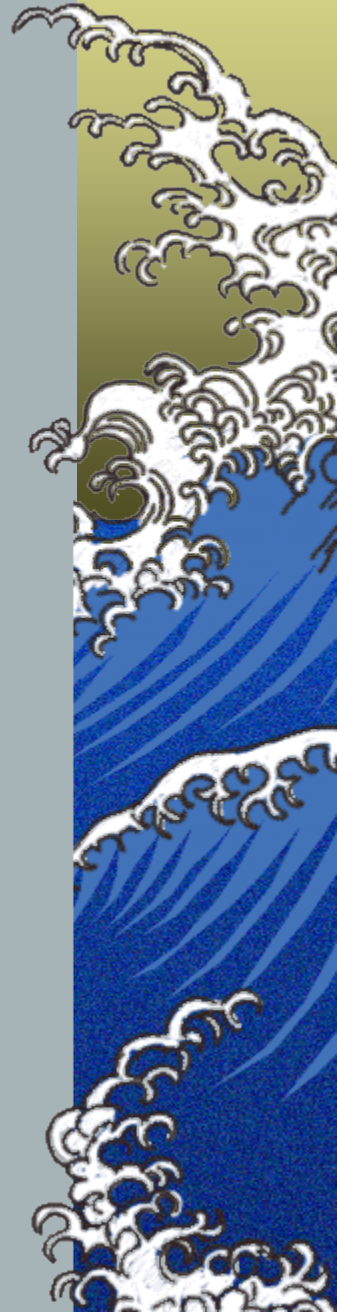


# Acute Pain Management for Spinal Fusion

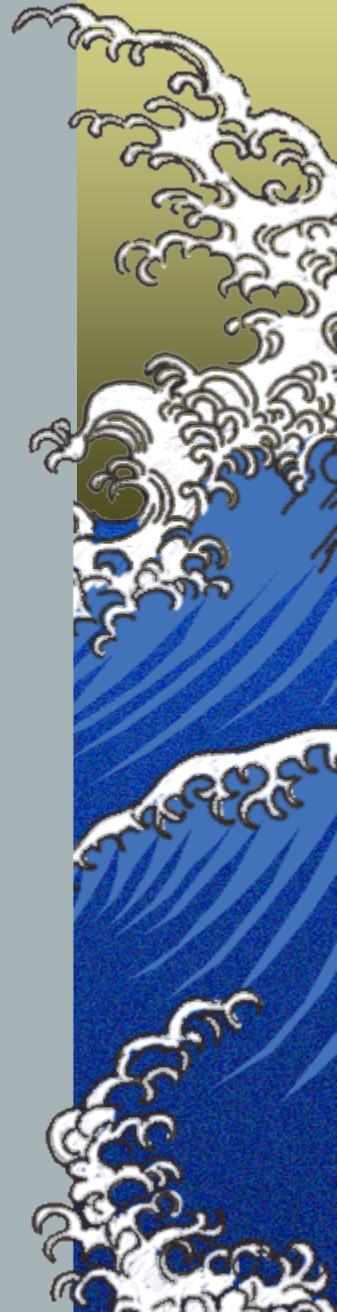
*Patrick Ross, MD*

*Children's Hospital Los Angeles*



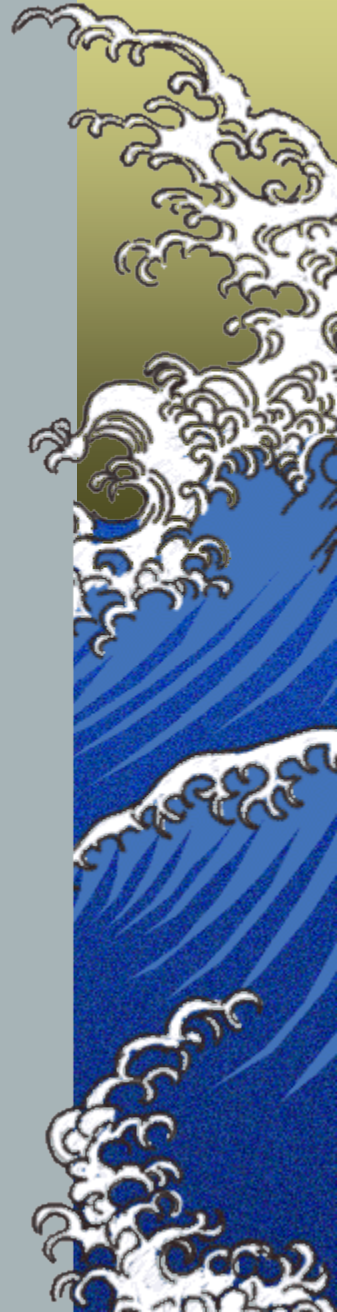
# Assumptions for Idiopathic

- ▶ *TIVA for neuromonitoring*
- ▶ *Blood sparing technique*
- ▶ *Otherwise healthy neurologically intact*
- ▶ *4 to 5 day hospitalization*
- ▶ *Want rapid emergence*



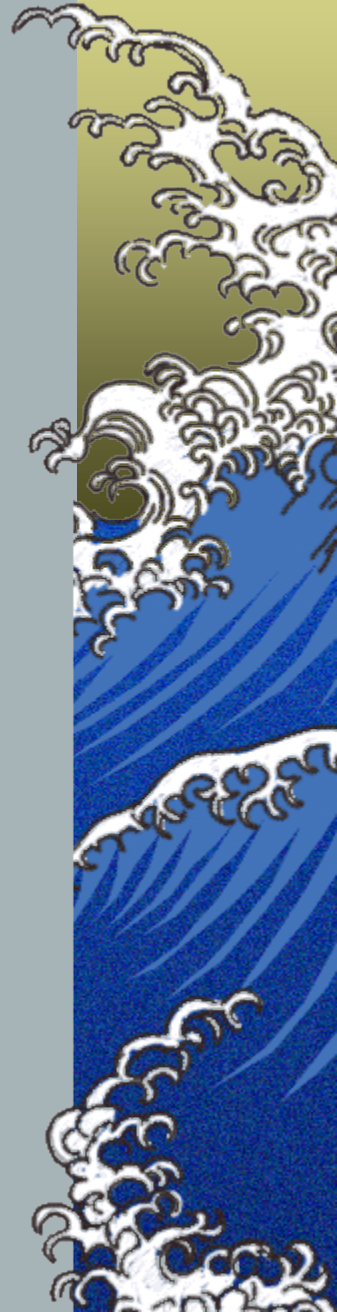
# Assumptions for Non-Idiopathic

- ▶ *TIVA for neuromonitoring*
- ▶ *Blood sparing technique*
- ▶ *Underlying disorders*
  - ▶ *Seizures, respiratory compromise*
- ▶ *6 to 10 day hospitalization*
- ▶ *May remain intubated*



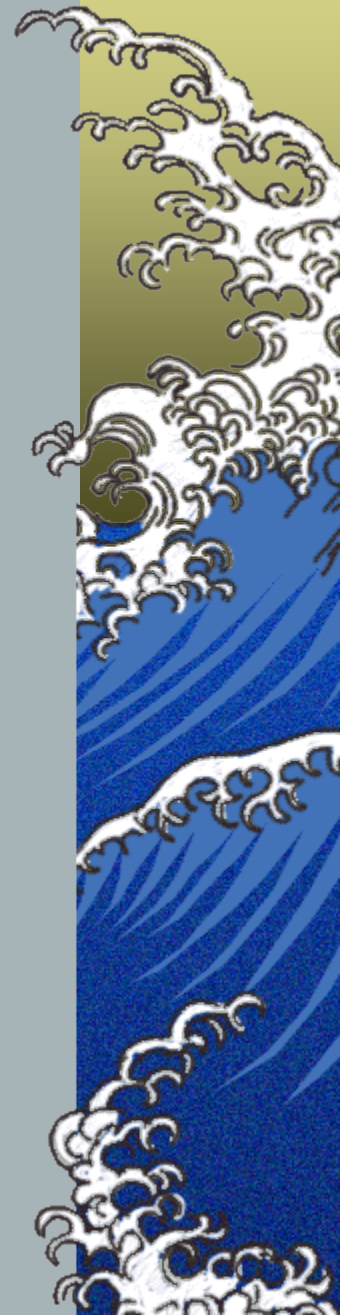
# Goals for Acute Pain

- ▶ *Effective*
- ▶ *Quick and easy to perform*
- ▶ *Low failure rate*
- ▶ *Good risk / benefit balance*
- ▶ *Does not require PICU*
- ▶ *Does not delay emergence*



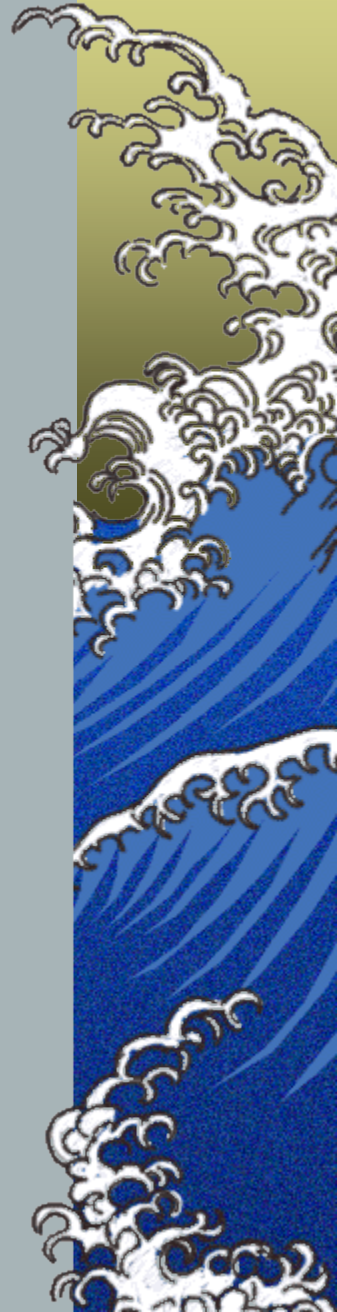
## Possible therapies to start in the OR

- ▶ *Intrathecal opioids*
- ▶ *Epidural catheter*
- ▶ *IV Methadone*
- ▶ *IV Ketamine*
- ▶ *IV acetaminophen*
- ▶ *Subcutaneous local anesthetics*
- ▶ *Decadron*



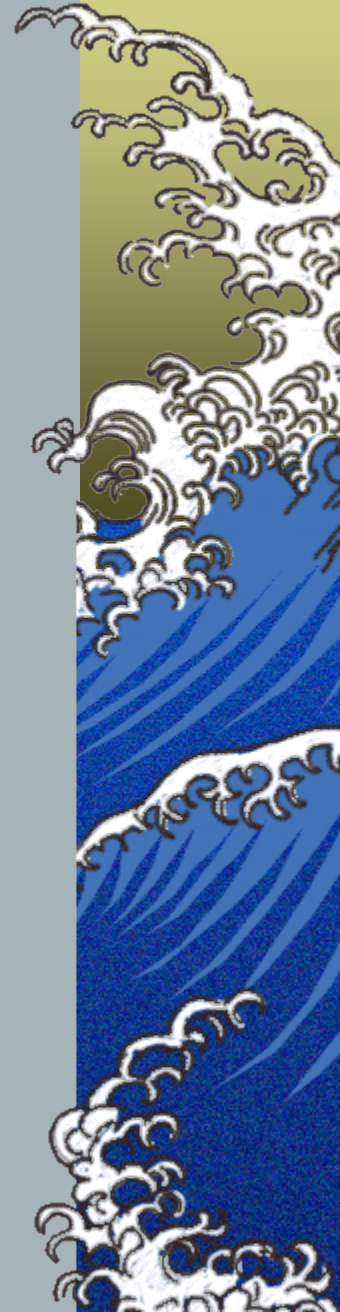
# Possible therapies to start after

- ▶ *Epidural PCEA*
- ▶ *Continuous opioids / PCA*
- ▶ *NSAIDs*
- ▶ *Diazepam*
- ▶ *Acetaminophen*
- ▶ *Others: Ketamine, Magnesium and Gabapentin*



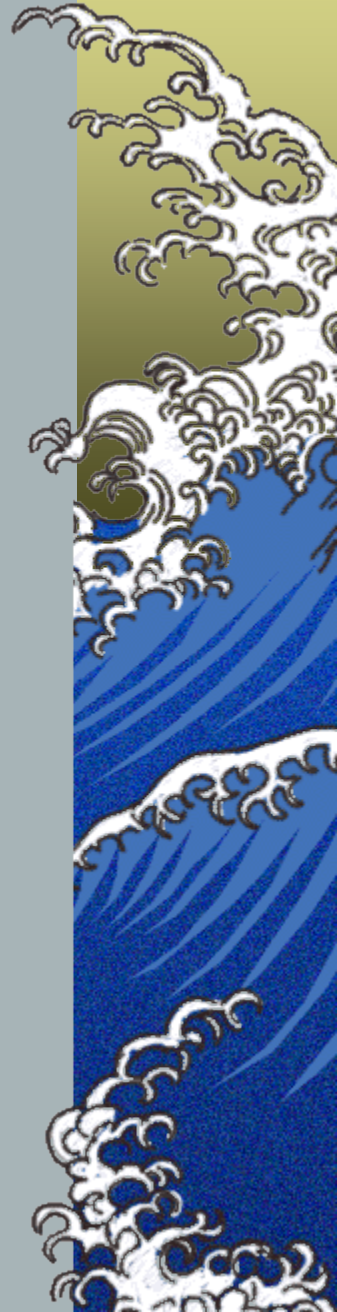
# Intrathecal Opioids

- ▶ *Prolonged post-operative analgesia*
- ▶ *Decreased anesthetic agents*
- ▶ *Limited effect on neuromonitoring*
- ▶ *Decreased blood loss*
- ▶ *Intrathecal morphine 20 mcg / kg with sufentanil 50 mcg total*
  - ▶ *M. Goodarzi. Pediatric Anesthesia 1998*



# Higher IT morphine dose does not improve efficacy

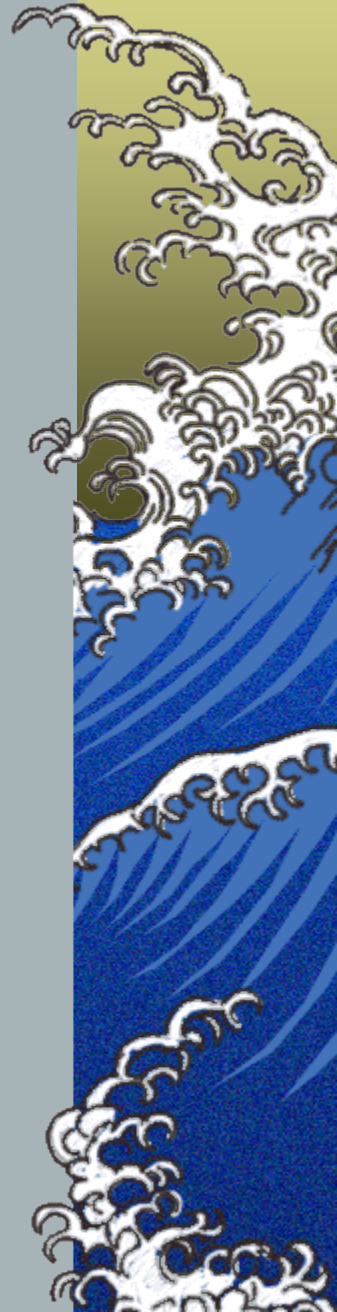
- ▶ *Prospective pediatric study comparing Intrathecal morphine 0, 5 mcg/kg, 15 mcg/kg*
- ▶ *IT morphine decreased EBL, post-op opioids, pain score*
- ▶ *Eschertzhuber et al. BJA 2008*
  
- ▶ *Retrospective pediatric study comparing Intrathecal morphine 0, mean 14mcg/kg, mean 24 mcg/kg*
- ▶ *IT morphine lower pain scores, longer time to rescue*
- ▶ *Higher dose associated with increased respiratory depression*
- ▶ *Tripi et al. Spine 2008*





# What is the correct IT morphine dose?

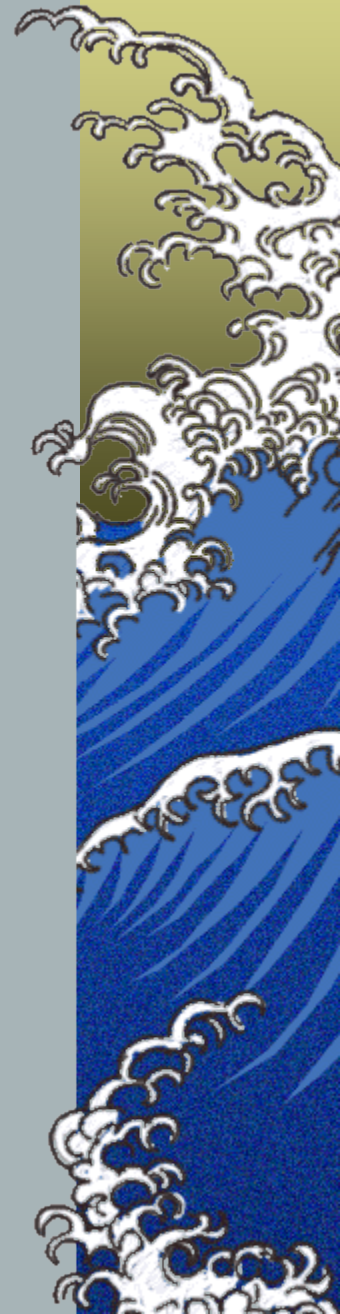
- ▶ *IT morphine ceiling effect*
  - ▶ *Higher doses do not improve analgesia*
- ▶ *Larger doses delay post-op IV morphine*
  - ▶ *20 mcg/kg may last 18 to 24 hours*
  - ▶ *May not matter with multi-modal therapy*
- ▶ *Decreased blood loss starting at 5 mcg/kg*
  - ▶ *Gall et al. Anesthesiology. 2001*
- ▶ *Several studies show low pain scores with IT morphine dosing 3 to 7 mcg/kg*



# What comes next?

## Epidural or IV morphine

- ▶ *Epidurals provide better analgesia*
  - ▶ *Taenzer et al. Paediatr Anaesth 2010*
- ▶ *Epidurals can fail (8.5 to 37%)*
- ▶ *ITM + PCA > Epidural alone > PCA alone*
  - ▶ *Milbrandt et al. Spine 2009*
- ▶ *PCEA alone > PCA alone*
  - ▶ *Gauger et al. J Pediatr Orthop 2009*
- ▶ *ITM + Epidural > PCA alone*
  - ▶ *Ravish et al. J Pediatr Orthop 2012*
- ▶ *All report low pain scores*



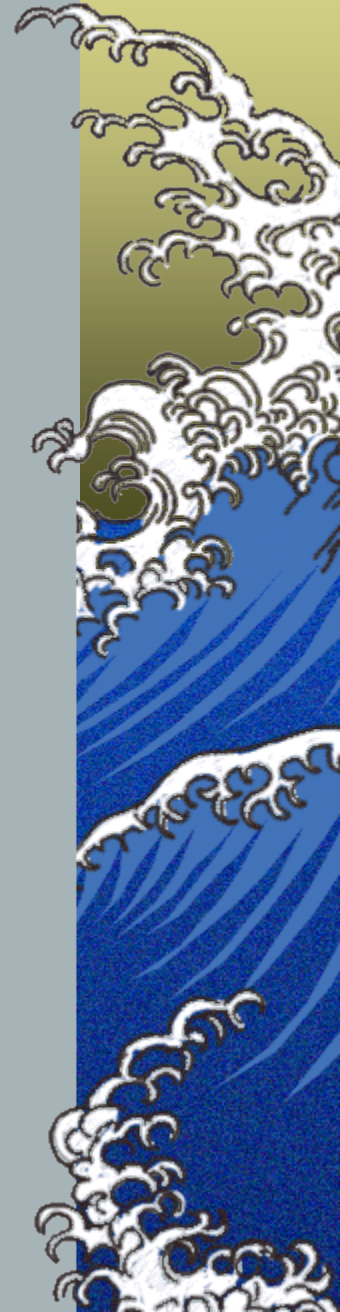
# Continuous Bupivacaine?

- ▶ *Decreased post-operative opioid use*
  - ▶ *Ross et al. Spine 2011*
- ▶ *It seemed appealing at the time*
- ▶ *Benefit outweighed by risk of infection*
- ▶ *No other reports in the spine literature*



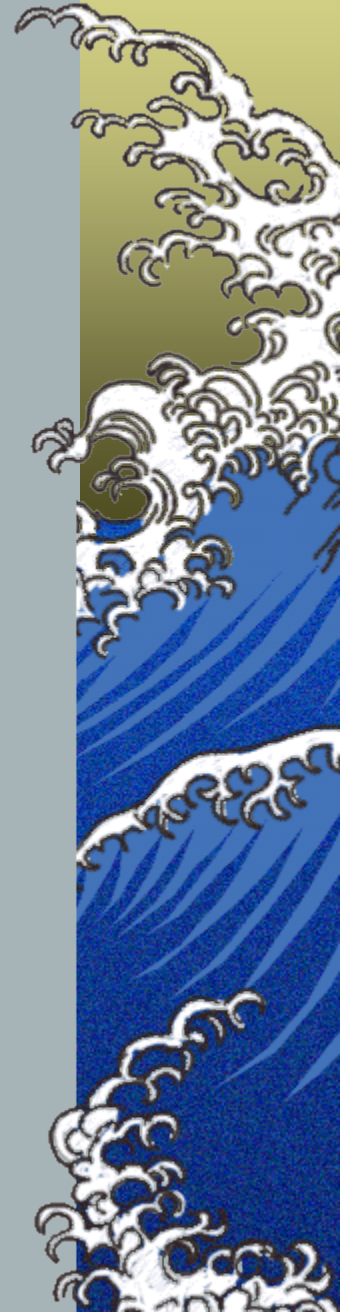
# Remifentanyl Hyperalgesia

- ▶ *Increases post-operative morphine use*
  - ▶ *Crawford et al. Anesth Analg 2006*
- ▶ *Is / Is not prevented by low dose ketamine*
  - ▶ *Is, Moustafa et al. Middle East J Anesth 2008*
  - ▶ *Is, Hadi et al. Int J Clin Pharmacol Ther 2010*
  - ▶ *Is not, Engelhardt et al. Anesth Analg 2008*
- ▶ *Not prevented by morphine*
  - ▶ *McDonnell et al. Can J Anesth 2008*
- ▶ *IT morphine? No studies*



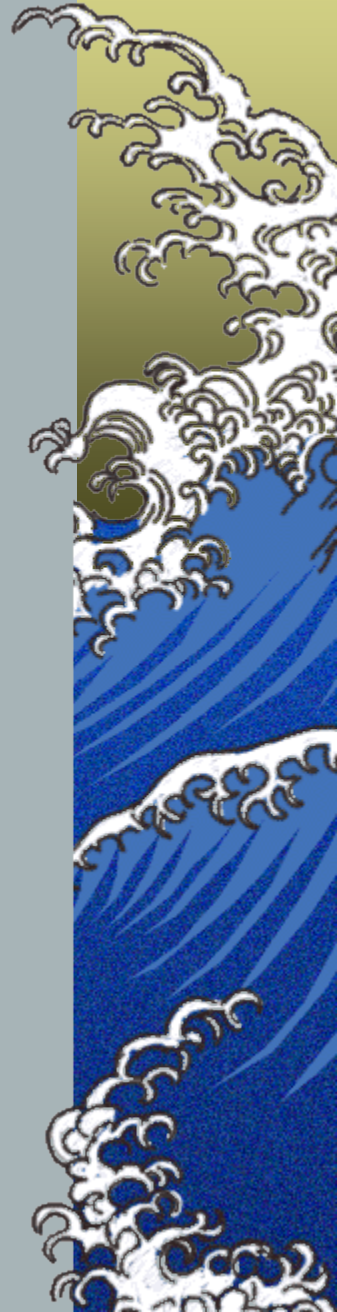
# IV Acetaminophen

- ▶ *Pediatrics- improved analgesia, did not reduce opioid use*
  - ▶ *No intrathecal morphine*
  - ▶ *Hiller et al. Spine 2012*
- ▶ *Adult- decreased morphine 46%, did not change pain scores*
  - ▶ *No intrathecal morphine*
  - ▶ *Hernandez-Palazon et al. Anesth Analg 2001*



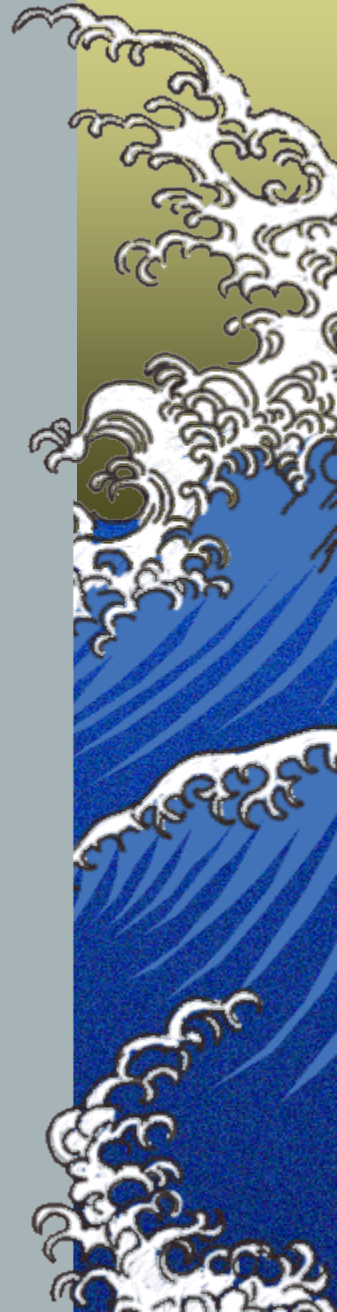
# Ketamine

- ▶ *Pediatric Spine Surgery*
  - ▶ *No change in pain score or opioid*
  - ▶ *Neither study used intrathecal morphine*
  - ▶ *Engelhardt et al. Pediatric Anesthesia 2008*
  - ▶ *Tsui et al. Pediatric Anesthesia 2007*
- ▶ *Pediatric Meta-analysis all surgeries*
  - ▶ *Decreased PACU pain scores*
  - ▶ *Did not decrease post-op opioids*
  - ▶ *Dahmani et al. Pediatric Anesthesia 2011*



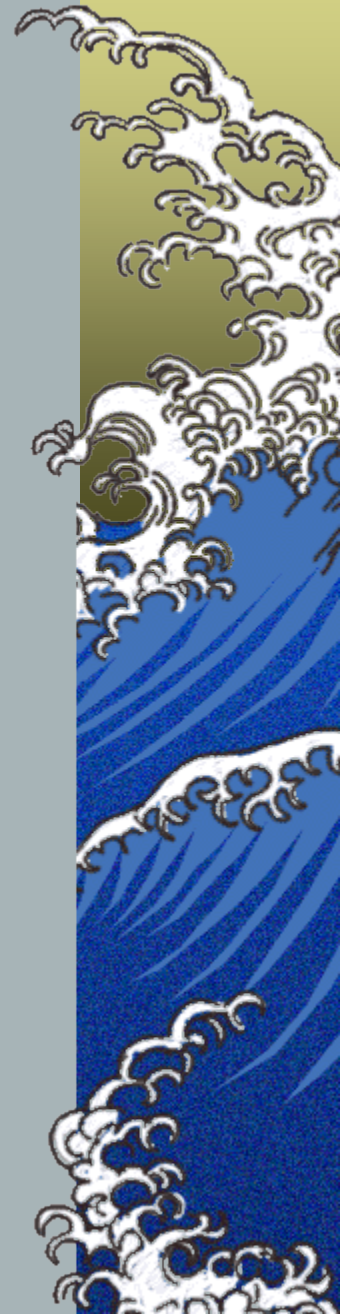
# Ketorolac Therapy

- ▶ *Low dose Ketorolac decreased pain scores and morphine usage*
  - ▶ *No intrathecal morphine*
  - ▶ *Munro et al. Can J Anesth. 2002*
- ▶ *Survey study; 59% of pediatric anesthesiologists prescribe NSAIDs*
  - ▶ *Hayes et al. Pediatric Anesthesia 2009*



# Ketorolac complications

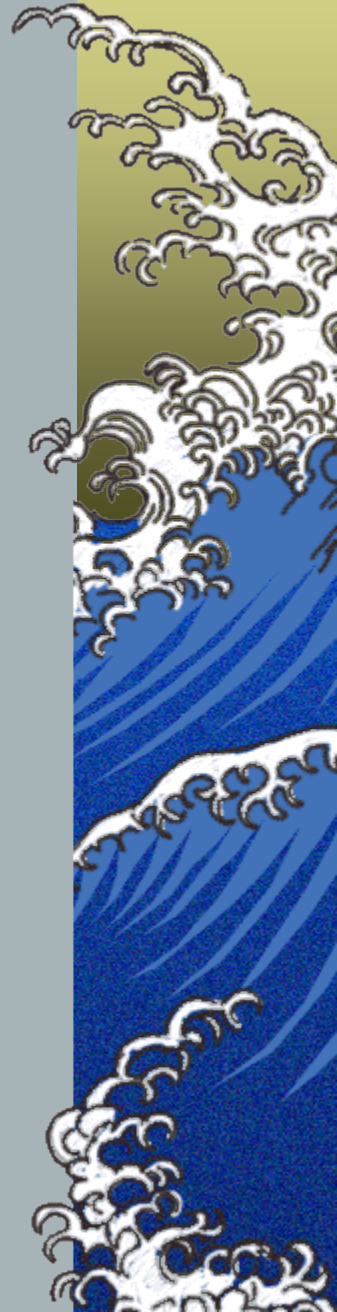
- ▶ *Does not increase risk of transfusion or reoperation*
  - ▶ *Vitale et al. The Spine Journal 2003*
- ▶ *Does not increase risk of pseudoarthrosis*
  - ▶ *Incidence pseudoarthrosis 2.5% each group*
    - ▶ *Sucato et al. Spine 2008*
  - ▶ *Similar adult findings with no increase risk of pseudoarthrosis*
    - ▶ *Pradhan et al. Spine 2008*





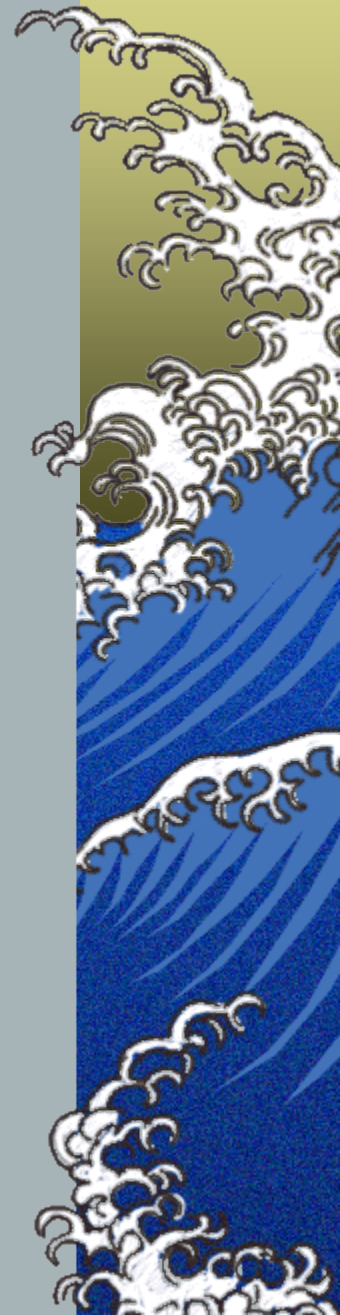
# Methadone

- ▶ *Decreased post-op opioids shown in adult spine fusion*
  - ▶ *0.2 mg / kg Pain scores same in first 24h*
  - ▶ *Control group sufentanil infusion*
  - ▶ *Gottschalk et al. Anesth Analg 2011*
- ▶ *Methadone has efficacy in pediatric Non-spinal surgery*
  - ▶ *Berde et al. J Pediatr 1991*



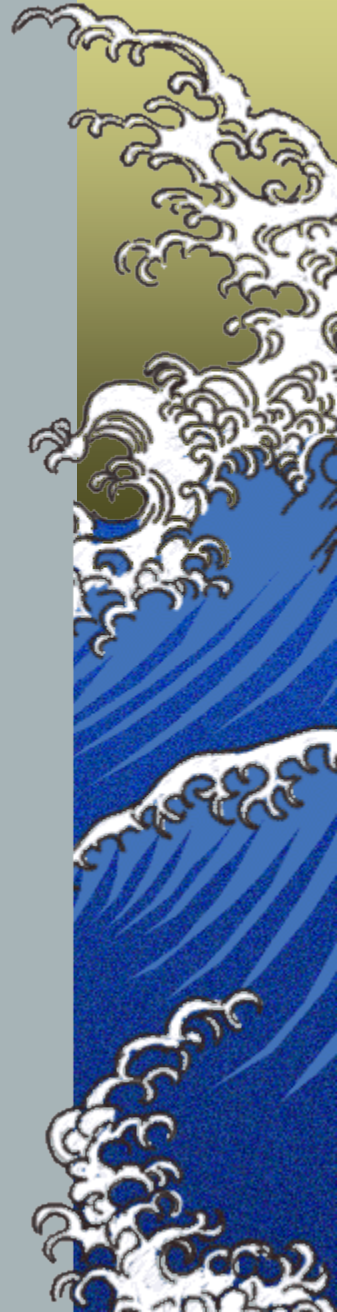
# Methadone Pediatric Spine Surgery

- ▶ *Pharmacokinetics similar to adults*
- ▶ *Only 2 studies so far*
- ▶ *No decrease in opioids or pain scores*
- ▶ *Bolus doses of up to 0.3mg / kg used*
- ▶ *Recommend bolus followed by infusion*
  - ▶ *Sharma et al. Anesthesiology 2011*
  - ▶ *Stemland et al. Paediatr Anaesth 2012*



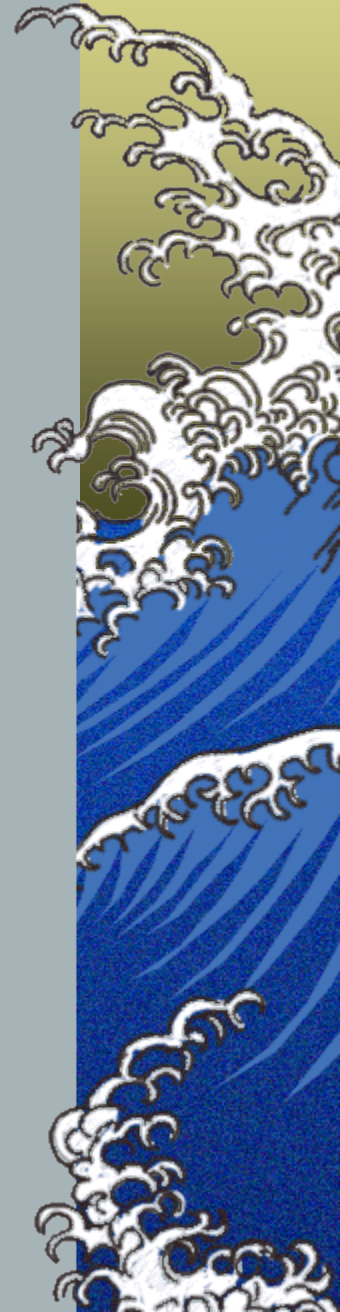
# Diazepam

- *Reduces muscle spasm*
- *Not studied separately in spine surgery, pediatric or adult*



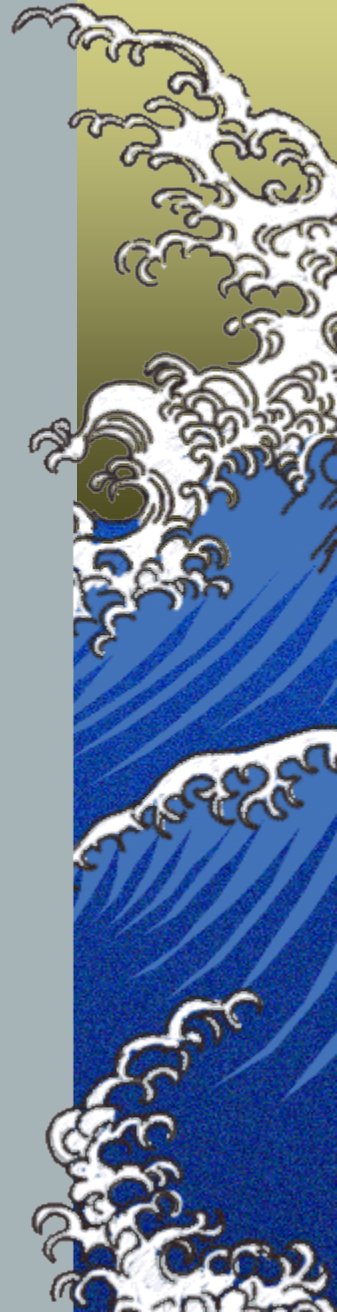
# IV Magnesium

- ▶ *Adult studies (none spine) show decrease pain and opioid consumption*
- ▶ *Meta-analysis reduces opioids and pain scores*
  - ▶ *Albrecht et al. Anaesthesia 2013*
- ▶ *Hypomagnesemia occurs after pediatric spine surgery*
  - ▶ *Chrun et al J Pediatr (Rio J) 2012*



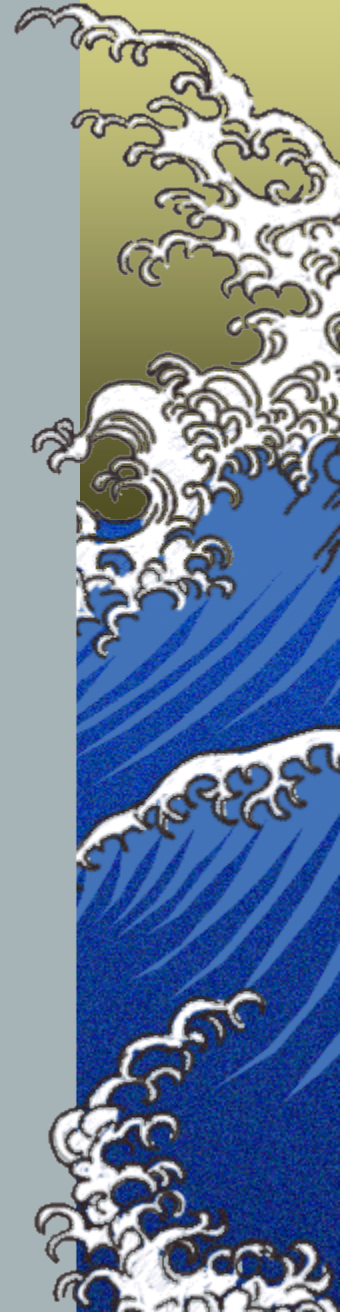
# Gabapentin

- ▶ *Pediatric scoliosis*
- ▶ *Gabapentin versus placebo*
  - ▶ *15 mg / kg pre-op, 5 mg / kg post TID*
- ▶ *Lower pain scores*
- ▶ *Decreased morphine usage*
- ▶ *Did not decrease opioid side effects*
  - ▶ *Rusy et al. Anesth Analg 2010*



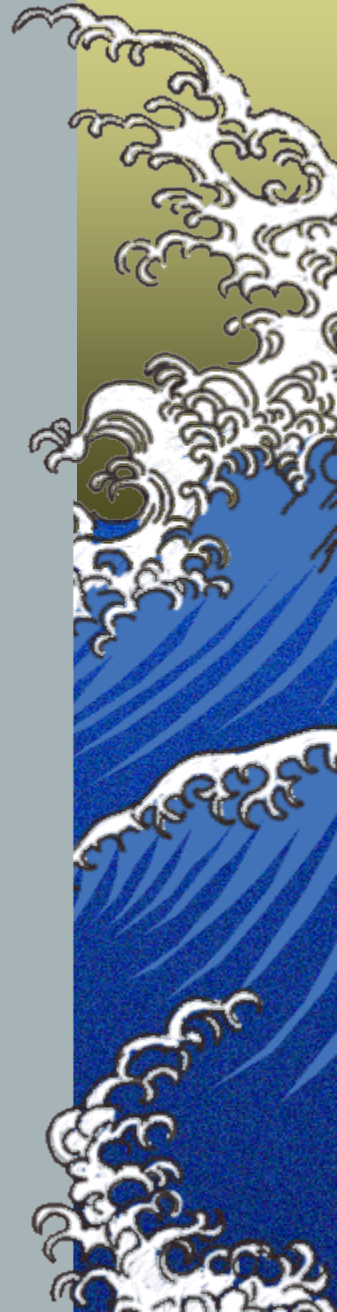
# Jens Voigt's Bike

15 lbs; >\$14,000



# Multimodal therapy

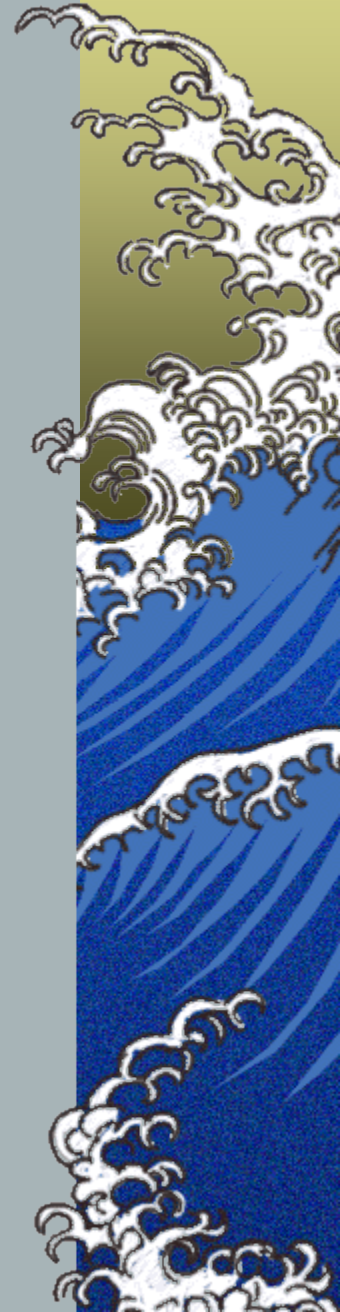
- ▶ *Each addition likely lowers pain scores and opioid use*
- ▶ *Unable to separate effect of the individual from the group*
- ▶ *Not a new concept*



# Multimodal published report

## ▲ *Adult study*

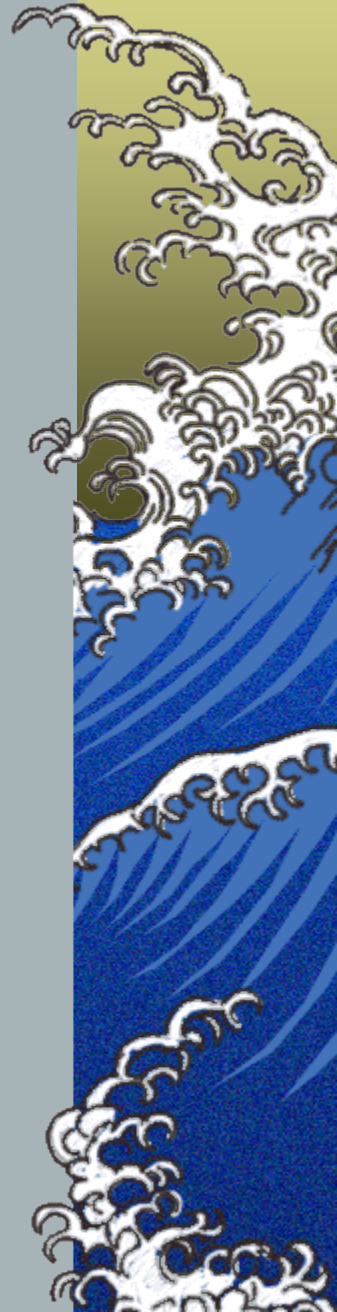
- ▲ *Pre-op: Acetaminophen, celecoxib, gabapentin, and usual opioid*
  - ▲ *Intra-op: Remifentanyl, propofol, dexamethasone, ketamine bolus and gtt, morphine, Epidural bupivacaine, ondansetron*
  - ▲ *Post-op: Acetaminophen, ibuprofen, gabapentin, Epidural bupivacaine and morphine (or) morphine PCA, ondansetron, droperidol, and dexamethasone*
- ## ▲ *Opioid consumption was reduced*
- ▲ *Mathiesen et al. Eur Spine J. 2013*





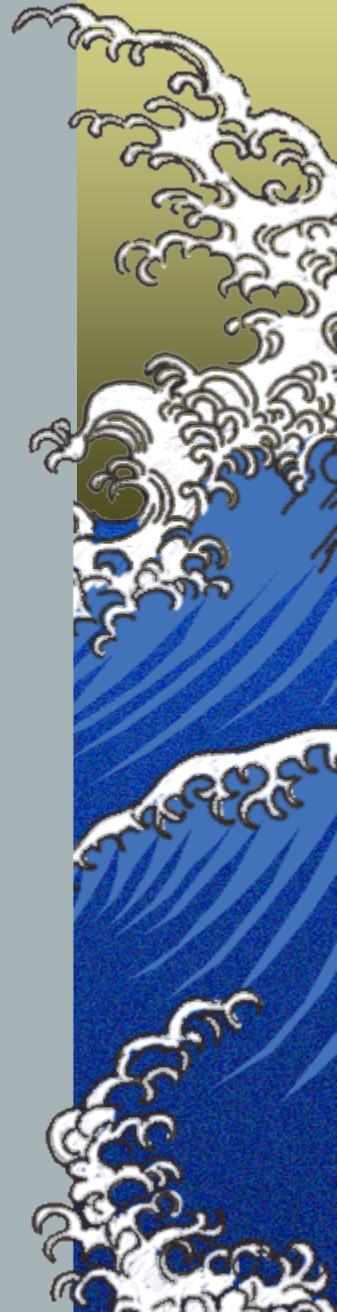
# Multimodal at CHLA

- ▶ *As an example for discussion*
- ▶ *Limited number of anesthesia, surgery, and pain service attendings*
- ▶ *Multiple iterations*
- ▶ *Pain service available 24/7*



# CHLA multimodal

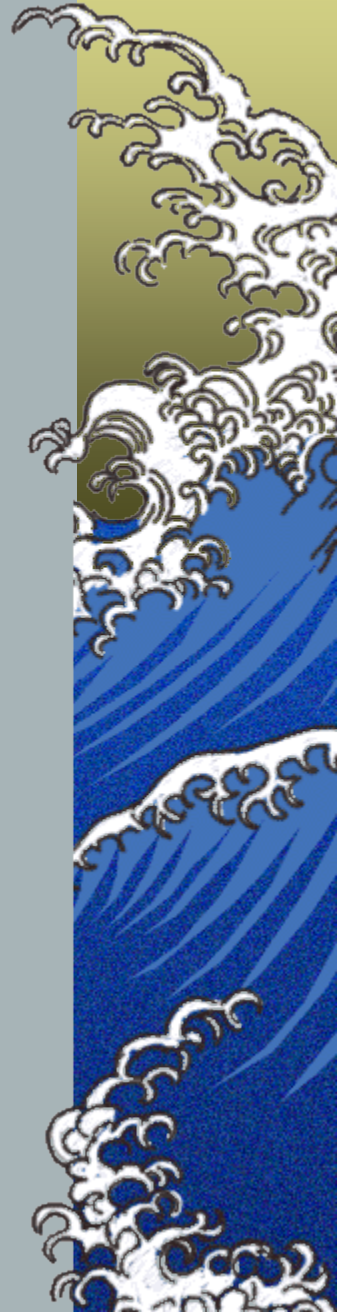
- ▶ *Pre-op: 2 mg midazolam*
- ▶ *Induction: An addition to standard*
  - ▶ *Ketamine 1 mg/kg to max 50 mg*
  - ▶ *Fentanyl 50 to 150 mcg as needed*
  - ▶ *Dexamethasone 0.2 mg/kg to max 10 mg*
- ▶ *Neuromonitoring performed*
  - ▶ *Remifentanil and propofol infusions*



# CHLA multimodal

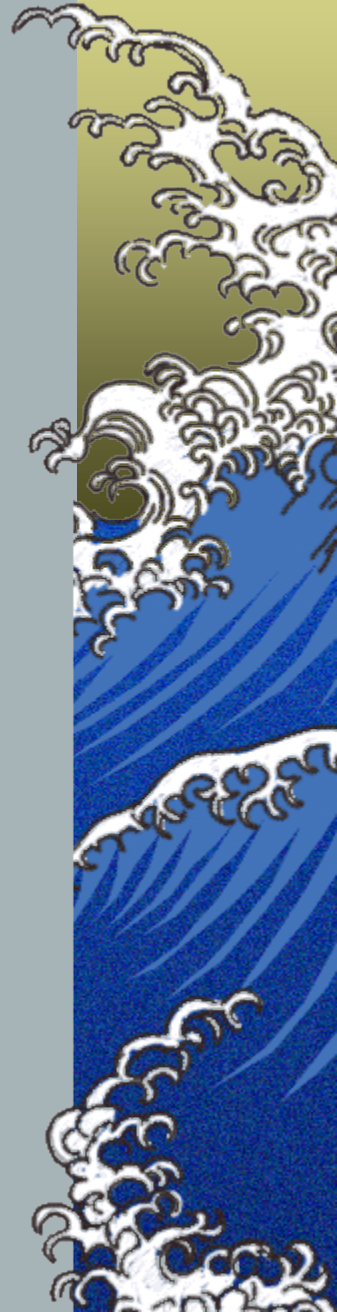
## ▶ *Intra-op:*

- ▶ *Duramorph intrathecal by surgeon early*
- ▶ *Duramorph 5 mcg/kg to max 250 mcg*
- ▶ *Duramorph drawn up by attending*
- ▶ *IV acetaminophen at the end of the case*
- ▶ *After extubation titrate morphine to need*
- ▶ *Transfer to PACU then floor*



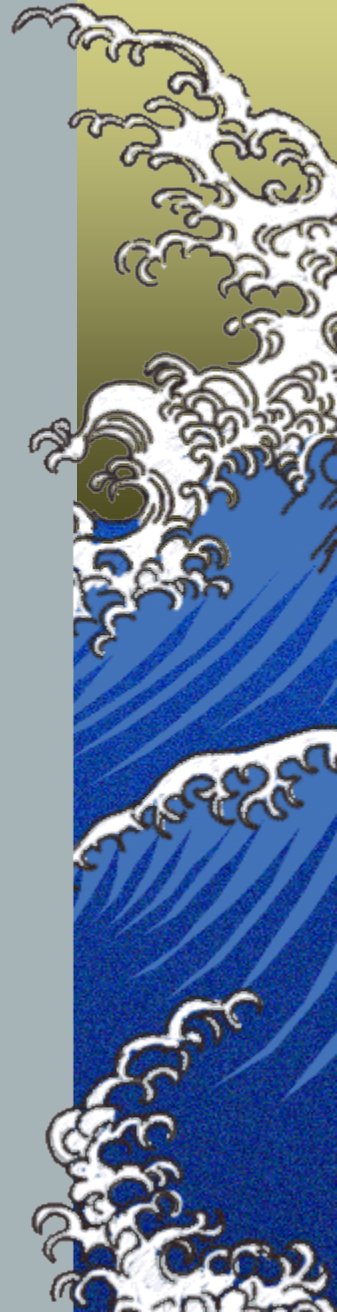
# CHLA multimodal

- ▲ *Post-op day 0:*
  - ▲ *Start morphine PCA immediately*
  - ▲ *No basal rate, bolus based on size*
  - ▲ *Valium scheduled RTC*
  - ▲ *Acetaminophen scheduled RTC*
  - ▲ *Ketorolac scheduled RTC*
    - ▲ *1 surgeon, others start POD 1*
  - ▲ *Start clears and advance as tolerated*



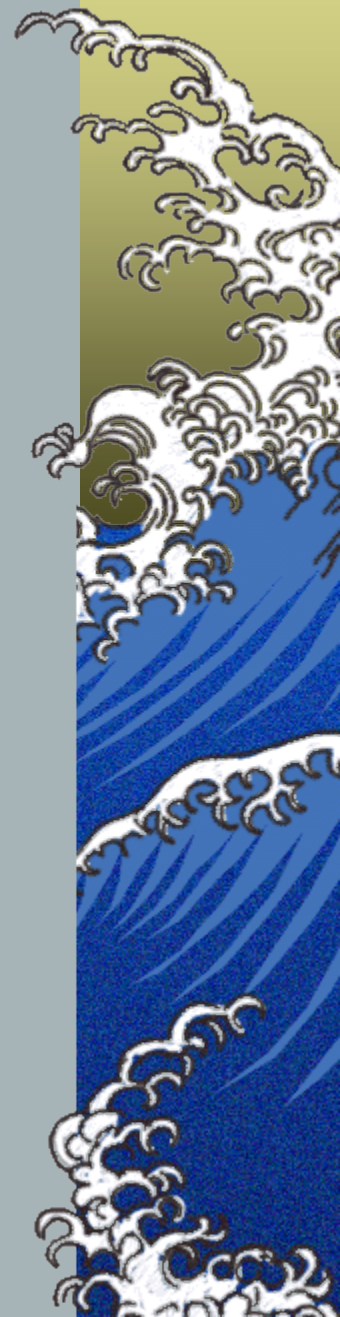
# CHLA multimodal

- ▶ *Post-op day 1:*
  - ▶ *Start ketorolac if not already going*
  - ▶ *Stop morphine PCA*
  - ▶ *Start oxycodone schedule Q4h RTC*
  - ▶ *D/C foley*
  - ▶ *PT/OT consult*
  - ▶ *Out of bed at least 2 times*
- ▶ *Current LOS for AIS under 4 days*



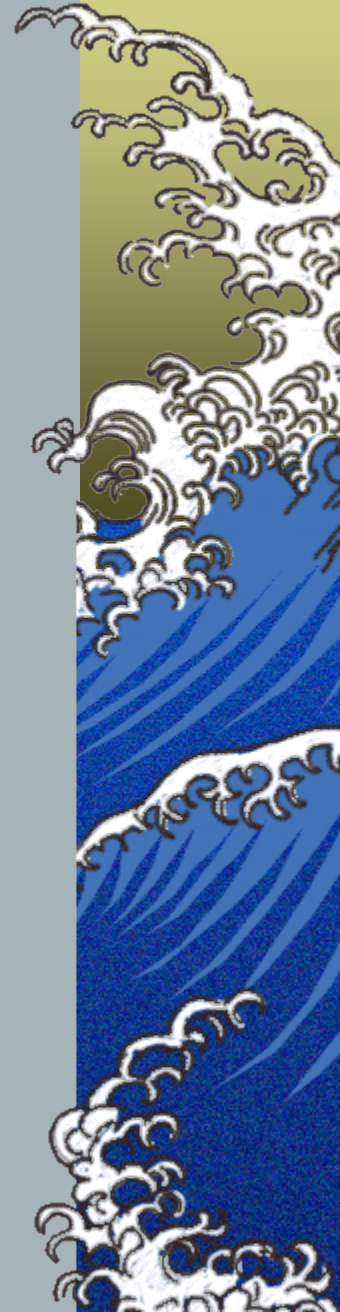
# Multimodal congenital scoliosis

- ▶ *Intrathecal morphine removed at attending discretion*
- ▶ *For older children PCA written as authorized agent controlled analgesia*
- ▶ *For younger children IV morphine infusion is used*
- ▶ *Non-verbal pain scale (FLACC) used*
- ▶ *All other therapy remains the same*

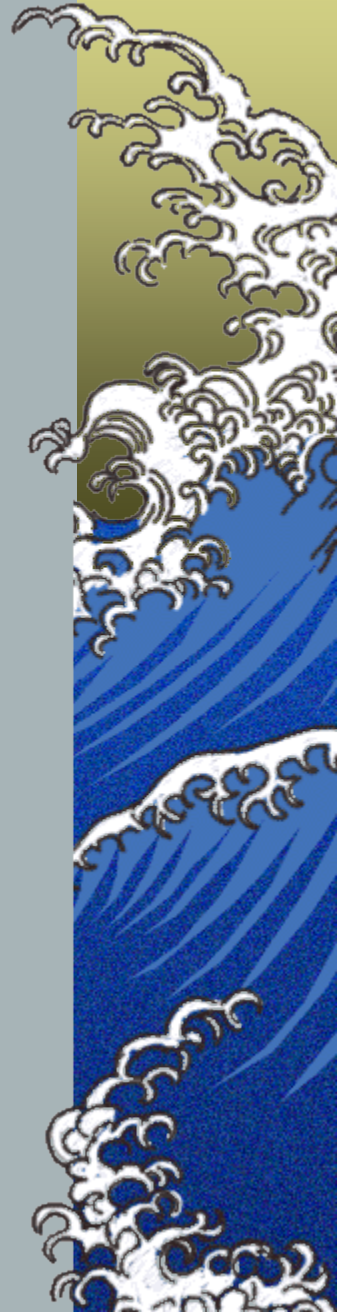


# Customize to your hospital

- ▶ *Intra-op: either IT morphine or IV methadone*
- ▶ *Post-op: either Epidural or IV PCA*
- ▶ *Adjuvants; choose any or all*
  - ▶ *Low risk: Acetaminophen, Diazepam, Dexamethasone*
  - ▶ *Slight risk: Ketorolac, Ketamine, Gabapentin*
  - ▶ *Limited info: Magnesium*



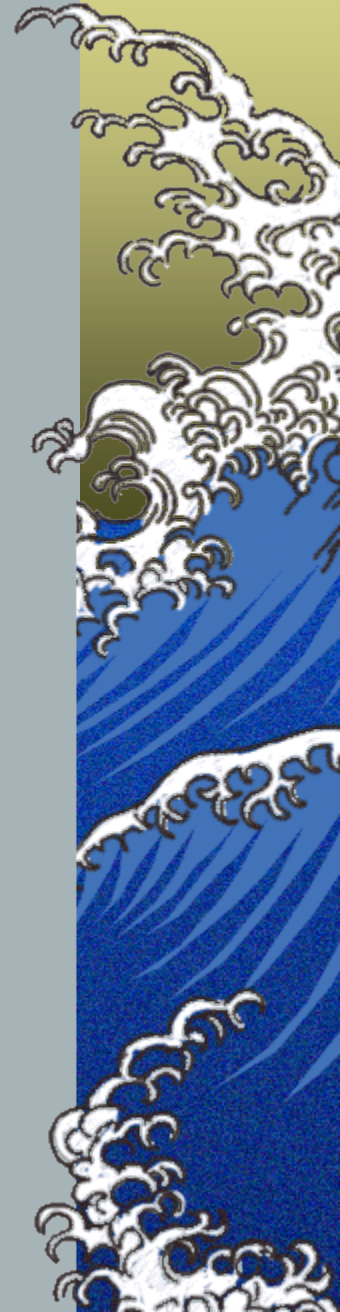
Thank you



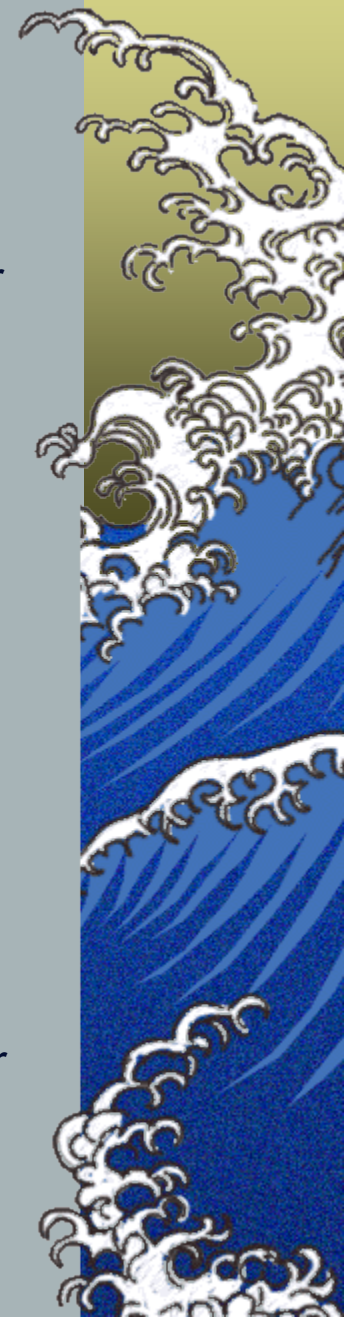


# Bibliography

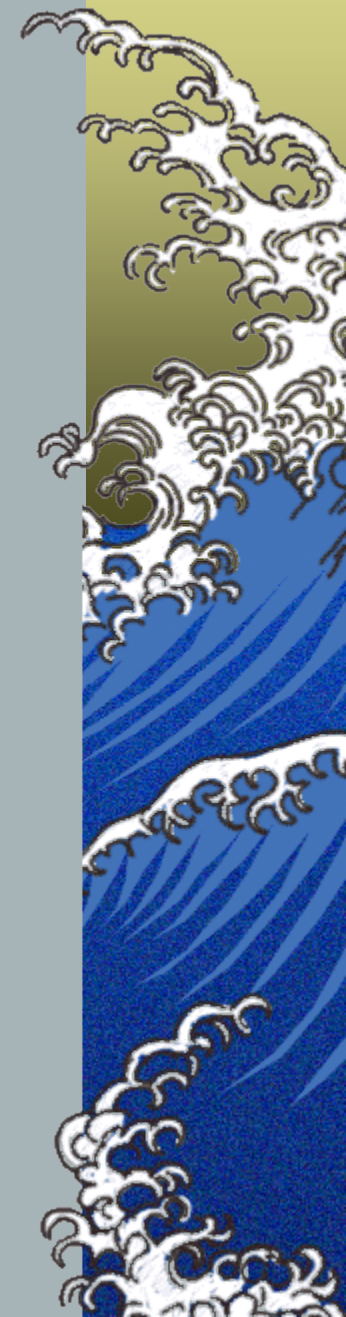
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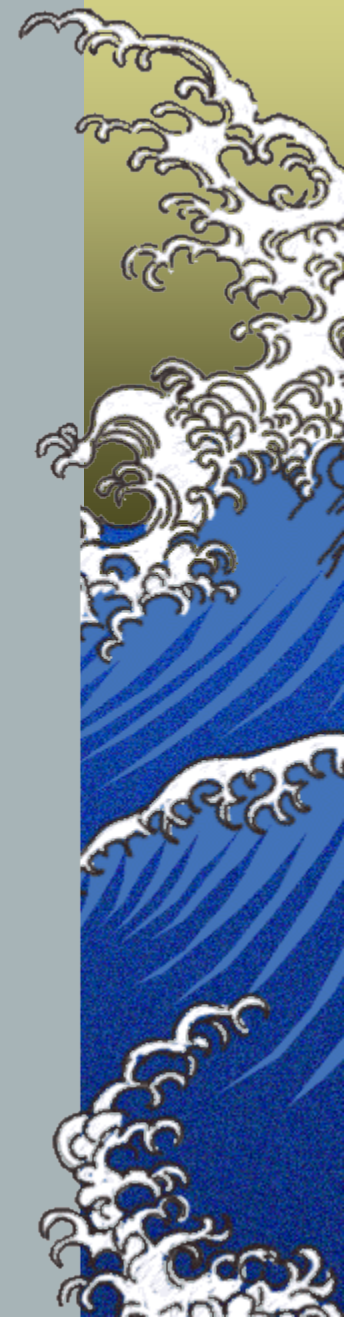
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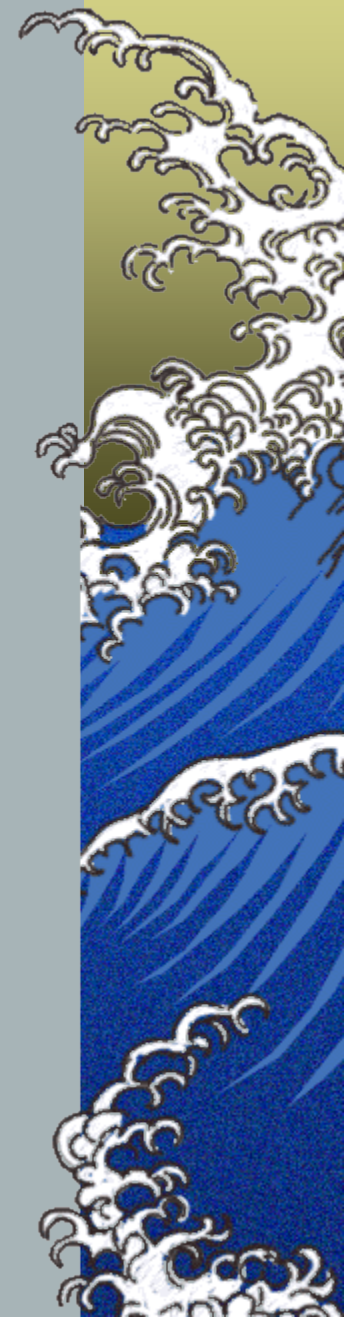
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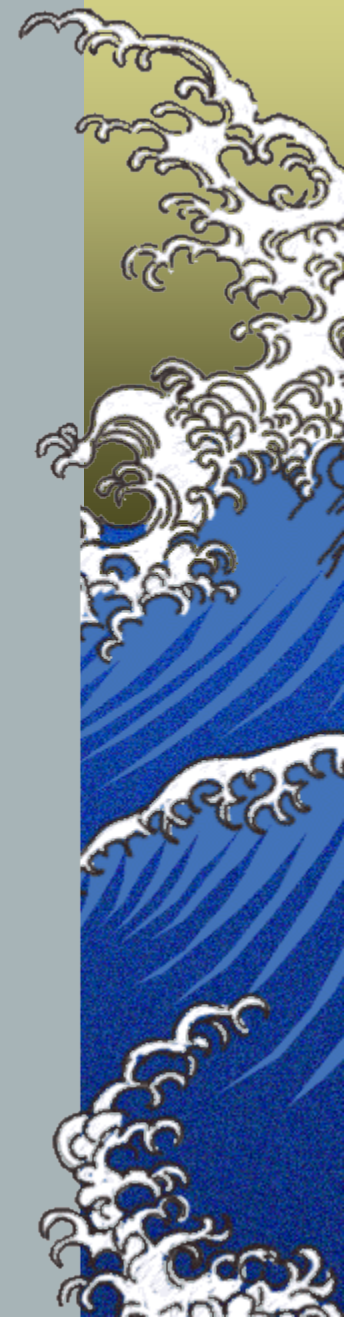
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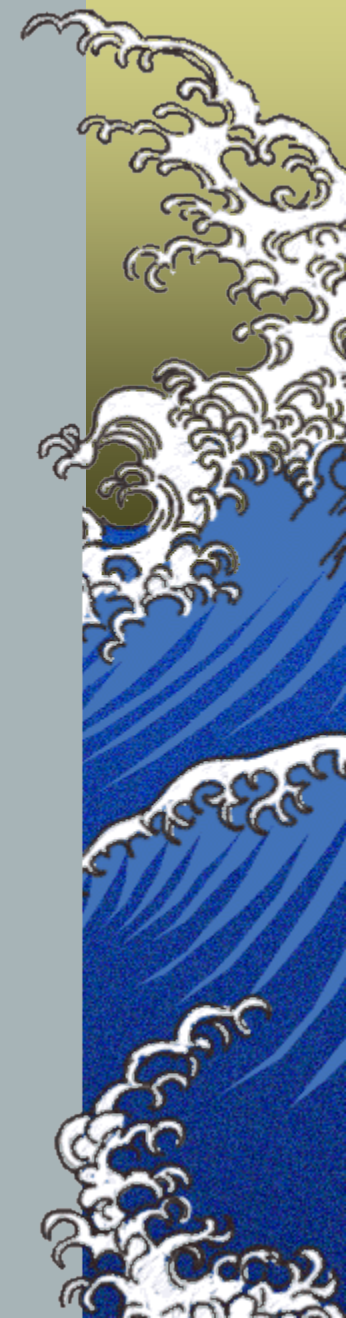
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