Locoregional anesthetic techniques

Markus F. Stevens - Academic Medical Center Amsterdam
Conflict of interest

• Teaching UGRA since 2004

• Paid by pharmaceutical companies and scientific societies for teaching UGRA

• Treasurer of DARA
Conflict of interest

DARA-ESRA Nederland Symposium
29-30 januari 2016 Conferentiecentrum Kapellerput - Heeze

How to perform Regional Anesthesia
Bench Marking, Improvements, Education
Structure

• Motivation
• Technique, complications
• Adjuvants
• Blocks:
  - upper extremity
  - lower extremity
  - truncal blocks (TAP)

-> Interactive case discussions
Motivation

- 27% moderate-severe postoperative pain is in pediatric anesthesia – especially in teenagers and infants (30-40%)
- ORID (opiate induced respiratory depression) is dangerous
  - Incidence about 1:10,000
  - In 27 incidence 7 death and 1 brain injury
- In comparison risk op paralysis after epidural (0-0.4:10:000)

Groenewald CB Pad Anesth 2012
Niesters M Brit J Anaesth 2013
Morton NS Ped Anesth 2010
Ivani G Reg Anesth Pain Med 2015
Technique

- Lumbar plexus
- Paravertebral
- Parascalen
- Sciatic (lateral & anterior)
- Sciatic (posterior)
- Axillary, femoral & fascia iliaca compartment
Technique
Technique

Hermanns H, Stevens MF  BJA 2006
Technique
Technique
Complications: LA toxicity

- Very rare with nerve blocks (0.04%)
- Increasingly rare with ultrasound
- Precautions (aspirate, fractionate, low concentration)
- Oxygen, hyperventilation
- Be prepared (intralipid 20%, 1-5 ml/kg bolus, repeat up to effect or 10 ml/kg, continuous infusion)
Complications: Nerve injury

Reasons for nerve injury

- Damage by needle
- Damage by injection pressure
- LA neurotoxicity
- Adjuvant neurotoxicity
- Tourniquet
- Positioning
- Surgery

Nerve injury incidence

0.02-0.04%

0.1 - 13%

Neal JM ASRA Practice Advisory
RAPM 2015
Adjuvants?

REVIEW ARTICLE

Adjuncts should always be used in pediatric regional anesthesia

Per-Arne Lönnqvist¹,²

1 Paediatric Anaesthesia & Intensive Care, Section of Anaesthesiology & Intensive Care, Department of Physiology & Pharmacology, Karolinska Institutet, Stockholm, Sweden
2 Paediatric Anaesthesia, Inetsive Care & ECMO Services, Astrid Lindgrens Children’s Hospital/Karolinska University Hospital-Solna, Stockholm, Sweden
Adjuvants?

- Opiates
  - Buprenorphine
  - Morphine
  - Fentanyl
  - Tramadol
- $\alpha$-agonists
  - $\alpha_1$-agonist: Epinephrine
  - $\alpha_2$-agonist: Clonidine, Dexmedetomidine
- Steroids: Dexamethasone
- Magnesium
Which adjuvant?

- Clonidine

<table>
<thead>
<tr>
<th></th>
<th>Number of patients LA+clonidine/LA alone</th>
<th>Mean duration of postoperative analgesia in controls (min)</th>
<th>Mean difference or WMD (min) [95%CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intermediate-acting LA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prilocaine 115 µg(^{19})</td>
<td>20/20</td>
<td>237</td>
<td>48 [10, 86]</td>
</tr>
<tr>
<td>Mepivacaine 100 µg(^{28}) 120 µg(^{11}) 150 µg(^{14,22})</td>
<td>87/81</td>
<td>225</td>
<td>103 [14, 193](^*)</td>
</tr>
<tr>
<td>Lidocaine 90 µg(^{18}) 140 µg(^{30}) 150µg(^{26})</td>
<td>59/59</td>
<td>154</td>
<td>111 [46, 176](^*)</td>
</tr>
<tr>
<td>Combined</td>
<td>166/160</td>
<td>200</td>
<td>112 [51, 173](^*)</td>
</tr>
<tr>
<td><strong>Long-acting LA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ropivacaine 150 µg(^{20,24,26})</td>
<td>53/53</td>
<td>690</td>
<td>141 [14, 269](^*)</td>
</tr>
<tr>
<td>Bupivacaine 150 µg(^{12,26})</td>
<td>35/33</td>
<td>954</td>
<td>178 [130, 226]</td>
</tr>
<tr>
<td>Levo-Bupivacaine 150 µg(^{12})</td>
<td>20/20</td>
<td>1102</td>
<td>289 [48, 530]</td>
</tr>
<tr>
<td>Combined</td>
<td>108/106</td>
<td>850</td>
<td>152 [76, 228](^*)</td>
</tr>
</tbody>
</table>

Poëpping DM Anesthesiology 2009
Which adjuvant?

- Clonidine

12 negative studies
15 positive studies

Kirksey MA PLOSone 2015
Which adjuvant?

- Dexmedetomidine

<table>
<thead>
<tr>
<th>Study</th>
<th>Analysis Time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rancourt 2002</td>
<td>21 hours</td>
</tr>
<tr>
<td>Marhofer 2013</td>
<td>10 hours</td>
</tr>
<tr>
<td>Lin 2013</td>
<td>5 hours</td>
</tr>
<tr>
<td>Fritsch 2014</td>
<td>20 hours</td>
</tr>
<tr>
<td>Agrawal 2014</td>
<td>15 hours</td>
</tr>
<tr>
<td>Keplinger 2015</td>
<td>18 hours</td>
</tr>
</tbody>
</table>

Kirksey MA PLOSone 2015
Which adjuvant?

- **Dexamethasone**

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>LA with dexamethasone</th>
<th>LA alone</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (min)</td>
<td>sd (min)</td>
<td>Total</td>
</tr>
<tr>
<td>Long-acting LA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shrestha 2003</td>
<td>765</td>
<td>320</td>
<td>20</td>
</tr>
<tr>
<td>Shrestha 2007</td>
<td>1028</td>
<td>195</td>
<td>30</td>
</tr>
<tr>
<td>Vieira 2010</td>
<td>1457</td>
<td>434</td>
<td>44</td>
</tr>
<tr>
<td>Cummings (Ropiv) 2011</td>
<td>1488</td>
<td>864</td>
<td>54</td>
</tr>
<tr>
<td>Cummings (Bupiv) 2011</td>
<td>1428</td>
<td>510</td>
<td>54</td>
</tr>
<tr>
<td>Tandoc 2011</td>
<td>1408</td>
<td>158</td>
<td>58</td>
</tr>
<tr>
<td>Desmet 2013</td>
<td>1433</td>
<td>510</td>
<td>49</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td></td>
<td></td>
<td>309</td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2=1366.24, \text{df}=6 (P=0.21); I^2=29\%$
Test for overall effect; $Z=20.91 (P<0.00001)$

<table>
<thead>
<tr>
<th>Intermediate-acting LA</th>
<th>LA with dexamethasone</th>
<th>LA alone</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (min)</td>
<td>sd (min)</td>
<td>Total</td>
</tr>
<tr>
<td>Movafegh 2006</td>
<td>242</td>
<td>76</td>
<td>30</td>
</tr>
<tr>
<td>Yadav 2008</td>
<td>452</td>
<td>54</td>
<td>30</td>
</tr>
<tr>
<td>Parrington 2010</td>
<td>334</td>
<td>43.5</td>
<td>24</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td></td>
<td></td>
<td>84</td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2=7999.94, \text{df}=2 (P<0.00001); I^2=98\%$
Test for overall effect; $Z=3.35 (P=0.0008)$

<table>
<thead>
<tr>
<th>Total (95% CI)</th>
<th>LA with dexamethasone</th>
<th>LA alone</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (min)</td>
<td>sd (min)</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td></td>
<td></td>
<td>393</td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2=37238.99, \text{df}=9 (P<0.00001); I^2=98\%$
Test for overall effect; $Z=6.26 (P<0.00001)$
Test for subgroup differences; $\chi^2=46.21, \text{df}=1 (P<0.00001); I^2=97.8\%$

Choi S BJA 2014
Route of application
Route of application

LA perineurally

LA perineurally + adjuvant systemically

LA + adjuvant perineurally
Dexamethasone

![Graph showing time to first analgesic request (min) vs. proportion of patients NOT requesting analgesia for different groups.](image)

- **Group R**
- **Group RDiv**
- **Group RD**

Desmot M BJA 2013
Why do they work? Dexamethasone

Proportion of patients without supplemental analgesia

Time to first analgesic request (h)

Desmot M Anaesthesia 2015
How should I use adjuvants?

• PREFER SYSTEMIC APPLICATION especially dexamethasone

• Effective are buprenorphine, clonidine, dexmedetomidine, dexamethasone, Mg

• The rest is useless and possibly dangerous
The support for use of adjuncts in the setting of peripheral nerve blocks in children is sparse and mainly limited to the use of clonidine. Adult meta-
Blocks
Blocks

SOLE  Fillet from the plancha, carrot puree & carrot broth
RED GURNARD  Baked on ham, sea vegetables & herbs, sweetcorn & egg puree
DZB BEEF RIB  Cranberry - shallot chutney, swiss chard and red wine beef jus
ROE DEER  Roasted loin with red current, celeriac in salt crust, Devilled sauce
Blocks
Nerve blockade
  ➢ interscalene
  ➢ supraclavicular
  ➢ infraclavicular
  ➢ axillary
  ➢ ilioinguinal/iliohypo.
  ➢ TAP
  ➢ penis block
  ➢ sciatic
  ➢ femoral
Blocks

Nerve blockade
- interscalene
- supraclavicular
- infraclavicular
- axillary
- ilioinguinal/iliohypogastric
- TAP
- penis block
- sciatic
- femoral
Blocks

Nerve blockade
➢ interscalene
➢ supraclavicular
➢ infraclavicular
➢ axillary
➢ ilioinguinal/iliohypogastric
➢ TAP
➢ penis block
➢ sciatic
➢ femoral
Nerve blockade

- interscalene
- supraclavicular
- infraclavicular
- axillary
- ilioinguinal/iliohypogastric
- TAP
- penis block
- sciatic
- femoral
Blocks

Nerve blockade
- interscalene
- supraclavicular
- infraclavicular
- axillary
- ilioinguinal/iliohypo.
- TAP
- penis block
- sciatic
- femoral
Blocks

Nerve blockade

- interscalene
- supraclavicular
- infraclavicular
- axillary
- ilioinguinal/iliohypo.
- TAP
- penis block
- sciatic
- femoral
Nerve blockade
- interscalene
- supraclavicular
- infraclavicular
- axillary
- ilioinguinal/iliohypo.
- TAP
- penis block
- sciatic
- femoral
Blocks

Nerve blockade:
- interscalene
- supraclavicular
- infraclavicular
- axillary
- ilioinguinal/iliohypogastric
- TAP
- penis block
- sciatic
- femoral
Blocks

Nerve blockade

- interscalene
- supraclavicular
- infraclavicular
- axillary
- ilioinguinal/iliohypo.
- TAP
- penis block
- sciatic
- femoral
• Carney J Anesth Analg 2010
Open appendectomy (n=40) TAP vs. Placebo
⇒ Double morphine consumption, higher VAS scores
• Sandeman DJ BJA 2011
Laparoscopic appendectomy (n=93) TAP vs. Placebo ⇒ pain score reduced (0 vs. 2); morphine consumption n.s.
TAP

- Fredrickson MJ Ped Anesth 2010
Inguinal hernia repair (n=41)
TAP vs. Ilioinguinal => more pain and more NSAID with TAP

- Schin L EJA 2013
Inguinal hernia repair (n=57) TAP vs. Placebo
Time to first rescue 4.7h vs. 17
Cumulative dose 1 vs. 3. (Rescue = PCM)
TAP

- Lapmahapaisan S Ped Anesth 2015
  Open abdominal surgery, (n=54)
  TAP vs. WI => no effect
- Faase MA J Ped Urol 2015
  Urologic laparoscopic surgery (n=51)
  TAP vs. Caudal => more intraop opioid for TAP
TAP

- External oblique
- Internal oblique
- Transversus abdominis
- Transversus abdominis plane
- QLB I
- QLB II
- Quadratus lumborum

Posterior
Anterior

ahead in perioperative care
department of anesthesiology
CONCLUSIONS

• RA better than systemic analgesia
• Peripheral anesthesia safer than neuraxial
• Pediatric equipment is needed
• No adjuvants for peripheral nerve block
• Beter 20-times two types of blocks than 2-times 20 types of block
• Be critical over your blocks and monitor your quality (PRAN or Quipsi/Pain-out)
Connective tissue disease
Connective tissue disease

• Is there anything to care about when doing RA in patient with connective tissue disease?
Ehlers Danlos Syndrome

- Transcutaneous LA do not work
- Infiltration of LA -> less effective
- PNB works (sometimes)
- Epidural anesthesia works
- Spinal anesthesia works
Connective tissue disorder

A patient with Marfan syndrome suffers from severe postpuncture headache 2 days after spinal anesthesia. What would be your first management
Marfan
Connective tissue disorder

• Prone to epidural ectasias
  • Ehlers-Danlos syndrome
  • Hypermotility syndrome
  • Marfan syndrome
• Be cautious with neuraxial blocks
• Risk of insufficient anesthesia
• Risk of liquor leakage
Case orthopedic procedure

- 17 yo scheduled for bilateral achilles tendon transposition (club feet, pes equinus)
- PMH
  - Congenital aortic stenose
  - Aortic valve reconstruction at age 12
  - Complicated by postcardiotomy syndrome
  - Remaining aortic insufficiency & stenosis
  - Developing renal insufficiency
Case orthopedic procedure

- PMH continued
  - Peritoneal dialysis complicated by infections
  - Kidney transplantation at age 12
  - Poor kidney (transplantate) function
  - At age 15 Ross procedure with complicated postoperative recovery
  - Remaining muscular infravalvular stenosis
  - Instable postoperative balance between hyper- and hypovolemia
Case orthopedic procedure

• PMH continued
  • Postoperative critical illness neuropathy
  • Development of bilateral clubfoot

• Echo:
  • Subvulvular muscular aortic stenosis (HOCM)
  • Mild aortic insufficiency
  • Severe left ventricular hypertrophy
  • Combined mitral insufficiency and stenosis

• Clinically no signs of insufficiency
Case orthopedic procedure

- Your anesthetic plan?
Case orthopedic procedure

• Our plan
  • Combined sciatic & femoral nerve block
  • Nerve block and procedure without sedation
  • Operate one leg at a time (LA toxicity)
  • Patient willing and able to undergo procedure awake
  • Schedule an anesthesiologist with experience in RA and PA
Case orthopedic procedure

- My experience
  - Team prepared for the plan
  - Girl extremely hospitalized
  - Communicating with mother in arab
  - Mother does not speak Dutch or English
  - Direct communication with girl difficult
  - Cooperation with block marginal
Case orthopedic procedure

- My experience
  - Ultrasound guided block easy
  - Testing of block difficult
  - No pain on incision, no pain to torniquet
  - Complaining of pain in leg
  - Complaining of pain to torniquet
  - Complaining of pain in other leg
  - Moving other leg
Case orthopedic procedure

- My experience
  - Start of mild sedation (propofol TCI)
  - Movements of other leg and back
  - Increasing dose of TCI (up to 6 mcg/ml)
  - Blood pressure mildly dropped
  - Treated with phenylephrine (100 mcg)
  - Further uncomplicated ....
Case orthopedic procedure

- Scheduled second operation
  - General anesthesia with popliteal sciatic nerve catheters
Case Nuss Procedure

- 14 year old girl with severe Pectus Excavatum
- Shortness of breath during sports
- Epigastric pain
- Constipation as child
- Scheduled for Nuss procedure
Case Nuss procedure
Case Nuss procedure

• How much pain experience patient postoperatively after this minimal invasive procedure?
Case Nuss procedure

• Our protocol postoperatively
  • PCEA bupivacaine 0.125% & clonidine 1mcg/ml; basal rate 0.2 mg/kg/h; bolus 0.025 mg/kg, lockout 20 min
  • Paracetamol and Metamizol 1g 4dd (>40kg)
  • As needed temazepam 0,1 mg/kg
  • As needed increase concentration bupivacaine/clonidine
  • Without epidural: Esketamine / i.v.Lidocaine / Clonidine / Gabapentine / Morphine-PCA / PCM / Metamizol
Case Nuss procedure

- Postoperatively asymmetric block (ri > li)
- Top-up given (lidocaine)
- Good first night
- One the morning of the first postoperative day again pain => extra bolus lidocaine
- During the day switching between numb right arm and maximal pain
- In the evening catheter retracted and again lidocaine bolus
Case Nuss procedure

- Sleeping well
- Waking up with a shock and excruciating pain
- Catastrophizing: “The bar is pressing on my heart”, “An elephant is standing on my chest”, “I am dying”.
Case Nuss procedure

- What do you do?
Case Nuss procedure

POD 0

POD 1
Case Nuss procedure

• Temazepam 10 mg given intravenously
• Patient went back to the ward
• On the late morning of POD 2
  • Horner syndrome right eye
  • Asymmetric breathing
  • Asymmetric breath sounds
  • Pectus excavatum seemed unchanged
Case Nuss procedure

• What is an adequate diagnostic procedure?
Case Nuss procedure

POD 2
Case Nuss procedure

POD 2
Case Nuss procedure

POD 0

Second operation
Case Nuss procedure

- Reoperation on the late POD 2
- Epidural removed
- PCA-morphine started
- Clonidine 2 mcg/kg 2dd
- Ketamine i.v. 0.1 mg/kg/h started
- PCM 1g 4dd and metamizol 1g 4dd continued
Case Nuss procedure

- Therapy continued for 3 days
- VAS scores up to 6-7
- Ketamine hallucinations
- 4 episodes of hyperventilation
- On POD 3 (5) morphine-PCA discontinued
- Psychological aid
- PCM/NSAID for months
Thank you for your attention!

See you over two weeks in Heeze!