

## Continuous Peripheral Nerve Catheters – What is the Current Thinking?

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### CPNB Outline:

- Problem of Pain
- Risks and Benefits
- Supplies, Equipment, Space
- Techniques
- Limitations, Billing
- Types of CPNBs:
  - Upper Extremity
  - Torso: PVB, TAP
  - Lower Extremity

### Problem of Trauma and Pain:

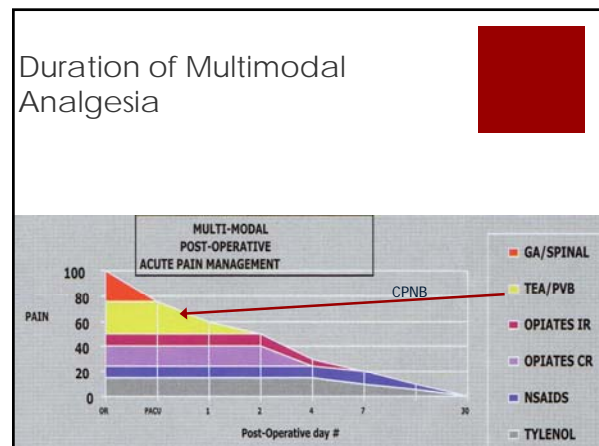
- American Intensive Care Units:
  - 74% mod-sev pain (Whipple)
  - 35% received analgesics
  - <20% given analgesics for procedures
- Nashville Ortho Surgicenter:
  - Mod-Severe Pain Using Regional Anesthesia
  - 3% DOS; 27% POD1; 20% POD2
- Acute to Chronic Pain:
  - Amputation > 50%
  - Thoracotomy 20-50%
  - Trauma 20-50%
- Resulting in:
  - Increased Cost
  - Increased Resources
  - Increased Mortality

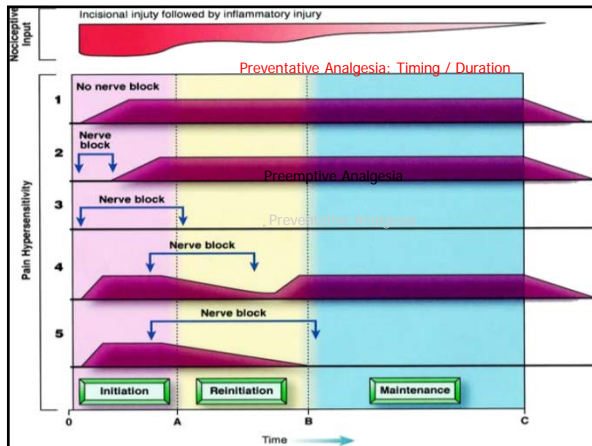
### Multimodal < Stress Response

- Correlates w/ severity of trauma (Seekamp)
- Pain directly accentuates stress response
- Stress response linked to morbidity
- MMA < stress response
- SNS activation:
  - incr NE, epi
  - leading to > HR, BP, ischemia
- Endocrine response:
  - < thyroid, > aldosterone (> renin, angiotensin, aldosterone) w/ > water and sodium
- Pituitary changes:
  - > pit w/ > ACTH, GH, vasopressin
- Metabolism changes:
  - > glucagon, < insulin leading to lipolysis, hyperglycemia, prot catabolism, wound inf
- Heme changes:
  - Hypercoag (< AT III)
- Immune changes:
  - Cytokine prod, IL1, IL6, TNF alpha, leukocyte release (> inflam, MODS)

### Risk Factors for Persistent Postsurgical Pain

NB: Fear = strongest intensifier of pain. Providers can affect postop pain, fear, expectations.





### CPNB Complications

- Common:**
  - Leaking:
    - 17-50 % incidence
    - Adv > 2cm
    - Cyano-acrylate glue
    - Dermabond
    - Surgiseal
  - Dislodgement 4%
  - Disconnects
    - 1% incidence
    - Tagaderm over connector
  - Skin irritation
    - (mastisol/tagaderm)
- Rare:**
  - Entanglement/ Cath breakage/ Diff removal
  - Hematoma:
    - Rare, even with lovenox
    - Superficial CPNBs with DVT prophylaxis is acceptable
    - Buckenmaier, 2006, BJA.

### CPNB Complications- Poor Analgesia/Failure

- Risk Factors:**
  - Inexperienced/trained providers
  - Opiate Tolerant patients
- Incidence:**
  - Malchow Series 1164 CPNBs
  - 85% "very good-Exc" analgesia
  - 11% "fair-good" analgesia
  - 4% failure
- Ensuring success:**
  - Experience/ Training
  - Dosing thru cath
  - Color Doppler
  - Visualization of catheter
  - Min cath depth (<3cm?)
  - Out of Plane Technique?...

### CPNBs- Infectious Complications

- Studies:**
  - Capdevila, 2005. 1416 pts;
  - Borgeat, 700 C-ISB;
  - Malchow, unpublished data of 1164 CPNBs
  - Wiegel 2007; Aveline 2011
- Findings:**
  - Colonization: 10-28.7%
  - Local inflammation: 3%
  - Superficial: 0.7-2% (requiring antibiotics)
  - Deep: 0.07-0.17% psoas abscess (recent nec fasciitis)
  - RFs: *duration > 2d, DM*, (steroids), ICU, male, low socioeconomic, ? Abx
  - Tunneling: Doubtful benefit (altho < dislodgement)
- Nonstim vs stimulating cathes:**
  - Stim cathes may present with deep infection (Lai/Malchow, 2011)
  - Fever and elevated WBC late findings
  - Don't rely on surgeons to evaluate pts with CPNB (nec fasciitis)

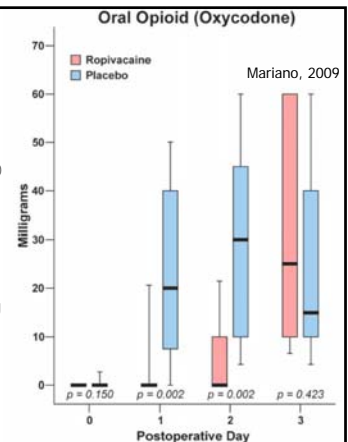
- Capdevila, 2005, 1416 CPNBs
  - 0.21% rate, all resolved within 10 weeks
- Borgeat, 2003, 700 C-ISBs. Rate of PONS:
  - 8% at POD10
  - 2.4% at 1mo
  - 0.3% at 3mos
  - 0.2% motor/sens deficits which resolved w/ 6mos
- Malchow, 1164 consecutive Home CPNBs (unpublished):
  - 3% residual sensory deficits 72hrs after cessation
  - 0.2% residual motor deficits 72hrs after cessation
  - Most resolved within 3-6 mos
- Wiegel, 2007, 1398 nerve stim CPNBs
  - 1 pt (0.07%) permanent FNB injury (retroperitoneal hematoma in C-FNB case)

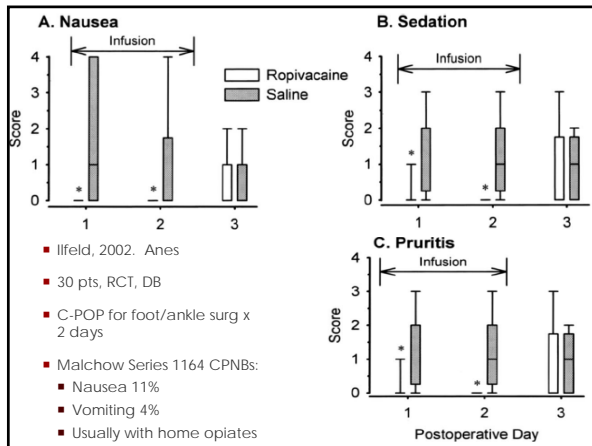
### CPNBs – Neurologic Complications

- Single Shot vs CPNB:
  - No difference in PONS rate
- USG vs n.stim technique
  - No difference in PONS rate

### CPNB advantages compared to systemic opiates

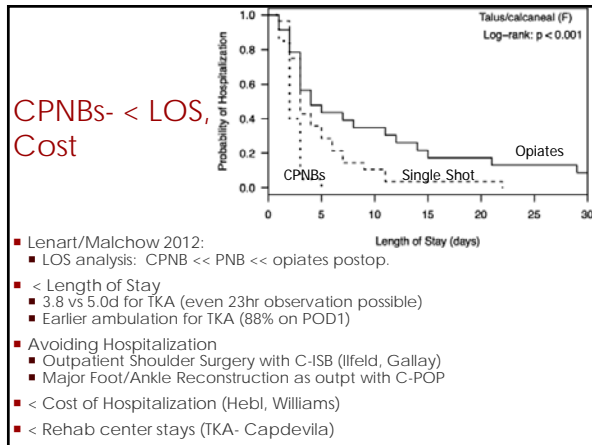
- < Opiates
  - C-ISB for shoulders (Mariano)
  - Critical for OSA/MO pts
- < Sedation
- < Postop Cognitive Dysfunction
- < Respiratory Depression (eg MO/ OSA pts)
- < PONV
- OIH/ Tolerance
- < Constipation





### CPNB advantages compared to Epidurals

- Ability to ambulate
- No urinary retention
- No pruritis (epidural opiates)
- < Hypotension
- Min concern with anticoagulation (excluding PVB, LPB cath) with extensive military use
- Capdevila, 1999. 56 TKA pts
  - C-FNB vs LEC vs PCA-M
  - Both RA grps >> analgesia, ROM
  - C-FNB << side effects



### CPNBs – Improved Quality of Life

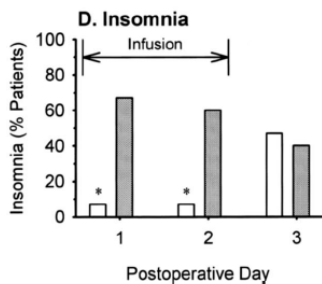
- Ilfeld Series of Studies
  - Home C-POP for foot/ankle surg, 2002, 2003
  - Home C-PVB for mastectomy, 2014
  - < pain, opiates and SEs
- Wu. > Quality of life with > function, mental health, sleep, cognition

**TABLE 3. Brief Pain Inventory During the Perineural Infusion**

POD	I		P
	Ropivacaine	Placebo	
<b>Pain (0-10 NRS)</b>			
Worst	5 (3-6)	7 (5-8)	0.046
Average	2 (0-3)	4 (1-5)	0.021
Least	0 (0-2)	2 (0-3)	0.053
Current	1 (0-4)	4 (0-5)	0.050
Pain subscale total (0-40)	9 (4-13)	16 (7-21)	0.021
<b>Relief provided by analgesics (%)</b>			
	90 (60-100)	50 (30-100)	0.060
<b>Interference with (0-10; 0, none)</b>			
General activity	1 (0-5)	6 (0-8)	0.052
Mood	0 (0-2)	3 (0-6)	0.038
Walking	0 (0-2)	3 (0-5)	0.046
Work (inside/outside of home)	0 (0-4)	5 (0-8)	0.017
Relationships	0 (0-1)	3 (0-6)	0.017
Sleep	0 (0-2)	3 (0-8)	0.034
Enjoyment of life	0 (0-5)	5 (0-8)	0.049
Interference subscale total (0-70)	3 (0-24)	33 (0-44)	0.035
Brief Pain Inventory total (0-120)	14 (4-37)	57 (8-77)	0.012

### CPNBs- Improved Sleep

- Ilfeld, 2002, Anes. X 2
  - Study 1: C-POP for foot / ankle surg
  - Study 2: C-ICB for Upper extremity surgery
  - Placebo 10 x insomnia rate and sleep disturbances in both studies
- Mariano, similar findings for C-ISB for shoulder surg
- Esp important in OSA patients



### CPNBs – Improved Patient Satisfaction

- Very high. Huge PR impact.
- Most patients thrilled to have CPNB available.
- 90% desired same pain mgmt next time (Rawal, 2002)
- C-ISB vs SS/opiates after shoulder surg.
  - Borgeat, 2000. C-ISB vs IV-PCA
    - > pt satisfaction in C-ISB group (9.7 vs 7.5)
  - Mariano, 2009. C-ISB vs SS/opiates
    - > pt satisfaction in C-ISB group (10 vs 7)

### Improved Post-Op Analgesia and Rehabilitation

- 603 pts, meta-analysis
- < pain with CPNB comp to opiates
  - at 24, 48, 72hrs
  - at rest and activity
- Minimize nursing requirement
- > ROM and < quad spasm in TKA

Richman, 2006, A&A:

Postoperative time	catheter	opioid
24 hours	(1.4-2.0)	(3.4-4.0)
48 hours	(0.9-1.3)	(2.2-2.6)
72 hours	(1.3-1.7)	(2.5-3.3)

### C-PVBs Decrease Pulmonary Complications

- C-PVB T3-8 in Mult Rib Fx (15)
- 2-3cm in space (50% difficulty)
- B0.25% at 0.1-0.2ml/kg/hr
- 20% contralat sprd; some epid spread.
- < VAS, RR
- > SaO2, FRC, PEF, cough
- Joshi, 2011 and Grider, 2012 C-PVB in Thoracotomy

Karmakar, Chest, 2003

Time	catheter	opioid
Pre	~1.2	~1.2
Post	~1.8	~1.5
Day-1	~1.8	~1.5
Day-4	~1.8	~1.5

### C-PVB May Improve Survival

- Exadaktylos, Anes, 2006. 129 pts Breast CA
  - 94% CA-free in C-PVB grp vs 77% in opiate grp at 3 yrs
  - Mechanism:
    - Stress resp < Natural Killer cell fxn
    - opiates < cellular/humoral immune fxn (Gupta, 2002)
- Deegan, Yeager, 2010
  - Periop cytokines x 10
  - 32 Breast CA patients
  - Propofol/ PVB vs Seva/opiates
  - < IL 1B, MMP3, MMP9
  - > IL10 (enhances NK cell act)
  - Favorable immunologic changes

### CPNBs: Decreasing Chronic Pain

- Borghgi, 2010, Italy
  - 71 mainly CA, LE pts, prospective, obs, cohort controls
  - C-SCI + C-FNB periop x 30d!
  - Ropiv 0.5% @ 5ml/hr; refilled Home Pumps
  - Nsaid, tramadol, OC prn
- Patients instructed only to remove catheters if no PLP or phantom sensations
- No PLP at 1yr pts who completed protocol

Also, Becotte, 2008, CJA.

### CPNB- Block Room

- Critical for CPNBs:
  - > Success
  - < Complications
  - > Patient Safety
  - Privacy, Monitors
- IV Premed
  - Anxiolysis
  - Our Std: V<sub>2</sub>/K<sub>10</sub>
- Emergency
  - Intralipid, propofol, sux
  - Airway, suction
- Supplies:
  - Cabinets, Carts, lockable
  - Needles, Syringes, Meds
- Challenges:
  - Space
  - Personnel (pre, during, post)

### CPNB- Sterile Procedure

- Probe Covers:
  - Sterile pouch required unlike single shot
  - Various products avail
  - Gel inside/outside sheath (x Safersonic)
- Sterile drapes, gloves
- Chlorhexidine prep
- Mask, hat

### Continuous PNB Needle/ Catheter Systems

- Catheter systems:
  - Non-stimulating caths
  - Stimulating caths
    - More difficult to place
- Morin, 2010, RAPM. Review
  - Suggestive of benefit with Stim caths...
    - C-ISB (< pain)
    - C-Pop, C-FNB (< onset time)
- Catheter:
  - multi vs single orifice
  - No less 20 gu

### CPNBs – USG and Cath Depth

- Ultrasound Guided:
  - < procedure time
  - ? > success
  - Primary benefit (< LATS and pneumo risk)
  - Helpful in fractures and amputations
  - Min help with C-PVB and C-SCI
  - Confirmation:
    - 3-5ml LA, saline, or D5W, agitated saline (+/- color)
    - Visualization of catheter
    - Extra providers needed
- Catheter Depth:
  - 1-5 cm in neural sheath (success vs dislodgement)
  - Ilfeld, 2011 Min difference. (Similar study at Vandy)

### Probe, Needle, Nerve Orientation Options

- 1<sup>st</sup> Choice:
  - Probe: Short Axis
  - Needle: In-Plane (most common for RA)
- 2<sup>nd</sup> Choice:
  - Probe: Short Axis
  - Needle: Out of Plane
  - Ideal for CPNB but difficult in some situations (C-POP)
- 3<sup>rd</sup> choice:
  - Probe: Long Axis
  - Needle: In-plane (Vasc access)

### Color Doppler

- Helpful for identification of Artery/Vein in area
- Artery- pulsatile, noncompressible
- Vein- larger, compressible
- Catheter confirmation agitated saline/LA

### CPNB Pumps

- Elastomeric/Spring loaded Pumps
  - On-Q: Accufusor; Baxter
  - Select-a-Flow 2-14ml/hr
  - On-Demand 5ml/dose available
  - Both Select-a-flow and On-Demand
  - Easy, disposable, no alarms
  - 110-130% flow rate 1<sup>st</sup> 8hrs
  - No refill of pump
- Electronic (batteries)
  - Ambit (Stryker)
  - Programmable, non-disposable
  - Higher volumes
  - More complex for patients
- Electronic "epidural" pumps for inpts
  - Pharmacopeia, chap 797, ISO 5.
  - Min risk level; clean air hood; extensive requirements

### CPNBs Solutions, Rates

- Local Anesthetics
  - Bupivacaine
    - 0.125%
    - mass (dose) prob more significant
  - Ropivacaine
    - 0.2% (< potency)
    - Expensive (\$8 vs \$110)
  - Reduce for severe hepatorenal dz
  - No adjuncts useful
  - Serum levels 0.5-1.8ug/ml
- Rates:
  - PCA setting ideal comp to set basal rate
    - < LA dose, > pump duration, > pt satisfaction
  - 2-14 ml/hr
  - PCA setting: 2-5 ml/30-60min
  - Multiple catheters:
    - Ex: Fem/Sci
    - Max:
      - 20ml/h total for both
      - 10ml/hr each frequent
  - Bupivacaine max 0.5mg/kg/hr

### Patient Education

- Reasonable expectations
- Prevent Disconnects, Leaking
- Patient Handout, Brochure
- Adjusting pump (analgesia w/o motor block)
- Protecting limb, Avoiding falls (slings, crutches, knee immobilizers)
- Exchange Phone #s
- Clean and Dry
- Observe for signs of infections
- Plan for Breakthrough Pain
- Plan for Removing Catheter

### Continuous Peripheral Nerve Catheters (CPNB)

#### Indications:

- Trauma/ Amputations:
  - Extensive military use
  - Burns, dressing changes
- Age: > 12 yo in our practice
- Home:
  - Independent, able to care for self
  - Compliant, available for f/u
- Moderate-high invasiveness
- Significant Co-morbidities
- Opiate Tolerance

### CPNB Contraindications

- Allergy
- Patient Refusal
- Infection at site
- Anticoagulation considerations:
  - Avoid deep catheters with anticoagulation (esp LPB)
  - Most CPNB acceptable with standard DVT prophylaxis
- Acute Compartment Syndrome concerns – relative
  - Avoid dense, long acting blocks
  - CPNB will dilute LA may be acceptable R/B (Mannion)
  - Wounded warrior diagnosed with ACS even w/ CPNB (also Walker, 2012, RAPM)
- Inability to care for catheter (Home use)
- Lack of Availability for follow-up

### CPNB- Limitations

- Poor Reimbursement
- Increased Cost
  - Needle/Cath \$30
  - Pump \$250
- Increased Time
  - Place (15 min)
  - Pump setup(15 min)
  - Pt Education (15 min)
- Increased Liability
  - Infections
  - Poor analgesia (plan for breakthrough pain)
- Postop Catheter responsibility
  - Inpatients – Acute Pain Service
  - Outpatients
    - ASC vs Hospital based
    - Nights and weekends
    - Phone number for patients

### Billing for CPNBs- Procedural Codes & RVUs

Block	Code	ASA Unit Work
Brachial Plexus	64416	13
Sciatic	64446	12
Femoral	64448	12
Lumbar Plexus	64449	12
Paravertebral	64520-22	13

Law changed 2009; CMS "unbundled" CPNB charge: new RVU roughly 10.

### Continuous Peripheral Blocks Codes- Daily Evaluation Charges

- Charge for Catheter placement and separate charges for *inpatient* evaluation and mgmt
- Total USB Billing – complicated
  - Procedure Fee
  - Facility Fee
  - USG Fee
- Daily Evaluation- Inpatient
  - Need 3 components (Hx/PE/plan and coordination)
  - Ave 15min at bedside
  - Use 99231 (Daily evaluation) code
  - 0.76 RVU
- Home CPNB services not billable essentially
- If face to face, could use 99211-99215 codes

### Other Billing Considerations:

- **Documentation requires:**
  - Type of Block/CPNB
  - Indication: 719.xx pain
  - Surgeon's request for pain block/catheter
  - Description
  - Date
  - Anesthesiologist
  - USG guidance and picture in chart
  - Pre or postop; primary or postop analgesia.
- **Upper Extremity**
  - Shoulder 719.41
  - Arm (upper) 719.42
  - Elbow 719.42
  - Forearm/Wrist 719.43
  - Hand 719.44
- **Lower Extremity**
  - Hip 719.45
  - Thigh/Pelvic 719.45
  - Knee 719.46
  - Lower Leg 719.46
  - Foot/Ankle 719.47

### Charge Modifiers

- 2 Anesthesiologists model ideal
- If 1 anesthesiologist model, different locations (ie block room)
- Type 2 Service charge modifier (rather than time to perform block)
  - Modifier "59"
    - Used for all blocks
    - Distinguish the block from std "global fee"
- Modifier "51"
  - Multiple blocks on the same extremity
    - Ex: Sciatic nerve catheter & single femoral block for ORIF Ankle - bill sciatic catheter w/ modifier 59, & bill femoral single block w/ modifiers "59" & "51."
  - 50% allowable charge for "51" modifier
- Modifier "50" - rare
  - Used for bilateral nerve blocks along with "59"
  - Example:
    - B/L TKA w/ 2 C-FNB would be coded 64448-59-50
    - 100% allowable for both blocks

### Upper Extremity Catheters-Interscalene

- Posterior vs Posterior-lateral vs Anterior
  - Boezart. N.stim, 2002
  - Antonakakis, USG, 2009
- 35% of all CPNB in our ASC
- Total Shoulder Arthroplasty
- Proximal Humeral Fx's
- Open Shoulder Cases
- Clavicular ORIFs - ? Cervical plexus cath at C4

### Upper Extremity -Supraclavicular or Infraclavicular CPNB

- Mid-Dist Humeral ORIF
- Major Elbow, Forearm, Hand Surgery
  - Amputations
  - Elbow Arthroplasty
- Burns
- Reimplantations:
  - Taras, 1998. J Reconstruct Microsurg.
    - Exc results with CPNB (forearm).
    - 93% success rate with reimplantation
  - Kurt. 2005. AnnPlasSurg using SCB CPNB
- C-SCB 3% and C-ICB 2% of all CPNB in our ASC
- Mariano, 2011, A&A. C-SCB vs C-ICB
  - C-ICB had < pain on POD1; no diff in pt satisfaction
- Malchow preference, C-SCB (success rate, pt satisfaction)

### Lower Extremity Catheters

- LPB
- TKA
- Hip fxs; THA
- Femoral/Fascia Iliaca
  - TKA
  - Fem ORIF
  - AKA/BKA (Fem/Sci)
  - Tib Plat ORIF (Fem/Sci)
  - Burns
- Saphenous/ Adductor
  - May require post op placement
  - Minimizes fall risk
  - Add for major medial ankle surgery
- TKA Considerations:
  - Difficult to assess neural function post-op (esp sciatic)
  - Weakness can complicate PT or predispose to falls
  - Paul, 2010, Anes
    - No Diff betw C-FNB vs SS
    - Most feel C-FNB gold std
  - C-Adductor vs C-FNB Catheters
    - Nearly equivalent analgesia
    - Less Motor Block

### Sciatic/ Popliteal CPNBs

- | Sciatic/Popliteal:                                   | Considerations:                                   |
|--|---|
| ■ Calcaneal ORIF                                     | ■ Subgluteal most comfortable sciatic             |
| ■ Ankle Reconstruction                               | ■ Consider Tourniquet Location if primary         |
| ■ Ankle arthrodesis                                  | ■ Consider Surgical Prep if preop CPNB            |
| ■ Dist Tib/fib ORIF                                  | ■ Couple with femoral or saphenous blocks usually |
| ■ Hallux Valgus Repair                               |   |
| ■ 55% of all Home CPNBs C-Popliteal at Nashville ASC |   |

## CPNB for Thoracic / Abdominal Surgery

### C-PVB

- Thoracotomy
- VATS
- Mult Rib Fractures
- Mid-CAD
- Major Breast Surgery

### C-TAP

- Open Cholecystectomy
- Laparotomy
  - Malchow, 2011
  - Avoided postop opiates
- Hysterectomy
- ICBG

## C-PVB vs TEA for Thoracotomy

- Joshi, 2011, A&A.
- Grider, 2012 J Cardiothor Vasc Anesth
- Analgesia:
  - Equivalent analgesia with LA alone
  - > analgesia with TEA-LA+ opioid
  - > Inc Spirometry with TEA-LA+ opioid
  - TEA-opioid alone = systemic opiates
- Side Effects:
  - > Hypotension with TEA-LA alone
  - > pruritis with TEA-LA+ opioid (35%)
  - > pulm complications with systemic opioids vs C-PVB or TEA
- Post-thoracotomy Pain Syndrome:
  - 20% with TEA or C-PVB
  - Up to 50% without Adv RA

- Henrik Kehlet, Denmark
- Evidence based, procedure specific postop pain mgmt
- [www.postoppain.org](http://www.postoppain.org)

“Prospect Group”

## Conclusion

- Continuous Peripheral Nerve Blocks
  - Introduction
  - Risks and Benefits
  - Supplies, Techniques
  - Indications, Limitations
  - Specific Types
- Questions and Answers?

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