Update: Analgesia in Cardiothoracic Surgery

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Disclosure:

- I have no disclosures to report regarding financial incentives or gains from pharmaceutical companies or manufacturers.

Analgesia for CT Surgery

- Introduction/ Background
- Regional Analgesia
  - TEA, PVB, Other
  - Benefits, Risks, Efficacy
- Multimodal Analgesics
  - Tylenol/ NSAIDs
  - Ketamine
  - Anticonvulsants
  - Other

Pain Following CT Surgery

- Procedures in US per year:
  - 200k Thoracotomies
  - 300k-500k CABG
- Acute Pain:
  - Up to 87% mod-severe pain
  - Up to 97% shoulder pain
  - > Pain assoc w/ LIMA and <60YO
  - Assoc Ischemia, hypoxia, ileus, prolonged stay
- Causes:
  - Incisional, rib fx/disloc, saph vein, sternal retract, tubes/drains, brach plex
  - Chronic Pain:
    - 25% CABG
    - 30-60% Post-thor
    - Difficult to treat
    - Unemployment, decr function

Prevalence of Complications after CT Surgery

- High Rate of Cardiac Complications:
  - Mortality = 1.2% (30d)
  - MI = 9%
  - High risk for ischemia (30% p card surg)
  - Arrhythmias (up to 22%)
  - CHF, other

Complications following CT Surgery

- High Rate of Pulmonary Complications:
  - High risk for atelectasis, hypoxemia
  - Pneumonia (up to 30%)/ VAP $40k
  - Ventilator support, other

- High Rate of Other Complications:
  - Delirium (>20%), POCD
  - CVA (up to 4%)
  - Ileus, PONV, Constipation
  - Renal Insufficiency (>5%)
  - Prolonged Hosp Stay
Goals for Analgesia:
- Minimize pain and suffering
- Maximize patient satisfaction
- HCAHPS, ACA, IPPS
- Maximize mobilization, function
- Minimize side effects
  - Constipation, PONV, urinary retention, delirium, pruritis, hypotension
- Decreased Chronic Pain
- Titratable
- < stress resp, sympathectomy

Rationale for Multimodal Analgesia:
- Decrease Morbidity
  - < Cardiac morbidity
  - < Pulmonary morbidity
  - < Resp depression
  - < early extubation
  - < PONV
  - < delirium
  - < pruritus
  - < urinary retention
  - Decrease Costs
  - Decrease ICU stay
  - Length of Stay
  - Decrease complications

Prospect Group

Potential Cardiac Benefits of TEA:
- < Ischemia
  - > coronary blood flow
  - > O2 supply
  - < ST changes, < RWMA’s
  - < lactate, troponin levels post-CABG
  - < Infarction Size

- < LV & RV function
- < Arrhythmias (both atrial and ventricular)
- Avoids >SVR in AVR pts (post-repair)

Potential Pulmonary Benefits of TEA:
- Earlier extubation p CABG
- > FRC, cough, VC, paO2; IS
- Less decrement in postop pulm function (compared to parental opioids)
- < episodes of desat, pneumonia, atelectasis
- > Diaphragm function
- < mortality Thoracotomies 7% to 1-2% past 20 years (? Assoc w/ > TEA use)
### Decreased Mortality and Chronic Pain

- **Mortality**
  - Rodgers, 2000, BMJ; Wu, 2004, RAPM; Wu, 2006
  - 30% decrease in mortality with epidural analgesia in > 9500 pts (Rodgers)
  - Prob. most helpful with high invasiveness and co-morbidities

- **Chronic Pain**
  - Obata, 1999, CJA
  - Intra-op and postop infusions
  - Toradol 15-30 mg qid x 3d
  - Tiipana, 2003, Acta Anaes Scand
  - TEA < PTPS at 6 mos
  - Other studies: inconsistent

### Other Possible Benefits of TEA:

- CNS complications:
  - confusion, delirium, insomnia
- GI complications:
  - ileus, n/v, constipation, malnutrition
- DVT’s, PE’s
- Relevant w/ today’s prophylaxis

### TEA in CT Surgery

- SCA Survey: 7% of anesthesiologists use TEA for cardiac
  - 58% of responders in US
  - Not uncommon in U.K., Canada
  - 40% preinduction, 33% after surgery
- High Prevalence of TEA for Thoracotomies
  - “The Gold Standard”
- TEA vs PVB

### Epidural Hematoma Risk in Cardiac Surgery:

- 2 case reports w/ 1000’s of CPB/central neuraxis tech
  - Rosen, ’04: tpa given in ICU, cath pulled
  - 2nd case, 2004, UK
- Latest Risk w/ Epid:
  - 1:12,000 (1:2100 – 1:68,000), Bracco, 2011
- Traumatic Tap
  - Consider placing epidural day before surgery
  - Consider arterial vs venous blood

### Other TEA Risks:

- Failure: 2-15%
- PDPH: < 1% in older pts
- Hypotension:
  - Up to 40%
  - esp. elderly, other antihypertensives
- Compensated by vasopressin release
- Caution in significant AS/MS
- Urinary Retention:
  - w/ Intrathecal morphine and Lumbar EA
  - Uncommon with Thoracic Epidural Analgesia
- Infection - 0.1-1% (duration, disconnects, etc)

### TEA: Other Considerations

- Discuss periop anticoag (eg Valves)
- Location:
  - T3-4 Sternotomy
  - T6 Thoracotomy
  - Peineuduction placement/ Test Dose
  - Arrow Flex-tip?
  - Limit advancement, 3cm
  - Secure catheters (devices?)
  - Half rate during CPB
- Combine with Opioid or clonidine – synergy
- MSO4 40 ug/ml
- Dilaudid 5-10 ug/ml
- Clonidine 0.5-1.0 ug/ml
- UE numbness common
- LE deficits concerning
- Duration: 72hrs/ CT’s out
**TEA in CABG: Notable Studies**

- **Positive**
  - Scott, 2001: 420 pts, U.K., RCT, DB
  - TEA – BC vs PCA-M
  - Results:
    - < time to extubation
    - < pneumonia (15 vs 29%)
    - < SVT (10 vs 22%)
    - < ARF (2 vs 7%)
    - < Confusion
  - Liu, 2004: Meta-analysis
    - Also, < time to extubation
    - < dysrhythmias

- **Negative**
  - Svircevic, 2011: 694 pts, Netherlands, RCT, not blinded, “healthier pt pops”
  - TEA- BM vs PCA-M x 48hrs
  - Improperly powered for 50% reduction in outcome measures
    - 10-20% effect more realistic (eg POISE, ISIS-2 study)
    - Would need >4200 pts

- TEA for OPCAB (Off-Pump Coronary Bypass)
  - TEA more attractive due to less anticoagulation (1/2 ACT)
  - Similar postop pain scores (Sandekoppam, 2014)
  - Caputo, 2011, 226 pts, RCT
    - TEA-BC vs PCA x 72hrs
    - Results:
      - 40% < arrhythmias
      - < pain, opiates
      - < time to extubation, LOS
      - 15% epid failures, 1 substantial resuscitation

**Dual Epidural Catheters: Ivor-Lewis Esophagectomies**

- **Advantages:**
  - Less hypotension (4%)
  - < risk of cord compression w/ hematoma (ASRA guidelines)
  - Sympath block
    - unlike Intercostal Blocks
  - < stress resp, pain

- **Disadvantages:**
  - Risk of Ptx’s (1:300)
  - ? Spread of LA
  - Lack of opioid synergy
  - ? efficacy comp to TEA

**PVB’s in CT Surgery**

- Advantages:
  - Less hypotension (4%)
  - < risk of cord compression w/ hematoma (ASRA guidelines)
  - Sympath block
    - unlike Intercostal Blocks
  - < stress resp, pain

- Disadvantages:
  - Risk of Ptx’s (1:300)
  - ? Spread of LA
  - Lack of opioid synergy
  - ? efficacy comp to TEA

**Paravertebral vs Thoracic Epidural:**

- TEA with local anesthetic plus opioid better analgesia than either with LA alone
- Both improved analgesia comp to intercostal or opiates/PCA
- Equivalent Analgesia: PVB and TEA (LA alone)
- < Pulm complications comp to PCA (both PVB and TEA)
  - SaO2, FRC, FVC, PEF, cough (Both)
  - > Inc Spirometry with TEA (LA + opioid)
- Both < Persistent Postop Pain
- Andreac, 2013, Meta-analysis
  - Inconsistent finding

**PVB vs TEA:**

- **Side Effects/Complications**
  - Side Effects:
    - < Hypotension w/ TEA (LA+ opioid) and PVB group
    - comp to TEA (LA alone)
    - < urinary retention (PVB comp to TEA-LA/opioid)
    - < pruritis and nausea (PVB comp to TEA-LA/opioid)
  - Similar anticoagulation concerns per ASRA
  - Pneumothorax 1:300 PVB (< Concern in thoracotomy)
  - LATS: 1 case report of death in C-PVB pt (Fagenholz, 2012)
  - Beware of repeated boluses
  - Higher plasma levels with Intercostal/paravertebral

Joshi 2008; Scarci, 2010; Joshi, 2011; Pintaric 2011; and Grider, 2012
**C-PVB for Cardiac Surgery**

- Lat Thoracotomy => pain
- Placement: T6
- C-PVB preferred over TEA:
  - Only need unilateral anesthesia
  - Anticoagulation risk
  - < Hemodynamic changes
  - Ganapathy, 1999
- C-PVB very effective for analgesia
  - Case Report
  - Min postop opiates
  - Discharged after 58 hrs

**Reg Anes for VATS**

- Compared to thoracotomy:
- < acute pain (< incision, < rib trauma, etc)
- < referred shoulder pain
- < chronic pain (although still up to 40%)
- TEA:
  - Not necessary usually
  - Consider if > prob of open or Opiate Tolerant pt
- PVB/C-PVB:
  - Freq choice in U.K., other
  - < opiates, < pain
  - ICB/ C-ICB: may be helpful (3 studies)
  - Intrapleural Caths: may be helpful (2 studies)

**Referred Shoulder Pain**

- 60-97% incidence with thoracotomy
- Probably mediated via phrenic nerve
- Helpful:
  - TEA not beneficial
  - Both Acetaminophen + Ketorolac
  - Consider surgical infiltration in periphrenic fat pad (3 studies)
  - Consider Intercalene Block
  - Not helpful:
    - Suprascapular Block
    - (Direct) phrenic block not recommended

**Intrathecal Morphine and/or Clonidine**

- Positive:
  - Opiate sparing
  - Significant, prolonged analgesia
  - Min epid hematoma risk
  - Lema, 2003 and 2006, cardiac surgery
  - M: 4ug/kg
  - C: 1.0ug/kg
  - < extubation times
  - > analgesia
- Negative:
  - meta-analysis: no diff in outcome, (Liu, ’04)
  - Stress-response: limited if any effect
  - Time to extubation: most RCT’s no benefit (even at low dose)
  - Pruritis, N/V common
  - High Clon: < HR, BP

**Intercostal Blocks**

- Most frequent Reg Anesthetic worldwide for thoracotomies
- Meierhenrich, 2011
- ICB + PCA-M < effectiveness comp to TEA
  - > pain, < resp function
- ICB does not block sympathetics
- Potential role in VATS (Kaplowitz, 2012)
- Especially C-ICB
- Ptx Risk: 0.1-0.4%

**Intrapleural Caths**

- Advantages:
  - < hypotension, < anticoag concerns
- Technique:
  - Blind vs Intraop
  - LOR, air
  - Cath 6-8 cm post
- Efficacy
  - MIDCAB & VATS: some evidence exists
  - Not recommended for thoracotomy
- Complications:
  - < 1% ptx
  - LA Toxicity
  - phrenic blk
Wound Catheters

- **Technique:**
  - Usually 2 soaker caths, 12 cm
  - Ropiv or Bupiv 0.25-0.5%
  - 4 ml/hr x 2-3 days

- **Efficacy:**
  - < pain, opiates
  - < time to ambulation, LOS
  - Inconsistent
  - (Agarwal 2013 no benefit)

- **Complications:**
  - 9% sternal infection (Agarwal) required cessation of study
  - 75% of infections - deep


Cryoablation

- **Goal:** < PTPS
- > Chronic neuralgia due to cryo itself
- 60-70 deg, 14 gu probe under direct vision
- 1 min freeze x 2 each level x 3 levels
- Adds 15-30 min to case

Mustola 2011

Acetaminophen

- **Mechanism:**
  - ? COX-3 Inhibitor
  - Centrally acting

- **Advantages:**
  - < pain, opiates, PONV
  - No sedation, constipation
  - No bleeding, renal concerns

- **Disadvantages:**
  - Cost: > $40/d now
  - 100 ml vial over 15 min

- **IV Formulation:**
  - Europe: 2002, Paracetamol
  - US: 2010, Ofirmev
  - > efficacy > plasma/effect site concentrations

- **Transferable Evidence:**
  - NNT 3.8 for analgesia
  - < PONV, > pt satisfaction

- **Efficacy in CT Surgery:**
  - < ICU, LOS (42pts)
  - < shoulder pain

Acetaminophen: 2002, Paracetamol; 2010, Ofirmev

Nonselective NSAIDs

- **Mechanism:**
  - Inhibit cyclooxygenase, < PGs (esp PGE2), < inflamm

- **Advantages:**
  - < PONV
  - No sedation, delirium
  - No constipation

- **Disadvantages:**
  - Bleeding, renal insuff, gastritis/ ulcers
  - FDA Black Box Warning

- **Transferable Evidence:**
  - < pain (rest, movement)
  - < opiates (20-50%)
  - < PONV; > pt sat
  - > bleeding (2.4 vs 0.4%)

Mustola 2011

Nonselective NSAIDs:

- **Efficacy in CT Surgery**

COX-2 Inhibitors

- **Mechanism:**
  - Inhibits COX-2 (< inflamm, pain) primarily

- **Advantages:**
  - Maintains COX-1 enzyme (gastric mucosa); 50% < risk
  - No bleeding, sedation, constipation risk; < PONV

- **Disadvantages:**
  - > thrombotic risk
  - Same > renal risk as nonselect

- **Celecoxib 100-200mg bid**

- **Transferable Evidence:**
  - NNT: 2.1-3.5 < pain
  - (same as nonselect NSAIDs)
  - < PONV, opiates

- **Efficacy in Thoracic Surgery:**
  - < pain (rest, cough, mobilization)
  - > pat satisfaction
  - No diff in troponin levels
  - (contraindicated in cardiac surgery)

Sun 2008, Senard 2010

COX-2 Inhibitors:
**Ketamine in CT Surgery:**
- **Mechanism:**
  - NMDA antagonist primarily
- **Advantages:**
  - Abolishes OIH; windup
  - < pain, opiates (25-50%)
  - Min sedation, nausea
  - > pat satisfaction
- **Disadvantages:**
  - Subanes doses: very few
  - Anes doses: psychomimetic effects, > HR / BP, > saliva possible
- **Dosing:**
  - Infusion: 1-2 ug/kg/min
  - PCA-M/K: 1:1 ratio ideal

**Ketamine: Efficacy in Thoracotomy**
- < pain
- < opiates (using PCA 1:1)
- No psychomimetic effects

**Gabapentin, Pregabalin in CT Surgery**
- **Mechanism:**
  - Activates descending inhibitory pathway via Ca chan (> NE, < EAA)
  - Pregab 6x infinity
- **Advantages:**
  - Helpful w/ opiate tol pts
  - Anxiolysis
- **Disadvantages:**
  - Sedation (> doses/elderly)
  - Dizziness (same)
- **Dosing:**
  - GPN:
    - Preop: 600-1200mg
    - Postop: 300mg tid
  - Pregabalin:
    - Preop: 150-300mg
    - Postop: 75mg bid

**Clinical Results for Gabapentin/Pregabalin**
- **Transferable Evidence:**
  - < pain
  - < opiates/ side effects
  - < OIH, anxiety
  - > pt satisfaction
  - < chronic pain (esp pregab)
- **Efficacy in CT Surgery:**
  - Cardiac (OPCAB):
    - Preop only
  - Thoracic: preop only with postop TEA

**Alpha_2 Agonists in CT Surgery:**
- **Mechanism:**
  - Activation of Desc inhibitory pathway
  - > NE, GABA, serotonin; < EAA
- **Advantages:**
  - < stress response (< sympath)
  - < opiate requirement, side effects
  - < OIH, anxiety
- **Disadvantages:**
  - < HR, BP (high doses, elderly, other antihypertensives, < vol)
  - Expensive; Dex qtt required
- **Medications:**
  - Clonidine: useful as TEA adjunct
  - Dexmedetomidine:
    - 7 x affinity for receptor
    - 0.25-0.6ug/kg/hr

**Dexmedetomidine in CT Surgery**
- **Cardiac:**
  - < mortality (in-house, 30d, and 1 yr) retrospective data
  - < delirium, pain, opiates
  - > bradycardia, hypotension
- **Thoracic:**
  - In combination with TEA...
  - < supplemental opiates
  - Not recommend due to lack of data
Lidocaine in CT Surgery:

- **Mechanism:**
  - Membrane stabilizer
  - Na channel blockade
  - < dorsal horn activity

- **Advantages:**
  - < pain, opiates (esp lap)
  - < ileus (esp colon surg)

- **Disadvantages:**
  - Requires infusion
  - Requires ICU monitoring due to potentially hi levels

- **Dosing:**
  - 1-2mg/min
  - Some as high as 4mg/min

Efficacy in CT Surgery:

- Meta-Analysis, 2011
- 29 RCTs, incl CT surgery
- < pain, opiates, ileus, N/V

Cardiac:

- Evidence for cerebral and cardiac protection (CPB)
- (1) neg study for analgesia

Thoracic:

- < pain
- < opiates

Music in CT Analgesia:

- Alternative technique, low cost, no risk
- < anxiety, catecholamines
- < ICU noise
- ? Combine with positive imagery

Ozer, 2013.
- 87 Cardiac surgery patients
- < pain, > O₂ saturation after 30min music

Summary

- Reviewed The Rationale and the Goals for Analgesia in CT patients
- Reviewed the Evidence and Efficacy for Regional Anesthesia
- Multimodal Analgesia is Critical to Comprehensive Recovery
- Effective Acute Pain Control probably more impt than method

Select References:

- www.postoppain.org (Prospect Group)