Femoral Nerve Blocks

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Objectives

1. Become familiar with the evolution of peripheral nerve blocks.
2. Describe the advantages and disadvantages of femoral nerve blocks.
3. Identify up-to-date information on the use of femoral nerve block.
4. Recognize future implications.
History of Anesthesia

- The use of anesthetics began over 160 years ago.

General Anesthesia
- In 1845, Horace Wells used nitrous oxide gas during a tooth extraction

- 1st- public introduction of general anesthesia October 16, 1846.
  - Known as “Ether Day” (William Morton)
  - In front of audience at Massachusetts General Hospital

- First reported death in 1847 due to the ether

- Other complications
  - Introduction to ether was prolonged
  - Vomiting for hours to days after surgery

Schatsky, 1995, Hardy, 2001
History of Anesthesia

- In 1874, morphine introduced as a pain killer.
- In 1884, August Freund discovers cyclopropane for surgery
  - Problem is it is very flammable
- In 1898, heroin was introduced for the addiction to morphine
- In 1923 Arno Luckhardt administered ethylene oxygen for an anesthetic
History of Anesthesia

• **Alternatives to general anesthesia**

  • In the 1800’s Cocaine used by the Incas and Conquistadors

  • 1845, Sir Francis Rynd applied a morphine solution directly to the nerve to relieve intractable neuralgia. (first recorded nerve block)
    • Delivered it by gravity into a cannula

  • In 1855, Alexander Wood is a glass syringe to deliver the medication for a nerve block. (also known as regional anesthesia)

  • In 1868 a Peruvian surgeon discovered that if you inject cocaine into the skin it numbed it.

  • In 1884, Karl Koller discovered cocaine could be used to anesthetized the eye of a frog.
History of Anesthesia

- In 1885, James Corning introduced cocaine for spinal analgesia (dog)
- In 1898, August Bier administered spinal analgesia on humans.
- In 1900 first spinal analgesia for vaginal delivery
- In 1903, Ernest Fourneau introduced first synthetic local anesthetic (Amylocain)
- In 1946, Paul Ansbro introduced a continuous nerve block
- In 1965, Bupivacaine is first marketed as a pain reliever
- In 1999, first reviews are published using the use for nerve blocks.
Regional Anesthesia

- Local anesthetic induced blockade of peripheral or spinal nerve impulses from a targeted body part with preserved level of consciousness

http://medical-dictionary
Types of Regional Anesthesia

- local anesthetic (Bier block)
- spinal, epidural
- Peripheral nerve blocks (PNB)
  - Truncal (paravertebral, TAP blocks)
  - Plexus (brachial plexus, lumbar plexus)
  - Distal (femoral, sciatic)
Peripheral Nerve Blocks
Advantages

- Can combine the regional anesthetic with light general anesthetic.
- Decrease in post operative nausea and vomiting, delirium and respiratory depression.
- All with the goal of a decreased
  - length of stay in the hospital.
  - Decreased narcotic requirements after surgery
  - Earlier return of bowel function
  - Improved pain scores within *first 24 hours*
Disadvantages

- Variable duration
- Failed blocks
- Intraoperative awareness and discomfort
- *Sustained Motor blockade*
- Rare serious complications
Contraindications

- Excessive sedation
- On anticoagulants
- Preexisting nerve injury
- Infection
Relationship to Physical Therapy

- Allows for earlier mobilization status post total arthroscopic surgery. (Capdevila, 2005)
- Earlier mobilization improves short and long term functional outcomes (Atkinson, 2008)
Complication of Peripheral Nerve Blocks

- Local anesthetic toxicity
- Bleeding/hematoma
- Infection (Neuburger, 2007)
- Nerve injury (transient paralysis 1-3%) (Capdevila, 2005)
  - Permanent injury 1/10,000
Specific kinds of blocks

- Brachial plexus
  - Interscalene block
  - Supraclavicular block
  - Axillary block

- Lower extremity
  - Lumbar plexus
  - *Femoral nerve block and saphenous nerve block*
  - *Sciatic nerve block: anterior, gluteal and popliteal*

- Truncal
  - Paravertebral block
  - Transverse abdominus plane (TAP) block
Femoral Nerve Block for TKA

- Used for postoperative pain relief of the thigh or knee.
- Most commonly with ACL repairs and total knee arthroplasties
Injection
Motor and cutaneous distribution

Figure 2
Cutaneous innervation

- Lateral femoral cutaneous nerve
- Obturator nerve (inner thigh)
- Femoral nerve
- Saphenous nerve

## Medications with Femoral Nerve Block

<table>
<thead>
<tr>
<th>Medication</th>
<th>On set</th>
<th>Anesthesia (hrs)</th>
<th>Analgesia (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3% 2- chloroprocaine (+HCO3)</td>
<td>10-15</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3% 2- chloroprocaine (+HCO3+ epi)</td>
<td>10-15</td>
<td>1.5-2</td>
<td>2-3</td>
</tr>
<tr>
<td>1.5% Mepivacaine (+HCO2)</td>
<td>15-20</td>
<td>2-3</td>
<td>3-5</td>
</tr>
<tr>
<td>1.5% Mepivacaine (+HCO2+ epi)</td>
<td>15-20</td>
<td>2-5</td>
<td>3-8</td>
</tr>
<tr>
<td>2% lidocaine</td>
<td>10-20</td>
<td>2-5</td>
<td>3-8</td>
</tr>
<tr>
<td>0.5% ropivacaine</td>
<td>15-30</td>
<td>4-8</td>
<td>5-12</td>
</tr>
<tr>
<td>0.75% ropivacaine</td>
<td>10-15</td>
<td>5-10</td>
<td>6-24</td>
</tr>
<tr>
<td>0.5 Bupivacaine</td>
<td>15-30</td>
<td>5-15</td>
<td>6-30</td>
</tr>
</tbody>
</table>

NYSORA
Application

- Do patients that undergo a total knee arthroplasty, and receive the Femoral Nerve block, perform better than those who have had traditional methods of pain control?
<table>
<thead>
<tr>
<th>Reference</th>
<th>Journal</th>
<th>Block</th>
<th>#pt</th>
<th>Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen et. al, 1998</td>
<td>Anesthesia and Analgesia</td>
<td>FNB, FNB + SNB</td>
<td>36</td>
<td>VAS, morphine consumption, side effects</td>
<td>The FSNB group had decreased pain scores only on POD 1</td>
</tr>
<tr>
<td>McNamee et al, 2001</td>
<td>ACTA Anaesthesiologica Scandinavica</td>
<td>SSFNB+Sciatic, SSFNB +Sciatic + PCA</td>
<td>50</td>
<td>VAS, activity, morphine consumption</td>
<td>Morphine consumption was significantly reduced in SSFNB + Sciatic SSFNB + sciatic + PCA</td>
</tr>
<tr>
<td>Macalou et al, 2004</td>
<td>Anesthesia and Analgesia</td>
<td>SSFNB, PCA</td>
<td>57</td>
<td>VAS, morphine consumption, side effects</td>
<td>Pain rating were the same for all groups, pain was experienced in back of knee</td>
</tr>
<tr>
<td>Pham Dang et al, 2005</td>
<td>Regional Anesthesia and Pain Medicine</td>
<td>FNB, FNB + SNB</td>
<td>28</td>
<td>Amplitude of knee flexion, side effects</td>
<td>Pain scores at rest were significantly higher in the FNB group compared to the FSNB group. This difference disappeared after 36 hours after surgery. The FSNB group consumed 81% less morphine compared to the FNB group.</td>
</tr>
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<td>Reference</td>
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<td>Outcomes</td>
<td>Results</td>
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<td>---------------------</td>
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<td>---------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Morin et al, 2005</td>
<td>Regional Anesthesia and Pain Medicine</td>
<td>FNB, FNB + SNB, PNB</td>
<td>90</td>
<td>Morphine consumption, pain scores, maximal bending and extending of the knee, walking</td>
<td>Postoperative morphine consumption during 48 hours was significantly lower in the FSNB group than in the FNB group. Postoperative pain scores were not different</td>
</tr>
<tr>
<td>Good et. al., 2007</td>
<td>American Journal of Orthopedics</td>
<td>SSFNB, PCA</td>
<td>42</td>
<td>VAS, side effects, morphine consumption</td>
<td>SSFNB consumed less morphine and pain ratings remained the same for both groups</td>
</tr>
<tr>
<td>Hung et. al, 2009</td>
<td>The Journal of Arthroplasty</td>
<td>FNB, FNB + SNB</td>
<td>88</td>
<td>VAS, morphine consumption</td>
<td>The FSNB group had lower pain scores on the day of surgery both there was no difference on POD 1 and 2. The FSNB group used significantly less PCA morphine compared to the FNB and control group</td>
</tr>
<tr>
<td>Kadic, et al, 2009</td>
<td>ACTA Anaesthesiologica Scandinavica</td>
<td>CFNB, PCA</td>
<td>53</td>
<td>VAS, morphine consumption, side effects</td>
<td>CFNB had less pain and nausea.</td>
</tr>
</tbody>
</table>
## Range of motion

<table>
<thead>
<tr>
<th>Reference</th>
<th>Journal</th>
<th>Block</th>
<th>#pt</th>
<th>Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singelyn et al, 1998</td>
<td>Anesthesia and Analgesia</td>
<td>PCA, CFNB+ SNB, EPI</td>
<td>45</td>
<td>VAS, Knee flexion, side effects, length of stay</td>
<td>Significantly better knee flexion, ambulation distance up to 6 weeks post op, at 3 months no difference</td>
</tr>
<tr>
<td>Wang et al, 2002</td>
<td>Regional Anesthesia and Pain Medicine</td>
<td>SSFNB vs placebo</td>
<td>30</td>
<td>VAS, knee range of motion, length of stay in hospital</td>
<td>Knee range of motion at discharge was not statistically different, length of stay shorter for blocks</td>
</tr>
<tr>
<td>Nngai, et al, 2007</td>
<td>The Journal of Arthroplasty</td>
<td>PCA, low FNB (.15%) and high (.2%) dose FNB</td>
<td>60</td>
<td>VAS, range of motion, morphine use.</td>
<td>FNB had better range of motion initially</td>
</tr>
<tr>
<td>Kadic, et al, 2009</td>
<td>ACTA Anaesthesiologica Scandinavica</td>
<td>CFNB, PCA</td>
<td>53</td>
<td>VAS, morphine consumption, side effects</td>
<td>Better knee range of motion in first 6 days, after 3 months the same.</td>
</tr>
<tr>
<td>Fetherston, et al, 2011</td>
<td>Journal of Orthopedic surgery and Research</td>
<td>PCA, CFNB</td>
<td>53</td>
<td>Pain, range of motion, TUG</td>
<td>FNB had lower range of motion than PCA</td>
</tr>
</tbody>
</table>
Functional recovery

- At 6 months, gait distance was the same for all groups (Kadic, 2009)
- The TUG times were better for the PCA group as compared to the CFNB group.
  - Men prepared better than the women. (Fetherston, 2011)
- 1.6% of 1018 patients had fallen within 48 hours after surgery had a nerve block. (Sharma, 2010)
- Lower extremity nerve blocks result in decreased leg stiffness and lateral instability, which may lead to difficulty with pivoting maneuvers. (Muraskin, 2007)
- Demonstrated there is a causal relationship between CPNB and the risk of falling after knee and hip arthroplasty. (Ilfed, 2010)
Sensation and motor recovery

• Prolonged nerve blockade can last up to 30 hours (Hadzic et al 2004, Selandar et al 1988)

• Prolonged sensory deprivation up to 1 year after surgery. (Sharma, 2010)
Summary of literature

- **Pain scores at rest**
  - At 24 hours, majority of patients with CFNB exhibited less pain than those that received a PCA.
  - At 48 hours, no significant differences between groups.

- **Pain with activity**
  - At 24 hours, all blocks had less pain than PCA.
  - At 48 hours, those who received the sciatic block had better pain scores.

- **Knee range of motion**
  - There were no significant differences at discharge in knee range of motion scores for all groups.
What are the clinicians saying?
Case Study

- The patient was an 88 year old male diagnosed with osteoarthritis of the left knee. This patient underwent a left TKA and received a CFNB with Ropivacaine. The patient received physical therapy via the standard joint camp protocol, starting on postoperative day 1.

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## Joint Camp Exercises

**Table #2 Total Knee Arthroscopy Exercises**

<table>
<thead>
<tr>
<th>Postoperative Day</th>
<th>Exercises</th>
</tr>
</thead>
</table>
| Day 1             | 1. Independent with gluteal sets  
2. Minimum assistance needed to perform ankle dorsiflexion, plantar flexion and heel slides.  
3. Maximum assistance needed to perform straight leg raise (SLR), short arch quad (SAQ) and long arch quads (LAQ). Patient was unable to perform a quad set.  
Patient performed 10 repetitions of each exercise in semi reclined position. |
| Day 2 AM          | 1. Independent with gluteal sets, ankle pumps and heel slides.  
2. Moderate assistance needed for SLR, SAQ, and LAQ and moderate cuing for quad set.  
Patient performed 15 repetitions of each exercise in semi reclined position. |
| Day 2 PM          | 1. Independent with gluteal sets, ankle pumps and heel slides  
2. Moderate assistance needed for SLR, SAQ, and LAQ and moderate cuing for quad set.  
Patient performed 15 repetitions of each exercise in semi reclined position. |
| Day 3 AM          | 1. Independent with gluteal sets, ankle pumps an heel slides.  
2. Moderate assistance needed for SLR, SAQ, and LAQ and moderate cuing for quad set.  
Patient performed 15 repetitions of each exercise in semi reclined position. |

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## Functional Outcomes

<table>
<thead>
<tr>
<th>Functional Outcomes</th>
<th>Postoperative Day 1 afternoon</th>
<th>Postoperative Day 2 morning</th>
<th>Postoperative Day 2 afternoon</th>
<th>Postoperative Day 3 morning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulation assist</td>
<td>Minimal assistance</td>
<td>Contact guard assist</td>
<td>Contact guard assist</td>
<td>Contact guard assist</td>
</tr>
<tr>
<td>Ambulation device</td>
<td>Standard walker</td>
<td>Wheeled walker</td>
<td>Wheeled walker</td>
<td>Wheeled walker</td>
</tr>
<tr>
<td>Ambulation Distance</td>
<td>60 feet</td>
<td>150 feet</td>
<td>150 feet</td>
<td>150 feet</td>
</tr>
<tr>
<td>Ambulation Pattern</td>
<td>Step to gait</td>
<td>Step to gait with verbal cues to step</td>
<td>Step to gait</td>
<td>Step through gait</td>
</tr>
<tr>
<td>Pain (Visual Analog Scale)</td>
<td>8</td>
<td>7</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Range of motion(degrees)</td>
<td>Flexion 94</td>
<td>NA</td>
<td>Flexion 90</td>
<td>Flexion 90</td>
</tr>
</tbody>
</table>

Ronnebaum, 2012
Conclusions

• The continuous femoral nerve block did prevent the side effects found with the traditional methods of pain relief.

• At discharge patient was unable to perform independent SLR and SAQ.

• Patient did achieve 90 degrees of knee flexion by discharge but had -6 degrees of extension.

• The patient went home with knee immobilizer secondary to quadriceps weakness.

• Patient was referred to OPT PT secondary to quadriceps weakness.

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Future studies

• Examine the spike in pain rating 16-28 hours after surgery

• Examine prolonged quadriceps weakness

• Examine the effects of infiltration techniques as compared the PCA and nerve blocks.
References

• Morin AM, Kratz CD, Eberhart LH, Dinges G, Heider E, Schwarz


- Ronnebaum, J. Acute Care Outcomes Status Post Total Knee Arthroplasty with Continuous Femoral Nerve Block. Journal of Acute Care Physical Therapy. 3(1)2012:149-156.