Ultrasound guided Nerve Blocks in Orthopedic Surgery

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No conflict of interest to disclose.
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Why to use ultrasound guidance?
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Just another daily case ...

- 32 yr old male
- 140 kg, 175 cm
- **BMI = 45.7 kg/m²**
- Dyspnea at rest
- Deviated septum
- Arterial hypertension
- Work accident
**General anaesthesia?**

**Advantages:**
- ✓ Surgeon comfort
- ✓ Patient comfort

**Disadvantages:**
- ✓ Loosing the airway and hypoxic brain damage
- ✓ Mendelson’s syndrome
- ✓ Postoperative respiratory depression
- ✓ Nausea and vomiting
Why should we use PNB?

1. Lower systemic impact
2. Use of few drugs
3. Lower complications
4. No hemodynamic effects
5. Rare respiratory effects
6. Strong and long lasting analgesia
7. Low postoperative opioid consumption
8. Reduced need for PACU monitoring
9. Reduced nausea and vomiting
10. Reduced postoperative sedation
11. Permits early rehabilitation
12. Reduced hospital length of stay
13. Reduced incidence of chronic postoperative pain
14. Cost efficiency
15. High patients and ANAESTHETIST SATISFACTION 😊 !
Regional anaesthesia (n = 2644) 
versus 
General anaesthesia (n = 2644)  
National Surgical Quality Improvement Program database (2005-2010)

“The use of regional anesthesia in patients with COPD is associated with lower incidences of composite morbidity, pneumonia, prolonged ventilator dependence, and unplanned postoperative intubation”

Hausman MS jr et al. Anesth Analg 2014
The essence of the peripheral nerve blocks (PNB) = the deposition of the local anaesthetic solution around the nerve

A success nerve block means:

• Good anaesthesia and postoperative analgesia
• Satisfied patient
• Good outcome
Modulation of the inflammatory effect by the local anaesthetics

• Lidocaine protects vascular and endothelial smooth muscle against cytokine-induced injury via lidocaine action on ATP-sensitive potassium channels

• local anesthetics suppressed metabolic activation and secretory function of leukocytes in a dose-dependent manner

Regional analgesia and opioid consumption

✓ 7 RCT femoral nerve block vs no block resulted in a significant difference in additional pain medication use, favoring nerve blocks (p = 0.006)

Peripheral nerve blocks versus general anesthesia for total knee replacement

RCT – 213 patients >65 yr
✓ general anaesthesia or lumbar and sciatic nerve block for total knee arthroplasty


<table>
<thead>
<tr>
<th>Parameter</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure and heart rate</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Recovery – physiological, emotional, modified cognitive</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Intraoperative drugs</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Postoperative opioid consumption</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>= 0.059</td>
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</table>
Ultrasound guided regional anaesthesia (UGRA)

Ultrasound-guided supraclavicular approach for regional anesthesia of the brachial plexus.

Ultrasound guided peripheral nerve blocks

✓ early onset, improved quality
✓ lower doses of local anaesthetics
✓ reduces the number of needle passes
✓ reduced intravascular “placement” of the block
✓ interesting and facile for younger doctors

At the moment:
✓ no differences regarding complication rates

Meta-analysis

32 RCT (compared US, neurostimulation, combined) for peripheral nerve block in upper and lower limb

✓ 2844 participants
✓ ultrasound guidance produced higher success rates, and less conversion to general anaesthesia
✓ less time to perform nerve blocks in the ultrasound group but more time when combined with a PNS technique

“peripheral nerve blocks performed by ultrasound guidance alone, or in combination with PNS, are superior in terms of improved sensory and motor block, reduced need for supplementation and fewer minor complications reported”

UGRA in children

- 20 RCT
- 1241 participants
- Blocks were performed under general anaesthesia
- Greater benefit in small children when used US

Block duration was longer with US
Time to perform the procedure was reduced
Reduced number of needle passes with US
Pain scores in PACU were lower with US

Guay J, Cochrane Database Syst Rev. 2016 Feb 19;2:CD011436
Conclusion

“Ultrasound guidance seems advantageous, particularly in young children, for whom it improves the success rate and increases the block duration. Additional data are required before conclusions can be drawn on the effect of ultrasound guidance in reducing the rate of bloody puncture.”

Guay J, Cochrane Database Syst Rev. 2016 Feb 19;2:CD011436
film
There are rumors about increasing OR time...

<table>
<thead>
<tr>
<th>Category</th>
<th>Ultrasound-guided</th>
<th>Neurostimulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block performing time (min)*</td>
<td>1.8</td>
<td>6.5</td>
</tr>
<tr>
<td>Needle insertions (nr)*</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Fewer vessel punctures (p=0.03)</td>
<td></td>
<td></td>
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Orebaugh SL et al.
Reg Anesth Pain Med 2007;2:448-54
RCT compared US guided supraclavicular (n = 40), infraclavicular (n = 40) axillary (n = 40) approaches for brachial plexus block.

No differences regarding:

* Total anesthesia-related time: 23.1-25.5 min
* Success rate: 95%-97.5%
* Block related pain scores
* Vascular puncture
* Paresthesia

Peripheral blocks inconvenient

✓ lack of familiarity by surgeons with the benefits of peripheral nerve blocks
✓ time pressure
✓ rapid turnover of cases
✓ logistical impediments
✓ patients fear
✓ lack of training and equipment
Other limits...

- UGRA is operator dependent
- Requires good eye-hand coordination
- Two tasks: US imaging and needle guidance
- The procedure is time limited
SUGRA as Stimulating Ultrasound Guided Regional Anaesthesia

✓ Allows impedance measurement during PNB
✓ More than 4.3% increase in electrical impedance may indicate accidental nerve puncture during peripheral nerve block
✓ Improved safety
✓ Improved learning UGRA
✓ Improved patients comfort

Bardou P et al.  
*Can J Anaesth 2013; 60:253-258*
Supplementary costs?!

✓ analysis performed for economic arguments
✓ annual increases in profit /DRG:
✓ EUR 1,706 - EUR 467,359

✓ shortening the length of stay
✓ increased patient satisfaction and avoidance of complications

Patient Safety

✓ Local anaesthetic systemic toxicity
✓ Nerve injury
✓ Infection
✓ PNB in adult anesthetized patients?
✓ PNB in patients with neuropathies?

# ASRA checklist for LAST

**Checklist for Treatment of Local Anesthetic Systemic Toxicity**

The Pharmacologic Treatment of Local Anesthetic Systemic Toxicity (LAST) is Different from Other Cardiac Arrest Scenarios

- **Get Help**
- **Initial Focus**
  - Airway management: ventilate with 100% oxygen
  - Seizures suppression: benzodiazepines are preferred; AVOID propofol in patients having signs of cardiovascular instability
  - Alert the nearest facility having cardiopulmonary bypass capability
- **Management of Cardiac Arrhythmias**
  - Basic and Advanced Cardiac Life Support (ACLS) will require adjustment of medications and perhaps prolonged effort
  - AVOID vasopressin, calcium channel blockers, beta blockers, or local anesthetic
  - REDUCE individual epinephrine doses to <1 mcg/kg
- **Lipid Emulsion (20%) Therapy** (values in parenthesis are for 70kg patient)
  - Bolus 1.5 mL/kg (lean body mass) intravenously over 1 minute (~100mL)
  - Continuous infusion 0.25 mL/kg/min (~18 mL/min; adjust by roller clamp)
  - Repeat bolus once or twice for persistent cardiovascular collapse
  - Double the infusion rate to 0.5 mL/kg/min if blood pressure remains low
  - Continue infusion for at least 10 minutes after attaining circulatory stability
  - Recommended upper limit: Approximately 10 mL/kg lipid emulsion over the first 30 minutes
- **Post LAST events at** [www.lipidrescue.org](http://www.lipidrescue.org) and report use of lipid to [www.lipidregistry.org](http://www.lipidregistry.org)

## Two surveys on complications

**Auroy Y** – 53000 nerve blocks with neurostimulation or paresthesia  
**Ecoffey** – 27031 ultrasound guided nerve blocks

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<thead>
<tr>
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<th>Neurostimulation</th>
<th>UGRA</th>
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<tbody>
<tr>
<td>Local anaesthetic</td>
<td>1.1/10000</td>
<td>1.5/10000</td>
</tr>
<tr>
<td>systemic toxicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nerve injury</td>
<td>2.4/10000</td>
<td>0.37/10000</td>
</tr>
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</table>

*Auroy Y et al. Anesthesiology 2002; 97: 1274-80*  
*Ecoffey C et al. Eur J Anaesthesiol 2014;31:606-10*
Recommendations

✓ In –plane and out-of-plane US technique are considered equal with respect to patient safety
✓ The visualization of the needle tip is a must
✓ High injection pressure is to be avoided
✓ Single shot or continuous nerve blocks are permitted under sedation or general anaesthesia in adult patient

Patients satisfaction

- 11-item written questionnaire
- Given within 2 days after surgery
- Provision of information, pain, and interaction with the anesthesiologist
- Primary outcome: willingness to have PNB repeated

Results
- 9969 surgical procedures
- RR=61.6%
- 94.6% (95% CI, 94%-95.1%) willing to repeat PNB if necessary

Education

- 6 anaesthesia residents
- 520 nerve blocks
- 93.6% success rate and 4 complications
- 398 errors committed
- 2 most frequent:
  - failure to visualize the needle before advancement
  - unintentional probe movement

Quality-compromising patterns of behavior

Failure to recognize:
✓ the position of needle tip
✓ maldistribution of the local anaesthetic

Fatigue

Failure to correctly correlate the sidedness of the patient with the sidedness of the ultrasound image

Poor choice of needle-insertion site and angle

Conclusions

✓ US-guidance of peripheral nerve blocks provides:
  ✓ Fast onset
  ✓ Good quality anaesthesia/analgesia
  ✓ High success rate of PNB
  ✓ Low incidence of nerve injury
  ✓ Low incidence of vessels punctures
  ✓ Patients satisfaction
  ✓ Increased regional anaesthesia use, in general and in frail patients
Thank you for attention!