TEVAR FOR
THORACIC AORTIC TRAUMA

Dr Hanif Hussein
Vascular and General Surgeon
Department of Surgery
Hospital Kuala Lumpur
<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Vehicles Registered</th>
<th>Vehicle Involved</th>
<th>Road Length</th>
<th>Road Accidents</th>
<th>Road Casualties</th>
<th>Road Deaths</th>
<th>Road Ownership (Person per vehicle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>20,096,700</td>
<td>6,802,375</td>
<td>275,430</td>
<td>62,221</td>
<td>162,491</td>
<td>52,152</td>
<td>5,712</td>
<td>3.0</td>
</tr>
<tr>
<td>1996</td>
<td>21,169,000</td>
<td>7,686,684</td>
<td>325,915</td>
<td>64,511</td>
<td>189,109</td>
<td>53,475</td>
<td>6,304</td>
<td>2.8</td>
</tr>
<tr>
<td>1997</td>
<td>21,665,600</td>
<td>8,550,469</td>
<td>373,526</td>
<td>66,108</td>
<td>215,632</td>
<td>56,574</td>
<td>6,302</td>
<td>2.5</td>
</tr>
<tr>
<td>1998</td>
<td>22,179,500</td>
<td>9,141,357</td>
<td>366,932</td>
<td>66,741</td>
<td>211,037</td>
<td>55,704</td>
<td>5,740</td>
<td>2.4</td>
</tr>
<tr>
<td>1999</td>
<td>22,711,900</td>
<td>9,929,951</td>
<td>390,574</td>
<td>67,069</td>
<td>223,166</td>
<td>52,937</td>
<td>5,794</td>
<td>2.3</td>
</tr>
<tr>
<td>2000</td>
<td>23,263,600</td>
<td>10,598,804</td>
<td>441,386</td>
<td>68,770</td>
<td>250,429</td>
<td>50,200</td>
<td>6,035</td>
<td>2.2</td>
</tr>
<tr>
<td>2001</td>
<td>23,795,300</td>
<td>11,302,545</td>
<td>483,351</td>
<td>74,217</td>
<td>265,175</td>
<td>50,473</td>
<td>5,849</td>
<td>2.1</td>
</tr>
<tr>
<td>2002</td>
<td>24,526,500</td>
<td>12,068,144</td>
<td>507,995</td>
<td>74,641</td>
<td>279,711</td>
<td>49,552</td>
<td>5,891</td>
<td>2.0</td>
</tr>
<tr>
<td>2003</td>
<td>25,048,300</td>
<td>12,819,248</td>
<td>555,534</td>
<td>79,667</td>
<td>298,653</td>
<td>52,741</td>
<td>6,286</td>
<td>2.0</td>
</tr>
<tr>
<td>2004</td>
<td>25,580,000</td>
<td>13,828,889</td>
<td>596,533</td>
<td>71,814</td>
<td>326,815</td>
<td>54,091</td>
<td>6,228</td>
<td>1.8</td>
</tr>
<tr>
<td>2005</td>
<td>26,130,000</td>
<td>15,026,660</td>
<td>581,136</td>
<td>71,814</td>
<td>328,264</td>
<td>47,012</td>
<td>6,200</td>
<td>1.7</td>
</tr>
<tr>
<td>2006</td>
<td>26,640,000</td>
<td>15,790,732</td>
<td>635,024</td>
<td>72,781</td>
<td>341,252</td>
<td>35,425</td>
<td>6,287</td>
<td>1.7</td>
</tr>
<tr>
<td>2007</td>
<td>27,170,000</td>
<td>16,813,943</td>
<td>668,173</td>
<td>73,032</td>
<td>363,319</td>
<td>33,999</td>
<td>6,282</td>
<td>1.6</td>
</tr>
<tr>
<td>2008</td>
<td>27,730,000</td>
<td>17,971,901</td>
<td>671,078</td>
<td>73,419</td>
<td>373,071</td>
<td>32,274</td>
<td>6,527</td>
<td>1.5</td>
</tr>
<tr>
<td>2009</td>
<td>28,310,000</td>
<td>19,016,782</td>
<td>705,623</td>
<td>100,002</td>
<td>397,330</td>
<td>31,417</td>
<td>6,745</td>
<td>1.5</td>
</tr>
<tr>
<td>2010</td>
<td>28,910,000</td>
<td>20,188,565</td>
<td>760,433</td>
<td>111,378</td>
<td>414,421</td>
<td>28,269</td>
<td>6,872</td>
<td>1.4</td>
</tr>
</tbody>
</table>
Thoracic Aortic Injury

• Highly fatal

• Second cause of blunt trauma death
  • Clancy TV, et al. J Trauma. 2001;51:346-351. 85% on scene death

• 85% Death at the scene

• 1% per hour / next 48 hrs

• 50% survivors die within 24 hrs
Anatomy

• Thoracic Aorta
• Deep within chest wall
• Rib cage and its musculature
• Surrounding organs
• Heart and Lungs
Thoracic Aortic Injury

- High velocity, high impact, blunt injury
- MVA, fall from height
- Associated
  - Head, chest, intra-abd injuries
  - Long-bone fractures
Patho-Physiology

- Acceleration-deceleration injury
- Aortic isthmus after LSCA
- Mobile heart and aortic arch
- Fixed aortic isthmus
- Rapid increase in intra-luminal pressure - rupture
Grades of TAI

- Vancouver Classification
Grades of TAI
### Grades of TAI

<table>
<thead>
<tr>
<th>Absent External Contour Abnormality</th>
<th>Present External Contour Abnormality</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Aortic Injury</strong></td>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>Intimal Tear</td>
<td>No aortic external contour abnormality: tear and/or associated thrombus is &lt;10mm</td>
</tr>
<tr>
<td>Large Intimal Flap</td>
<td>No aortic external contour abnormality: tear and/or associated thrombus is &gt;10mm</td>
</tr>
</tbody>
</table>

Aortic Injury

- Grades I & II
- Asymptomatic
- CT diagnosis
- Grades III & IV
- Widened mediastinum
- High mortality
Diagnosis

• Autopsy
• High index of suspicion
• Mechanism of injury
  • Car vs motorbike
• Impact of injury
  • High speed
• Extent of injury
  • Poly trauma
• Head, intra-abd injury
Diagnosis

- Chest X-Ray
  - Widened mediastinum
  - 1st, 2nd ribs fracture
  - Hemothorax
- CT Scan
  - Incidental
  - Pseudoaneurysm distal to LSCA
  - “Dissection flap ...”
  - Contrast leak - late sign
Initial management

• Resuscitation - ATLS
• Imaging
  • CTA for TEVAR protocol
• Manage life-threatening conditions
  • Head injury
  • Intra-abdominal injury
• Repair of aortic injury
Open Repair

• Postero-lateral thoracotomy
• Single lung ventilation
• Concomitant thoracic, intra-abd, head injury
• Cardio-pulmonary bypass
• Blood loss
• Lung complications
• Mortality (0 - 54%)
• Paraplegia (0 - 36%)
EV Aortic Repair

• 1948 - First aneurysm surgery (Rae)
• 1951 - Open aneurysm repair
• 1991 - EVAR (Parodi)
• 1992 - TEVAR
EV Aortic Repair

• 1994 - Endoluminal stent graft for aortic disruption (Dake)

Transluminal Placement of Endovascular Stent-Grafts for the Treatment of Descending Thoracic Aortic Aneurysms
Michael D. Dake, D. Craig Miller, Charles P. Semba, R. Scott Mitchell, Philip J. Walker, and Robert P. Liddell
TEVAR

Endovascular Versus Open Repair for Blunt Thoracic Aortic Injury: Short-Term Results

John Kokotsakis, MD, PhD, Ioannis Kaskarelis, MD, PhD, Panagiotis Misthos, MD, PhD, Thanos Athanasiou, MD, PhD, Konstantinos Kanakakis, MD, Chariklia Athanasiou, MD, Constantina Romana, MD, Elian Skouteli, MD, PhD, and Achilles Lioulias, MD, PhD

Second Cardiac Surgical Department and Unit of Interventional Radiology, Evangelismos General Hospital, and Thoracic Surgery Department, Sismanoglio, General Hospital, Athens, Greece

• Annals Thorac Surg 2007;84:1965-70

Endovascular Stenting for Traumatic Aortic Injury: An Emerging New Standard of Care

Sina L. Moainie, MD, David G. Nesdis, MD, James S. Gammie, MD, James M. Brown, MD, Robert S. Poston, MD, Thomas M. Scalea, MD, and Bartley P. Griffith, MD

Divisions of Cardiac Surgery and Vascular Surgery, and R. Adams Cowley Shock Trauma Center, University of Maryland School of Medicine, Baltimore, Maryland

• Annals Thorac Surg 2008;85:1625-30
TEVAR

Evolution of treatment for traumatic thoracic aortic injuries

Rolando I. Celis, MD, a Sun C. Park, MD, a Ankur J. Shukla, MD, a Mazen S. Zenati, MD, b Rabih A. Chaer, MD, a Robert Y. Rhee, MD, a Michel S. Makaroun, MD, a and Jae-Sung Cho, MD, a Pittsburgh, Pa


Outcomes of surgical and endovascular treatment of acute traumatic thoracic aortic injury

Paul J. Riesenman, MD, MS, a Mark A. Farber, MD, a Preston B. Rich, MD, b Brett C. Sheridan, MD, c Robert R. Mendes, MD, a William A. Marston, MD, a and Blair A. Keagy, MD, a Chapel Hill, NC

TEVAR vs OR

- TEVAR is more advantageous over open repair
  - Mortality rate
  - Paraplegia
  - Intra-operative blood loss
  - Major complications
  - Hospital stay
Disadvantages

- Pseudoaneurysm at puncture site
- Iliac artery thrombosis
- Retroperitoneal hematoma
- Stent-related complications
- “Off-label” usage of stent
- Conformable GORE TAG
- Long-term results?
HKL Experience

Thoracic Endovascular Aortic Repair (TEVAR) in traumatic high-velocity blunt injury to thoracic aorta

Nor Elina Noor Shaari, MRCS (Glasgow), Naresh Govindarajan, M Surg, Hanif Hussein, M Surg, Zainal Ariffin Azizi, M Surg

- 5 patients between 2008 - 2011
- All male, 17 - 34 yrs age range
- MVA
HKL Experience

- Polytrauma in 4/5 : ISS 5 - 41
- Laparotomy (spleenectomy) - 2
- Craniotomy - 1
- ORIF of femur - 1
HKL Experience

- Site: Distal to left subclavian artery
- Medtronic Valiant stent
- LSA covered in 2/5 patients
- No revascularisation procedure
- No ischaemic symptoms
- No endoleak on F/U (2-5 yrs)
Case 1 - Post-Stenting
Case 3 - Pre-op CTA
TAI Mx Guidelines


W. Anthony Lee, MD, a Jon S. Matsumura, MD, b R. Scott Mitchell, MD, c Mark A. Farber, MD, d Roy K. Greenberg, MD, e Ali Azizzadeh, MD, f Mohammad Hassan Murad, MD, MPH, g and Ronald M. Fairman, MD, h Boca Raton, Fla; Madison, Wisc; Palo Alto, Calif; Chapel Hill, NC; Cleveland, Ohio; Houston, Tex; Rochester, Minn; and Philadelphia, Pa

• Systematic review of 7768 patients
• Lower mortality rates
• Lower SCI and ESRF
• Lower risk of graft infection
SVS Guidelines

• Timing
  • Urgent / other injuries treated / before discharge

• Grade of injury
  • All grade II to IV

• Endovascular - if suitable anatomy

• Selective revascularisation of LSA
Conservative Tx

Natural History of Traumatic Rupture of the Thoracic Aorta Managed Nonoperatively: A Longitudinal Analysis

James H. Holmes IV, MD, Robert D. Bloch, MD, R. Alan Hall, MD, Yvonne M. Carter, MD, and Riyad C. Karmy-Jones, MD
Virginia Mason Medical Center and Harborview Medical Center, University of Washington, Seattle, Washington


- 30 of 145 patients
- 15 had delayed surgery
- 15 non-op
Conservative Tx

- Delayed op (15)
  - 3 deaths
- Non-op (15)
  - 5 died of severe head injuries
  - 10 survived at 2.5 yrs (6 mths - 5 yrs)
Conclusions. Selected patients with multiple severe associated injuries or high-risk premorbid conditions may have their operations for TRA delayed temporarily or even indefinitely with acceptable survival rates. The potential for rapid progression of TRA in the same patients, however, mandates serial radiographic examinations during the first week of hospitalization after injury and diagnosis.

Conservative Tx

• 140 Blunt aortic injuries
• Intimal flaps, large intimal tear, pseudoaneurysm
• Not worsened
• 65% healed

Conclusion

- BLUNT TRAUMATIC AORTIC INJURY

- Highly fatal injury

- High index of suspicion for diagnosis

- TEVAR should be considered first
THANK YOU

DRIVE SAFELY

www.hklvascular.org