Complication reduction multidisciplinary strategies in adult spinal deformity surgery- Dual surgeon approaches and coagulopathy management strategies

Rajiv K. Sethi, MD
Clinical Assistant Professor
Group Health Physicians
Virginia Mason Medical Center
Group Health Research Institute
University of Washington Health Services
Seattle, WA, USA

Disclosures

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• University of Washington- grant support, institutional funds
• Scoliosis Research Society- grant support.

Can we continue like this?

We can think about deformity better

58 yo female D-LL-PI++, PT++, SVA++

Preop PI-LL=45 degrees, SVA=9 cm+, L3 PSO
Fixing iatrogenic problems: PSO of L2 and L4 needed to achieve spinopelvic balance

Preop PI-LL = 70 degrees, SVA - 24 cm+; Postop PI-LL = 3, SVA - 3 cm

- Preop PI-LL = 70 degrees, SVA = 24 cm+
- Postop PI-LL = 3, SVA = 3 cm

Debate: Degenerative Scoliosis
To Operate or Not to Operate
Bahroun A, Alalhama, MD+; Jannas W, Ophelia, MD, and K. W. Hammerberg, MD+

- Major surgical complications 56%-75%
- Unplanned reoperation rates 18-58%
- Unproven benefits regarding improvement of HRQOL

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Here is what we know

- Risk of pulmonary or cardiac complications is significant
- Increased LOS, cost to patient and society, compromised outcomes
- Our spine procedures are getting more complex (revision, # levels, age of patient)
- Can we minimize the risk of complications with preop or perioperative optimization?

Reoperation After Primary Fusion for Adult Spinal Deformity
Rate, Reason, and Timing

- 89 adults with adult spinal deformity
  - Minimum 4 segments fused
  - Minimum 2 year follow-up (average 3.8)
- Cumulative Revision Rate = 25.8%
  - 1yr = 13.6
  - 2yr = 22.8
  - 3yr = 24.8
We have some honest leaders with us today

The Morbidity and Mortality of Fusions from the Thoracic Spine to the Pelvis in the Adult Population
Christopher R. Herr, MD, John A. Hsu, MD, Michael J. Lee, MD, Richard L. Brandt, MD
Theodore A. Wagner, MD, Carlos Betancur, MD, and John E. Chapman, MD

Standardizing Care for High-Risk Patients in Spine Surgery
The Northwestern High-Risk Spine Protocol
Rajiv K. Sethi, MD

• Dedicated spine physicians representing multiple specialties
• Working in teams
• Standardization of pre, during and post phases

The Seattle Spine Team Approach to Adult Spinal Deformity and Reduction in Perioperative Complication Rates

Rajiv K. Sethi, MD
Group Health Physicians
Virginia Mason Medical Center
Group Health Research Institute
University of Washington Health Services
The Seattle Spine Team Approach

3 arms

- Live preop multidisciplinary clearance conference
- Two attending surgeons in the OR
- Intraoperative protocol for mgmt of coagulopathy

Our live multidisciplinary preoperative conference

- Screens all adult spinal deformity patients prior to providing full clearance for elective corrective adult deformity surgery
- This committee consists of orthopaedic spinal surgeons, neurosurgeons, spine anesthesiologists, internists, physiatrists and nurses

Surgical rate for adult scoliosis at three Seattle tertiary spine centers: 2008-2012

Methods

- Group A (2008-2009) managed without the three pronged approach---NO PROTOCOL
- Group B (2010-2011) were managed according to the three pronged approach---SEATTLE PROTOCOL
- Complications and readmissions assessed by an independent research team with both approaches at 30, 60 and 90 days

Sethi, Wernli, Andersen, UW CHASE 2013, Submitted JAMA
Patient Demographics

NO PROTOCOL GROUP - 40 PATIENTS (2008-2009)

<table>
<thead>
<tr>
<th>Age</th>
<th>Levels Fused</th>
<th>Anterior and Posterior</th>
<th>Posterior Alone (TLIF)</th>
<th>Lateral (XLIF) + Posterior</th>
</tr>
</thead>
<tbody>
<tr>
<td>62 (39-84)</td>
<td>9-15 levels</td>
<td>25%</td>
<td>75%</td>
<td>0%</td>
</tr>
</tbody>
</table>

PROTOCOL GROUP - 124 PATIENTS (2010-2011)

<table>
<thead>
<tr>
<th>Age</th>
<th>Levels Fused</th>
<th>Anterior and Posterior</th>
<th>Posterior Alone (TLIF)</th>
<th>Lateral (XLIF) + Posterior</th>
</tr>
</thead>
<tbody>
<tr>
<td>64 (18-84)</td>
<td>9-15 levels</td>
<td>9%</td>
<td>73%</td>
<td>18%</td>
</tr>
</tbody>
</table>

Results

<table>
<thead>
<tr>
<th>COMPLICATION</th>
<th>NO PROTOCOL</th>
<th>SEATTLE PROTOCOL</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Complication Rate</td>
<td>52 percent</td>
<td>16 percent</td>
<td>≤0.001</td>
</tr>
<tr>
<td>Wound Infection (%)</td>
<td>12.5 percent</td>
<td>0.8 percent</td>
<td>Not significant</td>
</tr>
<tr>
<td>Return to OR (%)</td>
<td>7.5 percent</td>
<td>1.6 percent</td>
<td>≤0.001</td>
</tr>
<tr>
<td>DVT/PE (%)</td>
<td>10 percent</td>
<td>3.2 percent</td>
<td>Not significant</td>
</tr>
<tr>
<td>Postop neuro deficit (%)</td>
<td>2.5 percent</td>
<td>0.5 percent</td>
<td>Not significant</td>
</tr>
<tr>
<td>Urinary tract infection (%)</td>
<td>32 percent</td>
<td>9.7 percent</td>
<td>≤0.001</td>
</tr>
</tbody>
</table>

SRS LYON 2013

Authors: Sethi, Rajiv K.; Qamirani, Erion; Theologis, Alexander A.; Leveque, Jean-Christophe; Ames, Christopher P.; Deviren, Vedat
Neurosurgery and Orthopaedics meet together at the spine

Cardiac surgery position statement recommends two surgeons

“A minimum of two qualified cardiac surgeons is required”

“Complex operating room environment” requires teams

http://www.facs.org/fellows_info/guidelines/cardiac.html
Methods

• 312 consecutive cases with an attending neurosurgeon and orthopaedic surgeon from two tertiary spinal deformity centers in Seattle and San Francisco
• Retrospective review of all cases
• 30 and 90 day readmission rates

Complications assessed

• Wound infections requiring reoperation
• Hardware failure requiring reoperation
• Pneumonia
• Urinary tract infection (UTI)
• Stroke
• Thromboembolic events (deep venous thrombosis and/or pulmonary embolism)
• Iatrogenic neurological injury
• Death

Results

<table>
<thead>
<tr>
<th>Complication</th>
<th>San Francisco</th>
<th>Seattle</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound infection requiring reop</td>
<td>12</td>
<td>10</td>
<td>22</td>
<td>2.2</td>
</tr>
<tr>
<td>SSI (stoma)</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>0.4</td>
</tr>
<tr>
<td>SIOD/COD</td>
<td>5</td>
<td>4</td>
<td>9</td>
<td>0.9</td>
</tr>
<tr>
<td>Return to OR for hardware modification</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>0.7</td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Neurological injury</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>0.4</td>
</tr>
<tr>
<td>UTI</td>
<td>8</td>
<td>10</td>
<td>18</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Overall complication rate: 8% at 30 days
20% at 90 days
### Results

<table>
<thead>
<tr>
<th>Complication</th>
<th>30 day</th>
<th>90 day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound Infection</td>
<td>4%</td>
<td>6.4%</td>
</tr>
<tr>
<td>CVA</td>
<td>0.64%</td>
<td>0.64%</td>
</tr>
<tr>
<td>DVT/PE</td>
<td>2.2%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Return to OR for hardware modification</td>
<td>1.6%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Death</td>
<td>0.3%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1.9%</td>
<td>1.9%</td>
</tr>
<tr>
<td>UTI</td>
<td>3.8%</td>
<td>4.9%</td>
</tr>
</tbody>
</table>

### Conclusions

- A combined orthopaedic and neurosurgical attending approach to adult spinal deformity surgery can enhance patient safety and substantially reduce perioperative complication rates by approximately 50% compared to current rates.
- This is the first report detailing this approach at two spinal deformity centers.

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Coagulopathy in adult de novo scoliosis surgery: Timing and onset of breakdown of the coagulation cascade as measured by D dimer and fibrinogen levels

Rajiv K. Sethi MD, Ryan Pong MD, JC Leveque MD, Thomas Duer MD, Stephen Whitecloud MD, Vishal Gala MD, Ching Lin MD, PhD, Kyle Kim MD, PhD

Virginia Mason Medical Center and Group Health Physicians, Departments of Neurosurgery and Anesthesia, Seattle, WA

Whitecloud Clinical Research Award Nominee, IMAST, Istanbul 2012; Submitted J Spi Dis Tech
Intraoperative protocol shouldn’t be subject to the whim of the anesthesiologist of the day
• Hourly measurements, EBL, Hct, INR, Plt, Fibrinogen, D dimer
• Same surgeons and anesthesiologists (complex spine team)
• STANDARDIZED INTRAOPERATIVE MANAGEMENT

Do we understand the problem?
• Most surgeons use PT-INR or the appearance of the wound as a surrogate for the status of the coagulation cascade during adult spinal deformity surgery
• Anesthesia asks “How does it look down there”
• A better tool is needed to track coagulopathy and to help the team increase patient safety and determine the need for staging, etc.

Methods
• Dual attending surgeon as presented at previous IMAST/SRS meetings
• Complex spine protocol followed in all cases
• Hourly measurements, EBL, Hct, INR, Plt, Fibrinogen, D dimer
• 13 consecutive cases in the study period meeting criteria
• Same surgeons and anesthesiologists (complex spine team)

Inclusion criteria
• All adult de novo cases (others excluded)
• Single stage
• T10-pelvis pedicle screw fixation
• TLIFS at L4-L5 and L5-S1
• Iliac fixation
• Operative steps exactly the same in each case
• PSOs, VCRs or staged cases excluded
**Results**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>67 ± 7.2</td>
</tr>
<tr>
<td>Surgical Time (hrs min)</td>
<td>5 hrs 56 min ± 40 min</td>
</tr>
<tr>
<td>Preoperative Lumbar Curve (degrees)</td>
<td>40 ± 28-51</td>
</tr>
<tr>
<td>EBL (ml)</td>
<td>2169 ± 817</td>
</tr>
</tbody>
</table>

Table 1. Surgery characteristics. 
Data represent mean ± standard deviation or mean (range)

**Results**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-dimer maximal increase (mcg/ml)</td>
<td>7.93 ± 3.68</td>
</tr>
<tr>
<td>Time of d-dimer maximal % hourly increase (minutes)</td>
<td>143 ± 63</td>
</tr>
<tr>
<td>Decrease in fibrinogen (mg/dl)</td>
<td>113 ± 36</td>
</tr>
<tr>
<td>Decrease in platelets (x10^3/ml)</td>
<td>77 ± 34</td>
</tr>
<tr>
<td>Increase in INR</td>
<td>0.25 ± 0.11</td>
</tr>
<tr>
<td>pRBC transfused (units)</td>
<td>3.8 ± 1.5</td>
</tr>
<tr>
<td>Thawed plasma transfused (units)</td>
<td>3.4 ± 1.9</td>
</tr>
</tbody>
</table>

Table 2. Hemodynamic characteristics. 
Data represent mean ± standard deviation

D dimer elevation during adult de novo scoliosis surgery

INR does not predict the status of the coagulation cascade

- Within 2-3 hrs after incision, a breakdown of the coagulation cascade begins with 3 fold elevation in D dimer levels
- Within 6 hrs from incision, there is a 19 fold increase in D dimer concentration and a corresponding 35% decrease in fibrinogen
- This is the first study quantifying the decline in coagulation cascade in adult spinal deformity surgery
- D dimer and fibrinogen are better measures of communication between anesthesia and surgeons regarding profound coagulopathy that develops in adult spinal deformity surgery
Conclusions

- Our data suggests that the three step approach
  - a live multidisciplinary screening process
  - dual attending approach to complex cases
  - intraoperative protocol for coagulopathy mgmt

Leads to a threefold decrease in overall complication rate and increases patient safety in these complex cases

Conclusions

- This is a TEAM sport! It cannot be done without the support of a major tertiary care center
- Our center uses two spinal deformity surgeons for each case
- A multidisciplinary approval process is essential in avoiding catastrophes

Thank You