


**Pain Technologies & Toradol**

FACING THE CHALLENGE IN PEDIATRIC ORTHOPEDICS

Trudi Nelson RN, BC  
Renee Manworren, MS, RN, BC, CNS



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**Challenges with Controlling Pain  
Post Spinal Fusion Surgery**

- No past surgical experience  
No context of expectation
- No past use of opioids  
Opioid Naivety





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**Historical Overview**

- PCA Morphine and PCA Demerol +/- Ketoralac
- Epidurals introduced 1994 – Bupivacaine/Hydromorphone +/- Ketoralac
- Exit of Ketoralac
- Introduction and exit of IV Methadone
- Introduction of OnQ Pain Buster Ball/PCA combination



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## Objectives

- Compare Postoperative Pain Management:
- Continuous Epidural Analgesia (CEA) vs. Patient-Controlled Analgesia (PCA)\
  - Safety
  - Efficacy

2002 Sacato, etal. SPINE Volume 30, Number 2, pp 211-217, 2005

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## Methods

### INCLUSION CRITERIA

1. Primary Surgery
2. Adolescent Idiopathic Scoliosis

### RETROSPECTIVE CHART REVIEW

Demographic Data  
Operative Procedure  
Postoperative Pain Scores  
Complications/Adverse Effects

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## Methods

### CEA Medication

- Continuous Infusion: 0.1- 0.2 ml/kg/h  
Bupivacaine 0.1% with Hydromorphone (20 µg/ml)
- Initial Bolus:  
May or may not receive Hydromorphone 10-20 µg/kg
- If inadequate pain control:  
Intermittent Bolus: 50% of rate  
Infusion Rate Increased 10%

### PCA Medication

- Typical dose 0.02-0.03 mg/kg  
182 Patients had Morphine  
18 Patients had Demerol

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## Results

613 Patients: 413 CEA & 200 PCA  
No Difference Between Groups:

|                 | CEA  | PCA  |
|-----------------|--|--|
| Age             | 14.5 yrs                                     | 14.6 yrs                                     |
| % Females       | 84.0%  | 82.0%  |
| Levels Fused    | 8.4 levels                                   | 8.6 levels                                   |
| Curve Magnitude | 57.9 °                                       | 56.9 °                                       |
| Surgery Type    | Posterior 78%<br>Anterior 17%<br>Ant/Post 5% | Posterior 75%<br>Anterior 22%<br>Ant/Post 3% |

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## Results

Average Pain Score for *All* Time

CEA: 1.29      P <0.0001

PCA: 1.82

*Maximum* Pain Scores

CEA: 2.66  
PCA: 3.25      P <0.0001

*Difference* of Pain Scores (Minimum to Max)

CEA: 2.37  
PCA: 2.68      P =0.0008

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## Continued Challenge

- True PCA with demand dose only:
  - Potentially tedious and tiring for patient.
  - Therapeutic blood levels can be more difficult to maintain.

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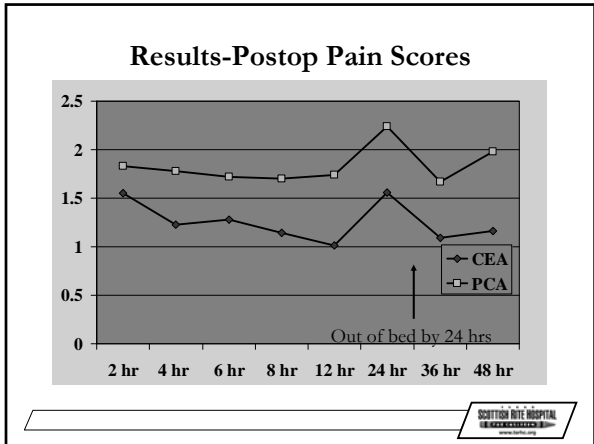
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- ### Results- CEA
- NO Correlation with Pain Scores
    - Gender magnitude of Curve
    - Number of Levels Fused
    - Use of Other Meds (Toradol)
    - Early vs Recent Experience with Epidural
  - Correlation with Pain Scores
    - African Americans less pain than others (@ 24 and 36 hours)
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### Results- Unplanned Discontinuation

***Permanently*** Discontinued

CEA: 13.0%      PCA: 0.0%

1. 61% Pain
2. 15% Sensory Changes
3. 6% Sedation:

P < 0.001

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### Continued Challenge: Cognitive Representations

- An accumulation of an experience and embody an individual's assumptions, beliefs, facts, and misconceptions.
- When well developed, CRs have strong impact on perception/behavior.
- Bias toward the familiar
  - Familiarity fosters concreteness
  - Objective information is concrete
  - Concrete information taken more seriously

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### Biases-Judgements

- Our interpretations of patient's pain to fit our beliefs, workload, and expectations.
- Depending on "behavioral" cues to support subjective pain rating.
- Family dynamics/influences

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### Biases-Judgements

- Acknowledge you have them
- Understand they do influence your actions.

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## Safeguarding

- Communicate - educate, observe, ask, listen
- Intervene - timely and appropriate
- Follow up - have we met the goal?
- Regroup
- Follow up AGAIN

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## Goal Setting

- Realistic Expectations
- Functional Goals
- Subjective pain/individual tolerances
- Patient Goal

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## Results- Unplanned Discontinuation

### *Temporarily* Discontinued

CEA: 12.4%

PCA: 7.0%

- |                          |                          |
|--------------------------|--------------------------|
| 1. Resp. Depression: 52% | 1. Sedation: 21%         |
| 2. Sensory Changes: 24%* | 2. Nausea/Vomiting: 21%  |
| 3. Sedation: 6%          | 3. Resp. Depression: 14% |

\* More Common in Anterior Surgery

P = 0.04

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## Results: Adverse Reactions

|          | CEA    | PCA    | P Value |
|----------|--------|--------|---------|
| Nausea   | 54.1 % | 37.0 % | <0.001  |
| Vomiting | 38.8 % | 29.0 % | 0.02    |
| Pruritis | 40.1 % | 11.0 % | <0.001  |

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## Continued Challenge

### Assessment Requirements

Close vigilance is required when using PCA and CEA for postoperative analgesia to monitor patients and take appropriate action to avoid permanent complications

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## Side Effects of CEA vs. Surgical Complications

- Potential post-op side effects
  - Motor block
  - Motor weakness
  - Numbness/tingling of extremities
- Potential post-op complications with spinal surgery
  - Paralysis
  - Brown-Sequard Syndrome – injury to one half of cord; sensory deficit on one side and motor deficit on other.
  - Nerve-root injury – specific to one nerve root, controlling a specific muscle. Sensory changes such as numbness/tingling. Results from disruption to blood supply to cord.

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## Assessment

### Sensory assessment

- Specific dermatomes identified that have sensory changes
- Assessed every two hours

### Motor assessment

- Full motor (includes all extremities/joint flexion)
- Degrees of motor changes based on ability to flex hips/knees/ankles
- Assessed every two hours<sup>4</sup>

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## Safety

- Education on side effects
- Unsafe side effects will alter opioid/sedative use
- Advantages of mild agitation vs. somnolence

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## Discussion

- LARGE (613 patients) Comparison Study
- Epidural Analgesia
  - Better Average Pain Scores At ALL Time Periods
  - Less Maximum Pain Scores
  - Less Fluctuation in Pain Scores
- When compared to PCA:
  - Permanently stopped more often
  - Temporarily stopped more often
- NO PERMANENT COMPLICATIONS SEEN

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## Conclusion

BOTH CEA and PCA provide effective pain control following surgery for AIS

However, Postoperative CEA following surgery for AIS

1. More effective than PCA with >90% of patients obtaining effective pain relief
2. Very safe with no permanent complications

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## Present Practice

- On Q Pain Ball – Local anesthetic advantage for ASF with reintroduction of PCA
- Reintroduction of more regular use of Ketoralac

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## Introduction

- Nonsteroidal anti-inflammatory drugs (NSAIDS)
  - Widely used as an adjunct to opioid pain medication
  - Less opioid necessary
  - Less sedation
  - Improved pain scores
  - Improvement in postoperative ambulation

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## Introduction

- NSAIDS in animal models

Inhibits bone metabolism

Mechanism of Inhibition:

Inhibition of bone-forming cells at endosteal surfaces

Reduction of immune and inflammatory responses

Inhibition of prostaglandin synthesis

Keller et al, Acta Orthop Scand 1987  
Bo et al Acta Orthop Scand 1976

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## Introduction

- NSAIDS in Spinal Arthrodesis

In adult L4 to sacrum fusions

Pseudoarthrosis

No ketorolac: 5 of 121 = 4.1%

Ketorolac: 29 of 167 = 17.4%

Conclusion: Avoid NSAIDS in postop period

Glassman et al, Spine 1998

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## Introduction

- Pseudoarthrosis Rate

Adult L4-S1 Fusions:

5-28%

Adolescent Idiopathic Scoliosis (AIS):

<5-6%

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## Methods

- Determine whether ketorolac influences the incidence of pseudoarthrosis in patients undergoing posterior spinal fusion and instrumentation (PSFI) for AIS
- Retrospective Review 1994-2000
- Inclusion Criteria
  - All patients who had PSFI for AIS
  - Primary Surgery
- Exclusion Criteria
  - Anterior spinal fusion and instrumentation
  - Anterior release/fusion prior to PSFI

Sucato, et al. SPINE Volume 33, Number 10, pp 1119-1124, 2008.




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## Results

No differences in *Patient Demographics*

|           | Ketorolac Group<br>(N=133)                     | No Ketorolac Group<br>(N=131)                  |
|-----------|--|--|
| Gender    | Female: 85%<br>Male: 15%                       | Female: 84.0%<br>Male: 16%                     |
| Age       | 14.4 years                                     | 14.1 years                                     |
| Ethnicity | Caucasian: 75.2%<br>African American:<br>20.3% | Caucasian: 84.2%<br>African American:<br>12.2% |
| Smoking   | 0  |  |




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## Results

No differences in *Radiographic Parameters*

|                 | Ketorolac Group<br>(N=133)      | No Ketorolac Group<br>(N=131) |
|-----------------|---------------------------------|-------------------------------|
| Curve Magnitude | 58.3°                           | 57.2°                         |
| Levels Fused    | 9.5                             | 9.6                           |
| Proximal Level  | T4                              | T4                            |
| Distal Level    | L1                              | L1                            |
| Bone Graft      | Iliac Crest: 96.2%<br>Rib: 3.8% | Iliac Crest: 100%<br>Rib: 0%  |

- Ketorolac Group: Motrin Use More Likely  
\*P<0.05




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## Results

- Postoperative Analgesia \*

|                    | Ketorolac Group (N=133) | No Ketorolac Group (N=131) |
|--------------------|-------------------------|----------------------------|
| Epidural Analgesia | 89.5%                   | 10.5%                      |
| PCA                | 13.7%                   | 92.6%                      |

\* P < 0.05



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## Results

- *Incidence of Pseudoarthrosis*

|                 | Ketorolac Group (N=133) | No Ketorolac Group (N=131) |
|-----------------|-------------------------|----------------------------|
| Pseudoarthrosis | 3.0%<br>(4 of 133)      | 3.8%<br>(5 of 131)         |

\* P = 0.7



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## Results

- Analysis of only *Dual Rod Instrumentation*

|                 | Ketorolac Group (N=84) | No Ketorolac Group (N=112) |
|-----------------|------------------------|----------------------------|
| Pseudoarthrosis | 3.6%<br>(3 of 84)      | 0.9%<br>(1 of 112)         |

\* P = 0.18



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## Results

- Incidence of Pseudoarthrosis:

No Correlation to:

- Number of levels fused
- Age
- Gender
- Bone graft used
- Date of Surgery
- Type of Post-op Analgesia

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## Discussion

- Ketorolac in AIS patients

208 patients

60 Ketorolac

148 No Ketorolac

No differences between groups:

Postoperative hematocrit

Need for transfusion

Gastrointestinal complaints

Revision Surgery

Vitale MG et al, Scoliosis Research Society, 2001

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## Discussion

- Posterior spinal fusion/instrumentation for AIS and the use of Ketorolac

Incidence of pseudoarthrosis is similar

- There did not appear to be any adverse effects with use of ketorolac

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## Conclusion

- Ketorolac can be safely utilized following PSFI for AIS when segmental fixation and autologous bone grafting are utilized

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## Continued Challenges

- Regaining regular use of Ketorolac for all spine patients.
- Gaining consistency in assessments/interventions.

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