RCRI = &lt;3% mortality</td>
</tr>
</tbody>
</table>

BNP & CRP improve RCRI accuracy


Does Risk Assessment Change Management?

Will risk stratification affect the patient’s decision to proceed with surgery? If yes, then accurate risk assessment is needed.
**Cardiac Risk Assessment Algorithm**

**Steps 1 - 3:**
- Risk factors: Age, sex, hypertension, diabetes, smoking, family history.
- Clinical history: Prior cardiovascular events, symptoms.

**Steps 4 - 7:**
- Evaluate risk factors:
  - Age
  - Sex
  - Hypertension
  - Diabetes
- Cardiac testing if change in management based on risk.

**Comparing Previous and Current Guidelines**

**2007 ACC-AHA Guideline:**
1. Known CAD, cardiac symptoms, and/or exam findings.
2. Urgency of surgery
   - Emergent: Proceed with medical optimization.
   - Non-emergent: Treat unstable cardiac conditions.
3. Proceed if low risk surgery.
4. Assess METs if elevated risk surgery.
5. Cardiac testing if change in management.

**2014 ACC-AHA Guideline:**
1. Known CAD or risk factors.
2. Urgency of surgery (time sensitive)
   - Emergent: Proceed with hemodynamic monitoring.
   - Non-emergent: Treat unstable cardiac conditions.
3. Clinical risk (any tool +/− BNP) for MACE.
4. Proceed if surgery and medical risk factors indicate low risk <1% MACE.
5. Assess METs if elevated risk surgery:
   - >10 METs: Proceed (Class Ia).  
   - 4-10 METs: Proceed (Class Ib).
6. Cardiac testing if change in management.
7. Medical optimization & risk assessment.

**Cardiac Risk Stratification: Role of Cardiac Testing**

**When is it indicated?**
- Surgery: non-emergent, elevated risk procedure.
- Patient: suspected moderate-severe valvular heart disease or unstable cardiac conditions.
- Unknown or poor functional capacity.
- Testing will change management:
  - Patient may decline surgery.
  - Preoperative coronary intervention is needed.

**Cardiac Testing**
- Echocardiography
- Exercise testing +/- Imaging
- Noninvasive pharmacological stress testing
- Coronary angiography
- (Insufficient evidence for CT coronary angiography).
Twelve or 30 Months of Dual Antplatelet Therapy after Drug-Eluting Stents

- 9961 patients randomized at 12 mo post PCI
- ASA + Thienopyridine vs ASA + placebo for additional 18 mo.
- Stent Thrombosis and Major Adverse Cardiac or Cerebrovascular events were endpoints.
- Bleeding was additional safety endpoint
- DAPT Trial

### Table 1: Characteristics of Patients Who Were Treated with Drug-Eluting Stents and Who Underwent Randomizations

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Continued Thienopyridine (N = 6811)</th>
<th>Placebo (N = 3150)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thienopyridine use at start of open-label period — no. (%)*</td>
<td>3279 (48.2)</td>
<td>2390 (76.4)</td>
</tr>
<tr>
<td>Pressure</td>
<td>1745 (26.8)</td>
<td>1271 (26.4)</td>
</tr>
<tr>
<td>Type of drug-eluting stent at index procedure — no. (%)</td>
<td>2345 (46.7)</td>
<td>2318 (47.7)</td>
</tr>
<tr>
<td>Phase-of-following examination</td>
<td>1158 (20.9)</td>
<td>1116 (25.4)</td>
</tr>
<tr>
<td>Death-rate examination</td>
<td>642 (12.8)</td>
<td>629 (12.6)</td>
</tr>
<tr>
<td>Death-rate examination</td>
<td>577 (11.0)</td>
<td>546 (10.8)</td>
</tr>
<tr>
<td>≤2 type</td>
<td>466 (2.3)</td>
<td>104 (2.2)</td>
</tr>
</tbody>
</table>

### Table 2: Stent Thrombosis and Major Adverse Cardiac and Cerebrovascular Events

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Continued Thienopyridine (N = 6811)</th>
<th>Placebo (N = 3150)</th>
<th>Hazard Ratio (95% CI)**</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>15 (0.4)</td>
<td>15 (0.4)</td>
<td>0.92 (0.41-2.04)</td>
<td>0.80</td>
</tr>
<tr>
<td>Definite</td>
<td>15 (0.4)</td>
<td>18 (0.6)</td>
<td>0.26 (0.14-0.48)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Probable</td>
<td>3 (0.0)</td>
<td>7 (0.2)</td>
<td>0.71 (0.22-2.23)</td>
<td>0.59</td>
</tr>
<tr>
<td>Major adverse cardiac and cerebrovascular events</td>
<td>231 (3.5)</td>
<td>270 (8.5)</td>
<td>0.71 (0.51-0.99)</td>
<td>0.0406</td>
</tr>
</tbody>
</table>

### Table 3: Bleeding Complications

<table>
<thead>
<tr>
<th>Bleeding Complications</th>
<th>Continued Thienopyridine (N = 6811)</th>
<th>Placebo (N = 3150)</th>
<th>Difference</th>
<th>Two-Sided P Value for Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>GUSTO severe or moderate</td>
<td>119 (2.3)</td>
<td>73 (2.4)</td>
<td>0.05 (1.05)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Severe</td>
<td>38 (0.6)</td>
<td>28 (0.8)</td>
<td>0.29 (2.16)</td>
<td>0.15</td>
</tr>
<tr>
<td>Moderate</td>
<td>83 (1.3)</td>
<td>65 (2.1)</td>
<td>0.7 (2.0)</td>
<td>0.004</td>
</tr>
<tr>
<td>SRM type 2, 3, or 5</td>
<td>24 (0.4)</td>
<td>43 (1.4)</td>
<td>2.9 (4.3)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Type 2</td>
<td>142 (2.4)</td>
<td>72 (2.3)</td>
<td>1.1 (6.1)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Type 3</td>
<td>32 (0.5)</td>
<td>68 (2.1)</td>
<td>2.7 (7.2)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Type 5</td>
<td>7 (0.1)</td>
<td>4 (0.1)</td>
<td>1.7 (3.9)</td>
<td>0.16</td>
</tr>
</tbody>
</table>

So What:

- Improved Cardiac Outcomes
- Increased Mortality???
  - 2% vs 1.5%
  - Further analysis detected an increased incidence of cancer patients and cancer related deaths in the study group (31 vs 14)
  - Exclusion of these patients eliminated the mortality difference
The key message of the DAPT study
- Some patients may benefit
- There is potential harm
- Unclear which patients will fall into each group
- Overall the ideal duration of DAPT remains unclear
- Suggest balancing risk of thrombosis vs bleeding on individualized basis

Extended duration dual antiplatelet therapy and mortality: a systematic review and meta-analysis

- Meta analysis – identified 14 RCTs
- Total patient population 69,644
- DAPT differences ranged from 1 month vs 12, up to the "DAPT" trial 12 vs 30 months

Impact of preoperative serum creatinine on short- and long-term mortality after cardiac surgery: a cohort study

- 9490 patients from a prospectively collected database – analysed retrospectively
- Study question: Mortality outcomes and relation to pre-operative renal function

Results
Results

- Comparison made to cohort in outside hospital database
- Uni- and multivariate hazard models for short- and long-term survival and multiple potential confounders
- Found that a baseline Cr value < 1.5 mg/dl carried a doubling in the risk of death both short term (<150 days), and long term.

Discussion

- Previous risk models including the RCRI, EUROSCORE etc, use CR cutoff of > 2.0 mg/dl
- Attempts to delineate stages of Chronic Kidney disease did not indicate any improved prediction
- Thus – Cr may well be a simple, quick marker for mortality associated with cardiac surgery.

Operative Indications: DTA/TAAA

- Connective Tissue Disorder > 5.5 cm
  - saccular, pseudoaneurysm
- Any aneurysm >6.0 cm
- Can be smaller if TEVAR is feasible
  – AHA/STS/ACC guidelines 2010

Thoracoabdominal Surgery and TEVAR

Thoracoabdominal Aortic Aneurysms
Crawford Extent and Paraplegia Risk

- Incidence of spinal cord ischemia according to Crawford extent of aneurysm

<table>
<thead>
<tr>
<th>Crawford Extent</th>
<th>Endovascular repair</th>
<th>Open surgical repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>10%</td>
<td>14%</td>
</tr>
<tr>
<td>II</td>
<td>19%</td>
<td>22%</td>
</tr>
<tr>
<td>III</td>
<td>5%</td>
<td>-10%</td>
</tr>
<tr>
<td>IV</td>
<td>3%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Thoracic Endovascular Aneurysm Repair

TEVAR - Thoracic Endovascular Aneurysm Repair

- Gore Tag approved in US March 2005
- Cook TX2 and Medtronic Talent 2008
- Gore C-TAG 2011

Weitzel, Nathaen, MD, Cardiothoracic Anesthesia Update 2014-2015
Applications of TEVAR


Criado FJ. 2013. TEVAR – New Technology

Figure 4. Cock’s investigational multibranched endograft for arch repair.

Circulation: Cardiovascular Interventions

Peripheral Artery Disease

Endovascular Repair of Type B Aortic Dissection
Long-term Results of the Randomized Investigation of Stent Grafts in Aortic Dissection Trial

Christoph A. Nienaber, MD, PhD; Stephan Kische, MD; Heved Rezai, MD, PhD; Helge Eggner, MD; Tim C. Reul, MD; Carmen Koch, MD, PhD; Antje Glass, MA; Dietrich Schünemann, MD, PhD; Martin Conery, MD, PhD; Tibor Kerei, MD; Burkhard Zöpel, MD; Luis Lubsen, MD; Rossella Fattori, MD, PhD; Mitu Daza, MD, PhD; for the INSTENT-XL trial

Gadolinium-enhanced sagittal MR angiogram of type B dissection before randomization (top) and 5 years after endovascular repair (bottom).
Management of complicated and uncomplicated acute type B dissections. A systematic review and meta-analysis

- Meta analysis of 2531 TEVAR patients and 1276 surgical repair patients across 54 articles for Acute Complicated / Uncomplicated Type B
- Mortality rates at 30 days was 7.0% vs 19%
- Pooled Spinal cord ischemia, Neurologic events 7.0% vs 9.8%
- Acute Uncomplicated Type B: Medical Management in 2347 patients
  - 30 day mortality 2.4%
  - Total Neurologic events 2%


Multilayer Flow Modulator stents

- First 103 cases out of the 380 cases implanted
- Increased Aneurysm sac over first 12 months – with gradual decline of growth
- Overall Conclusions: increasing sac volume, thrombus or diameter size was not associated with rupture. MFM implantation instigates a process of aortic remodeling involving initial thrombus deposition, which slows between six and twelve months.


Special Report

Standardizing Clinical End Points in Aortic Arch Surgery
A Consensus Statement From the International Aortic Arch Surgery Study Group

Tirman D, Yun, MHI, MD, MD, PhD; David H. Tian, BMed, Scott A. LaMaire, MD, PhD; G. Chad Hughes, MD, Edward P. Chen, MD; Martin Minfield, MD, PhD; Randall B. Goff, MD; Emad S. Kasic, MD, MD; Paul G. Barlow, MB, BChir, MD, PhD; Joseph A. Cosslett, MD; John A. Elmfeldt, MD, MD; Nicholas T. Keszthelyi, MD, Malcolm J. Unkleswood, MD; Joseph P. Mathieu, MD, MHS; Friedlich-William Motz, MD, PhD; Asady Oka, MD; Theresa M. Sandt, MD; Joseph E. Bivasia, MD; Roberto Di Bartolomeo, MD; Marco Di Francesco, MD, PhD; Santu Trischetti, MD, PhD, on behalf of the International Aortic Arch Surgery Study Group.

### Table 1. Grading System of the Severity of Clinical Complications Related to Aortic Arch Surgery

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Any deviation from the normal postoperative course but self-limiting or requiring simple therapeutic regimen*</td>
</tr>
<tr>
<td>II</td>
<td>Complications requiring pharmacological treatment for resolution</td>
</tr>
<tr>
<td>III</td>
<td>Complications requiring surgical, endoscopic, or radiological intervention but not requiring regional or general anesthesia or requiring interdisciplinary intervention</td>
</tr>
<tr>
<td>IV</td>
<td>Complications requiring surgical, endoscopic, or radiological intervention under regional or general anesthesia, or requiring new ICU admission or ongoing ICU management for &gt;7 d or hospitalization for &gt;30 d, or causing secondary organ failure</td>
</tr>
<tr>
<td>V</td>
<td>Death caused by a complication</td>
</tr>
</tbody>
</table>

*Including arrhythmias, antipyrine, analgesics, electrolytes, and physiotherapy.

### Table 2. Classifications of Clinical End Points of the Neurological System

<table>
<thead>
<tr>
<th>Neurological System</th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
<th>Grade IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild neurological deficit</td>
<td>Severe neurological deficit</td>
<td>Total neurological deficit</td>
<td>Severe permanent neurological deficit</td>
<td></td>
</tr>
<tr>
<td>Motor impairment</td>
<td>Sensory impairment</td>
<td>Autonomic impairment</td>
<td>Cognitive impairment</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3. Classifications of Clinical End Points of the Cardiovascular System

<table>
<thead>
<tr>
<th>Cardiovascular System</th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
<th>Grade IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocardial ischemia</td>
<td>Myocardial infarction</td>
<td>Cardiac arrest</td>
<td>Cardiac death</td>
<td></td>
</tr>
<tr>
<td>Low cardiac output</td>
<td>Cardiac failure</td>
<td>Cardiac shock</td>
<td>Cardiac collapse</td>
<td></td>
</tr>
<tr>
<td>Anemia</td>
<td>Tachycardia</td>
<td>Hypotension</td>
<td>Shock</td>
<td></td>
</tr>
<tr>
<td>Hypothermia</td>
<td>Hyperthermia</td>
<td>Hypoglycemia</td>
<td>Hyperglycemia</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4. Classifications of Clinical End Points of the Respiratory System

<table>
<thead>
<tr>
<th>Respiratory System</th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
<th>Grade IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypoventilation</td>
<td>Ventilator dependence</td>
<td>Severe respiratory failure</td>
<td>Multiple organ failure</td>
<td></td>
</tr>
<tr>
<td>Pulmonary edema</td>
<td>Acute respiratory distress syndrome</td>
<td>ARDS</td>
<td>Respiratory failure</td>
<td></td>
</tr>
<tr>
<td>Obstructive sleep apnea</td>
<td>Central sleep apnea</td>
<td>Sleep apnea</td>
<td>Sleep apnea</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5. Classifications of Clinical End Points of Other Systems

<table>
<thead>
<tr>
<th>Other System</th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
<th>Grade IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>GI bleeding</td>
<td>Upper GI bleeding</td>
<td>Lower GI bleeding</td>
<td>Massive GI bleeding</td>
<td></td>
</tr>
<tr>
<td>Renal failure</td>
<td>Acute kidney injury</td>
<td>Chronic kidney disease</td>
<td>End-stage kidney disease</td>
<td></td>
</tr>
<tr>
<td>Neurosurgical</td>
<td>Neurological deficits</td>
<td>Neurological damage</td>
<td>Neurological death</td>
<td></td>
</tr>
</tbody>
</table>

**Statement**

- Major Clinical Questions in Aortic Arch surgery is ideal neurologic protection strategy
- Includes DHCA, DHCA plus Retrograde Cerebral perfusion, DHCA plus antegrade cerebral perfusion, and finally moderate HCA plus antegrade cerebral perfusion.
• Profound Hypothermia < 14 °C
• Deep Hypothermia = 14 – 20 °C
• Moderate Hypothermia 20 – 28 °C
• Mild Hypothermia > 28 °C

What to do with a patient who is undergoing coronary-artery bypass graft (CABG) who has moderate MR?

Results
• No difference in LVESVI at one year
• No difference in Mortality
• Addition of MVR added longer bypass times, increased hospital stay, and increased neurologic events

• Objective to identify role for early surgical intervention in flail MV pathology vs medical management
• 2097 patients Mitral Regurgitation International Database
• France, Italy, Belgium, and the United States
• Enrollment
• Patients diagnosed with Flail leaflet and lack of Class I ACC guideline indications for MV surgery (symptoms, left ventricle [LV] ejection fraction <60%, or LV end-systolic diameter >40 mm)
• Two Cohorts: Medical management vs early surgery (within 3 months)

Results:

![Image of TEE Evaluation of MR](image)

**TEE evaluation of MR**

Quantification of Mitral Regurgitation by Real-Time Three-Dimensional Color Doppler Flow Echocardiography Pre- and Post- Percutaneous Mitral Valve Repair

Christiane Caner, MD,* Bernhard Heidinger, MD,* Johannes Berlau, MD, D Christian Fella, MD,§ Jürgen Böker, MD, § Matthias Grünfelder, MD,* Oliver Eder; MD,* Stefan H. M. Godenhay, MD,* Frank Herdmann, MD,* Johannes Herdmann, MD,* Oliver Eder, MD,* Stefan H. M. Godenhay, MD,* and Udo J. Eichhorn, MD,*
Results:

• Good reliability between visual MR assessment and 3D RT-VCFD testing
• No reliability using the PW 2D technique.
• Downside: Time consuming and off line analysis needed
• Not available in TEE at this time
• Who cares??

Short-Term Results of Transapical Transcatheter Mitral Valve Implantation for Mitral Regurgitation

The first human description of placement of the Tiara systems TAMI (trans-apical mitral valve) device

TAMI – not just TAVR anymore

• First in human description of placement of the Tiara systems TAMI (trans-apical mitral valve) device
Balanced General Advantages:
- Ease of access for TEE monitoring throughout
- Secured airway
- Ability to suspend respirations
- Better pain control

Disadvantages
- Airway instrumentation
- Risk of prolonged ventilation
- Concern for increased hemodynamic changes

Sedation vs General

Advantages:
- No need to instrument airway
- Awake patient → real-time neurologic monitoring
- Shorter emergence/hospital stay

Disadvantages
- Inability to use TEE
- Procedural need for lying in one position for prolonged period of time
- Intolerance to decrease in CBF with RVP
- Unprotected airway
- Inability to suspend ventilation
- Local anesthetic toxicity
- Escalation in sedation reaching general anesthesia levels

Local / Sedation

Results:

Conclusions—The less invasive transfemoral-TAVI under LA is preferred in clinical settings and seems to be acceptable; however, the higher incidence of postprocedural aortic regurgitation is emphasized. Therapeutic efforts should be made to reduce such complications during transfemoral-TAVI under LA. (Circ Cardiovasc Interv. 2014;7:602-610.)
Local vs GETA in TAVR

<table>
<thead>
<tr>
<th>Study</th>
<th>Total</th>
<th>Mean</th>
<th>SD</th>
<th>Total</th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference</th>
<th>MD</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vanaman</td>
<td>130</td>
<td>8.1</td>
<td>3.9</td>
<td>44</td>
<td>12.3</td>
<td>8.9</td>
<td>-4.18 [4.78 to -7.58]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mellich</td>
<td>41</td>
<td>8.8</td>
<td>5.0</td>
<td>33</td>
<td>11.9</td>
<td>8.8</td>
<td>-3.10 [3.56 to -9.68]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dhadه</td>
<td>14</td>
<td>8.4</td>
<td>5.0</td>
<td>91</td>
<td>15.5</td>
<td>10.3</td>
<td>-7.03 [8.04 to -4.02]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ben-Kee</td>
<td>70</td>
<td>8.5</td>
<td>4.4</td>
<td>31</td>
<td>7.9</td>
<td>5.9</td>
<td>-0.62 [1.04 to -2.44]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beulan</td>
<td>9</td>
<td>3.0</td>
<td>1.8</td>
<td>3</td>
<td>3.0</td>
<td>2.9</td>
<td>-0.99 [0.34 to -1.33]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liuua</td>
<td>647</td>
<td>11.0</td>
<td>7.3</td>
<td>440</td>
<td>16.9</td>
<td>10.0</td>
<td>-5.96 [4.95 to -7.96]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Random effects model | 801 | 642 |

Hospital stay (days), CI confidence interval, IP procedural time interval, US comparative interval.

Conclusions

- 2014 yielded a number of exciting concepts
- Cardiac Surgery is seeing a huge growth in the concept of interventional and hybrid techniques.
- Each new technique requires extensive evaluation for short and long term safety, but as technology continues to improve – we can not conceptualize much different approaches to complex disease states.

Case:

- 74 yo male with known aortic stenosis, and DM.
- No Htn
- No Renal disease
- Moderate activity - able to golf 9 holes
- Presents for AVR