Pre-optimization of spinal surgery patients: Development of a neurosurgical Enhanced Recovery After Surgery (ERAS) protocol

NeuroSafe

Tracy S. Ma, MD
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Financial disclosures

None
Low back pain in United States

• 1-2% population disabled from low back pain
• Low back pain is 2nd most common cause of adult disability (more than heart conditions, stroke, cancer combined)
• Total cost of low back pain > $100 billion/year: 2/3 related to lost wages, decreased productivity at work
Enhanced Recovery After Surgery (ERAS)

- 1997, Henrik Kehlet: multi-modal, evidence-based approach to prepare patients for surgery
- ERAS in colonic surgery, pancreaticoduodenectomy, cystectomy, gastrectomy, renal/pelvic surgery
Guidelines for Perioperative Care for Pancreatoduodenectomy: Enhanced Recovery After Surgery (ERAS®) Society Recommendations

Guidelines for Perioperative Care in Elective Colonic Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations

Guidelines for Perioperative Care in Elective Rectal/Pelvic Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations
Development of an Enhanced Recovery After Surgery (ERAS) approach for lumbar spinal fusion

Michael Y. Wang, MD,¹ Peng-Yuan Chang, MD,¹ and Jay Grossman, MD²

• Modified minimally invasive trans-foraminal interbody fusion (MIS TLIF)
• No general ETT: supplemental O2 or NC, no Foley, propofol and ketamine IV, no narcotic medications or spinal/reginal/epidural medications used (IV Marcaine in Kambin’s triangle only), cage & percutaneous screws
<table>
<thead>
<tr>
<th>Component</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>FDA Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working channel endoscope</td>
<td>8-mm incision, allows for a formal discectomy, clear visualization</td>
<td>Limited decompression capability, capital equipment costs, learning curve</td>
<td>On-label</td>
</tr>
<tr>
<td>Anesthesia w/o intubation</td>
<td>Patient neuromonitoring, limited anesthetic side effects, more normal homeostasis</td>
<td>Limited working time, airway not secured, close airway monitoring needed</td>
<td>On-label</td>
</tr>
<tr>
<td>Expandable cage</td>
<td>Implantable through 8 mm, improves foraminal space, reduces listhesis</td>
<td>Cage resorption and subsidence, risks of bone allograft, not available in all countries</td>
<td>Off-label</td>
</tr>
<tr>
<td>BMP</td>
<td>Robustly promotes osteogenesis, in widespread use, no need for autograft</td>
<td>Heterotopic bone formation, questions of teratogenesis, cost</td>
<td>Off-label</td>
</tr>
<tr>
<td>Small-caliber percutaneous screws</td>
<td>Premium implant cost</td>
<td>Learning curve</td>
<td>On-label</td>
</tr>
<tr>
<td>Liposomal bupivacaine</td>
<td>72 hrs of local analgesia, reduces narcotic/NSAID usage</td>
<td>Cost, risk of intrathecal injection</td>
<td>Off-label</td>
</tr>
</tbody>
</table>

BMP = bone morphogenetic protein; NSAID = nonsteroidal anti-inflammatory drug.
<table>
<thead>
<tr>
<th>Items</th>
<th>Summary and Recommendation</th>
<th>Responsible Team Member</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preadmission counseling</td>
<td>Patients should receive oral and written information to describe what they should expect and what their role is in recovery.</td>
<td>Surgeon</td>
</tr>
<tr>
<td>Preoperative enteral nutrition</td>
<td>All patients are encouraged to have improved enteral nutrition. Increased protein uptake is recommended, especially for underweight patients, and patients at risk for constipation are treated preoperatively.</td>
<td>Nurses</td>
</tr>
<tr>
<td>Preoperative fasting &amp; carbohydrate loading</td>
<td>The duration of preoperative fasting (NPO) is 8 hrs for liquids and 12 hrs for solid food. Routine carbohydrate loading is suggested.</td>
<td>Nurses</td>
</tr>
<tr>
<td>Antithrombotic prophylaxis</td>
<td>The application of compression stockings and intermittent pneumatic compression is suggested.</td>
<td>Nurses</td>
</tr>
<tr>
<td>Antimicrobial prophylaxis &amp; skin preparation</td>
<td>Routine prophylaxis with first-generation cephalosporin 1 hr before incision is recommended. Vaccination for MRSA is suggested.</td>
<td>Surgeon</td>
</tr>
<tr>
<td>Anesthesia protocol</td>
<td>No general anesthesia is recommended. Long-acting opioids and anesthetic agents should be avoided. Proper, short-duration sedation may be needed.</td>
<td>Anesthetist</td>
</tr>
<tr>
<td>Local analgesia</td>
<td>Skin blocks by local anesthesia are recommended for every skin incision. Long-acting liposomal bupivacaine is used for the screw entry sites.</td>
<td>Surgeon</td>
</tr>
<tr>
<td>Minimally invasive spinal surgery</td>
<td>Minimally invasive spinal procedures are required, including endoscopic decompression and deployment of expandable cages for interbody fusion. Percutaneous instrumentation of pedicle screws is needed.</td>
<td>Surgeon</td>
</tr>
<tr>
<td>Osteobiologics</td>
<td>Routine application of osteobiologic adjuvants to promote fusion are used, eliminating the need for bone graft harvesting and promoting the likelihood of a successful arthrodesis.</td>
<td>Surgeon</td>
</tr>
<tr>
<td>Surgical drainage</td>
<td>Routine use of surgical drains is not recommended.</td>
<td>Surgeon</td>
</tr>
<tr>
<td>Avoiding hypothermia &amp; hypotension</td>
<td>Intraoperative maintenance of normothermia and blood pressure is routinely performed.</td>
<td>Anesthetist</td>
</tr>
<tr>
<td>Fluid balance</td>
<td>Noninvasive cardiac output monitoring is used for minimally invasive monitoring of the fluid status during operation. Hypovolemia should be avoided.</td>
<td>Anesthetist</td>
</tr>
<tr>
<td>Urinary drainage</td>
<td>Avoidance of urinary catheterization reduces the likelihood of postop urinary retention.</td>
<td>Surgeon</td>
</tr>
<tr>
<td>Postop analgesia</td>
<td>Gabapentin, tramadol, and acetaminophen are frequently used, to favor less potential risk for bone fusion. Effective early pain control reduces patient anxiety and fear, promoting rapid mobilization.</td>
<td>Nurses</td>
</tr>
<tr>
<td>Postop nutrition</td>
<td>Patients are encouraged to have oral intake at will after recovery from surgery.</td>
<td>Nurses</td>
</tr>
<tr>
<td>Early mobilization</td>
<td>Early mobilization using a brace is recommended. No bending or weight lifting for patients who have had fusion surgery.</td>
<td>Nurses</td>
</tr>
<tr>
<td>Audit</td>
<td>Systemic audit is recommended for assessing impact and may influence compliance.</td>
<td>Multidisciplinary</td>
</tr>
</tbody>
</table>

MRSA = methicillin resistant Staphylococcus aureus; NPO = nil per os.
RESULTS In all cases the surgical procedure was performed successfully without conversion to an open operation. The patients’ mean age (± SD) was 66.1 ± 11.7 years, the male/female ratio was 20:22, and a total of 47 levels were treated. The mean operative time was 94.6 ± 22.4 minutes, the mean intraoperative blood loss was 66 ± 30 ml, and the mean hospital length of stay was 1.29 ± 0.9 nights. Early follow-up showed a significant improvement in the mean Oswestry Disability Index score (from 40 ± 13 to 17 ± 11, p = 0.0001). Return to the operating room was required in 2 cases due to infection and in 1 case due to cage displacement. An iterative quality improvement program demonstrated areas of improvement, including steps to minimize infection, improve postoperative analgesia, and reduce cage osteolysis.

CONCLUSIONS ERAS programs for improving spinal fusion surgery are possible and necessary. This report demonstrates a first foray to apply these principles through 1) a patient-focused approach, 2) reducing the stress of the operation, and 3) an iterative improvement process.
Enhanced Recovery After NEUROSurgery: A Patient-Centered Spine Surgery Pathway

Spine Surgery ERAS Protocol
- Smoking Cessation
- Wound Care
- Sleep Apnea Screen
- Narcotics/Alcohol Use
- Nutrition
- Diabetes Screen
- Mobility
- Analgesia
• Elective spinal surgery patients at Pennsylvania Hospital within UPHS
• Inclusion criteria: clinical history, diagnostic imaging to support spinal surgery, age > 18 yrs, ability to understand and actively participate in program as deemed by study team
• Exclusion criteria: contraindications to elective spinal surgery, liver disease, pregnancy
• Randomization via computer-generated list of random numbers at time of initial assessment visit: experimental (ERAS) vs. control (hospital standard)
• 3 separate components: Pre-op, peri-op, post-op
Pre-op

- Pre-optimization
- Maximize physical and functional status of the patient prior to surgical intervention
- Engage and educate patient about surgical expectations
PRE-OP
Maximizing physical, mental, and functional status to prepare patient for surgery after surgical intervention

DOMAIN

Surgical Education

Surgical Site Education

INTERVENTION

ASSESSMENT

ERAS Spine Patient Pathway Protocol

Chlorhexidine education and prep
PRE-OP
Maximizing physical, mental, and functional status to prepare patient for surgery after surgical intervention

DOMAIN

ASSESSMENT

INTERVENTION

Surgical Education

ERAS Spine Patient Pathway Protocol

Surgical Site Education

Chlorhexadine education and prep
Nutrition

Serum albumin level < 3.5 g/dL (for BMI < 18.5 or > 25)

- Nutritional consultation

Diabetes

Glucose > 200 mg/dL or HbA1c > 8% (Diabetics)

- Endocrinology consultation

Physical activity

Ambulation status

- Prehabilitation program

Smoking

Smoking screen

- Smoking cessation intervention

Narcotic/Alcohol use

Chronic opioid use assessment (> 30 MED > 4 weeks) & CAGE questionnaire

- Pain medicine consultation +/- mental health evaluation

Obstructive sleep apnea

STOP-BANG questionnaire

- Sleep medicine consultation

Discharge planning

Risk assessment and prediction tool (RAPT)

- Predictable discharge planning home vs. secondary facility
<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>C: Have you ever felt you should <strong>Cut</strong> down on your drinking?</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>A: Have people <strong>Annoyed</strong> you by criticizing your drinking?</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>G: Have you ever felt <strong>Guilty</strong> about your drinking?</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>E: Have you ever had a drink first thing in the morning (<strong>Eye opener</strong>)?</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

A total score of 0 or 1 suggests low risk of problem drinking  
A total score of 2 or 3 indicates high suspicion for alcoholism  
A total score of 4 is virtually diagnostic for alcoholism
What Do You Do if OSA Is Suspected: STOP-BANG

**STOP Questionnaire**
- Snoring
- Tiredness
- Observed you stop breathing
- Blood Pressure

**BANG**
- BMI > 35
- Age > 50
- Neck circumference > 40 cm (>15.7”)
- Gender male

High risk: Yes to >3 items → Refer for sleep testing

https://utswim.wordpress.com/tag/pulmonary/
<table>
<thead>
<tr>
<th>Question</th>
<th>Value</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is your age group?</td>
<td>50-65 years</td>
<td>=2</td>
</tr>
<tr>
<td></td>
<td>66-75 years</td>
<td>=1</td>
</tr>
<tr>
<td></td>
<td>&gt;75 years</td>
<td>=0</td>
</tr>
<tr>
<td>2. Gender?</td>
<td>Male</td>
<td>=2</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>=1</td>
</tr>
<tr>
<td>3. How far on average can you walk? (a block is 200 metres)</td>
<td>Two blocks or more (+/-rest)</td>
<td>=2</td>
</tr>
<tr>
<td></td>
<td>1-2 blocks (+/-rest)</td>
<td>=1</td>
</tr>
<tr>
<td></td>
<td>Housebound (most of time)</td>
<td>=0</td>
</tr>
<tr>
<td>4. Which gait aid do you use? (more often than not)</td>
<td>None</td>
<td>=2</td>
</tr>
<tr>
<td></td>
<td>Single-point stick</td>
<td>=1</td>
</tr>
<tr>
<td></td>
<td>Crutches/frame</td>
<td>=0</td>
</tr>
<tr>
<td>5. Do you use community supports? (home help, meals on wheels, district nursing)</td>
<td>None or one per week</td>
<td>=1</td>
</tr>
<tr>
<td></td>
<td>Two or more per week</td>
<td>=0</td>
</tr>
<tr>
<td>6. Will you live with someone who can care for you after your operation?</td>
<td>Yes</td>
<td>=3</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>=0</td>
</tr>
</tbody>
</table>

**Your score (out of 12)**

Key: Destination at discharge from acute care predicted by score.

- Scores <6 — extended inpatient rehabilitation
- Score 6-9 — additional intervention to discharge directly home (e.g. Rehabilitation in the Home)
- Score >9 — directly home.
Peri-op

• 1 week prior to admission, intra-operative, immediate post-operative
• Reduce surgical stress response
PERI-OP

1 wk prior to admission, intra-op, and inpatient post-op reduction of surgical stress responses

DOMAIN

INTERVENTION

Clear carbohydrate fluids the day before and up to 2 hours before surgery

Metabolism

Early postoperative nutrition

Chewing gum 1 stick TID
Analgesia

- Peri-operative analgesia
- Opioid sparing intra- and post-op analgesia pathway
- Individualized pain management pathway for chronic narcotic users

Surgery

- Safe spine surgery checklist
Analgesia

- Peri-operative analgesia
- Opioid sparing intra- and post-op analgesia pathway
- Individualized pain management pathway for chronic narcotic users

Surgery

- Safe spine surgery checklist
Mobility

- No foley catheter unless bedrest restrictions
- Out of bed <6 hours from surgery
- All meals out of bed in chair
- Inpatient walking program
Wound care

- POD 1 dressing removal
- Daily chlorhexidine wound wash
- Optimal perioperative antibiotic use
- Patient education wound care contract
Post-op

- Following inpatient discharge from hospital
- Incorporate goal-centered care and follow-up after surgery
POST-OP

Goal-centered discharge care and follow-up following surgery

DOMAIN

INTERVENTION

Clinical team communication

48 hr phone call

Primary care doctor follow-up (2 weeks)

Pain management follow-up for chronic opioid users
Mobility

- Physical/Occupational therapy short- and long-term goals

Wound care

- Wound care protocol
- Surgical wound triage protocol

Post inpatient discharge secondary sites

- Preferred Provider Network
Mobility

Physical/Occupational therapy short- and long-term goals

Wound care

Wound care protocol

Surgical wound triage protocol

Post inpatient discharge secondary sites

Preferred Provider Network
Mobility

Physical/Occupational therapy short- and long-term goals

Wound care

Wound care protocol

Surgical wound triage protocol

Post inpatient discharge secondary sites

Preferred Provider Network
## Conventional surgical care

<table>
<thead>
<tr>
<th>Pre</th>
<th>Peri</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical or cardiac pre-op risk stratification</td>
<td>Fasting</td>
<td>Limited and slow diet</td>
</tr>
<tr>
<td>No subspecialty evaluations other than in complex medical situations i.e. bleeding diathesis</td>
<td>No checklist</td>
<td>PCAs with transition to oral narcotics</td>
</tr>
<tr>
<td>No screening for diabetes, smoking cessation, narcotic use, OSA</td>
<td></td>
<td>Foley catheters</td>
</tr>
<tr>
<td>No pre-operative discharge planning</td>
<td></td>
<td>Meals in bed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No enforcement of daily wound washes</td>
</tr>
</tbody>
</table>
Primary outcome measures

- Patient reported outcomes
- PROMIS
- ODI
- VAS
- EuroQol

Initial visit
1 month, 3 months, 6 months post-operatively
Secondary outcome measures

- Length of hospital stay
- Post-operative duration of pain medication use
- Rate of re-admission
- Home disposition rates
- AM-PAC: Activity measure for Post Acute Care scores
- Patient satisfaction
- Duration of post-acute care services and admissions
- Deaths
- Morbidities
- Complications: SSI, UTI, cardiopulmonary events, wound dehiscence rates, non-union rates
- Overall cost
**ODI Score**

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 20%</td>
<td><strong>Minimal Disability:</strong> Patient can cope with most ADL’s. No treatment indicated except change posture, lifting etc.</td>
</tr>
<tr>
<td>21 – 40%</td>
<td><strong>Moderate Disability:</strong> Patient has more pain with sitting, lifting, standing. Social life is difficult, occasionally off work. Most ADL’s and sex activity not affected. Conservative therapies indicated.</td>
</tr>
<tr>
<td>41 – 60%</td>
<td><strong>Severe Disability:</strong> Pain is significant problem for patient with significant problems with sleep, travel, personal care, ADLs, sexual activity.</td>
</tr>
<tr>
<td>61 – 80%</td>
<td><strong>Crippled:</strong> Back pain has impact in all aspects of daily living and work. Surgical treatment indicated.</td>
</tr>
<tr>
<td>81 – 100%</td>
<td><strong>Bed bound:</strong> These patients are bed bound or exaggerating symptoms.</td>
</tr>
</tbody>
</table>
Visual Analogue Scale

Choose a Number from 0 to 10 That Best Describes Your Pain

No Pain | Distressing Pain | Unbearable Pain
---|---|---
0 | 1 | 10

ASK PATIENTS ABOUT THEIR PAIN
INTENSITY—LOCATION—ONSET—DURATION—VARIATION—QUALITY

"Faces" Pain Rating Scale

0 | 1 | 2 | 3 | 4 | 5
---|---|---|---|---|---
NO HURT | HURTS LITTLE BIT | HURTS LITTLE MORE | HURTS EVEN MORE | HURTS WHOLE LOT | HURTS WORST
MOBILITY
- I have no problems in walking about
- I have slight problems in walking about
- I have moderate problems in walking about
- I have severe problems in walking about
- I am unable to walk about

SELF-CARE
- I have no problems washing or dressing myself
- I have slight problems washing or dressing myself
- I have moderate problems washing or dressing myself
- I have severe problems washing or dressing myself
- I am unable to wash or dress myself

USUAL ACTIVITIES (e.g. work, study, housework, family or leisure activities)
- I have no problems doing my usual activities
- I have slight problems doing my usual activities
- I have moderate problems doing my usual activities
- I have severe problems doing my usual activities
- I am unable to do my usual activities

PAIN / DISCOMFORT
- I have no pain or discomfort
- I have slight pain or discomfort
- I have moderate pain or discomfort
- I have severe pain or discomfort
- I have extreme pain or discomfort

ANXIETY / DEPRESSION
- I am not anxious or depressed
- I am slightly anxious or depressed
- I am moderately anxious or depressed
- I am severely anxious or depressed
- I am extremely anxious or depressed

https://www.slideshare.net/OHENews/the-eq-5-d-and-use-internationally-devlin-may-2013
Barriers
Future Directions

• Elective spinal surgery
• Pennsylvania Hospital
• April 2017
• Initial data collection
Individually, we are one drop. Together, we are an ocean.
- Ryunosuke Satoro -
Acknowledgments
References

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