Objectives

• Review the uses for and benefits of peripheral nerve blocks
• Discuss patient preparation and monitoring needs when performing peripheral nerve blocks
• Address common complications of peripheral nerve blocks
• Discuss commonly-performed peripheral nerve blocks, their indications, and common complications
• Present information on peripheral nerve catheters in the ambulatory setting
Peripheral Nerve Block

- A peripheral nerve block (PNB) is the injection of a local anesthetic around a nerve or group of nerves with blockade of nerve impulse conduction, causing temporary analgesia and loss of sensory and motor function.

Injection of local anesthetic around the median nerve at wrist results in anesthesia of hand.
Uses for Nerve Blocks and Catheters in the Perioperative Setting

- Surgical anesthesia
- Post-operative analgesia
- Post-discharge analgesia
Peripheral Nerve Blocks

- At UVA, we performed 1680 peripheral nerve blocks last academic year
- Procedures amenable to nerve blocks
  - Orthopedic procedures
  - Plastic surgery procedures
  - Amputations
  - Arterial-Venous Fistulas (AVF) or grafts
  - Mastectomies
Benefits of Peripheral Nerve Blocks and Catheters

- Improved analgesia
- Less need for narcotics or other pain medications
- Decreased recovery room and/or hospital stay
- Improved blood flow to extremity due to sympathectomy
- Improved physical therapy, mobility, and functional recovery after surgery
- Improved patient satisfaction
Benefits of Peripheral Nerve Blocks and Catheters

• **Meta-analysis** of RCTs to determine the analgesic efficacy of postoperative perineural catheter analgesia compared with opioid PCA

• Peripheral nerve catheter analgesia provided a statistically and clinically significant improvement in postoperative pain control compared with opioids and a decrease in opioid-related side effects.

Swenson *et al.*
Post-operative VAS scores for nerve catheter versus opioid PCA

Swenson et al.
Evaluating Patients for Peripheral Nerve Blocks

- Know the surgical procedure
- Determine if your nerve block will be the primary anesthetic or for post-operative pain control
- Always match the surgery with the appropriate mode of pain control
- Always consider the risks and benefits of regional anesthesia
Evaluating Patients for Peripheral Nerve Blocks

• Contra-Indications to PNBs Include
  – Patient refusal
  – Infection at sight of block
  – Need to assess patient post-operatively for nerve function or concern for operative injury to nerves
  – Existing neurologic injury
  – Lack of knowledge or skill in performing the block
"Nurse, get on the internet, go to SURGERY.COM, scroll down and click on the 'Are you totally lost?' icon."
Preparing for a Peripheral Nerve Block
Patient Preparation

1. Surgical and anesthesia consent
2. Site verification
3. IV access
4. Appropriate monitors
5. Oxygen
6. Emergency equipment
   - Airway
   - Suction
   - ACLS medications
   - Lipid emulsion
Monitoring

• Monitors include:
  – Pulse oximetry
  – Blood pressure
  – EKG
  – Level of consciousness
Choice of Local Anesthetic

- Duration
- Onset
- Cost
- Toxicity Profile

2-Chlorprocaine
Prociane
Prilocaine
Lidocaine
Mepivacaine
Etidocaine
Bupivcaine
Tetracaine
Dibucaine
Cocaine

Least toxic

Most toxic
Adjuvants to Local Anesthetics

- Epinephrine
  - Increases duration due to local vasoconstriction and decreased vascular uptake
  - Improves quality of block due to alpha-2 agonism
  - Decreased local anesthesia blood concentrations
  - Intravascular marker
Adjuvants to Local Anesthetics

- Epinephrine
  - Concerns for worsening neurologic injury due to ischemia
  - Can cause hypertension and tachycardia due to systemic absorption
  - Doses range from 2.5-10 mcg/mL
Epinephrine and Nerve Blood Flow

Adjuvants to Local Anesthetics

- Clonidine
  - Alpha-2 agonism provides direct analgesia and improved quality of block
  - Increased duration due to local vasoconstriction
  - May potentiate local anesthetics
Adjuvants to Local Anesthetics

• Clonidine
  - Side effects include bradycardia, hypotension, and sedation
  - Doses range from 0.25-2 mcg/kg
  - Doses greater than 150 mcg may cause sedation and greater side-effects
Perioperative Neurologic Injury

- Occur pre-operatively while placing blocks—mechanical damage to nerve, hematoma formation
- Intra-operatively—surgical injury, positioning, tourniquet injury
- Post-operatively—pressure injuries from positioning of anesthetized limb, bandage/cast too tight
What are the Specific Risks Involved With Performing the Block?

- Failure of the block or incomplete block
- Local anesthetic toxicity or allergic reactions
- Injury to nearby structures such as nerves, blood vessels, lung
- Infection
- Hematoma or bleeding
- Each block has its own specific concerns and complications
Local Anesthetic Toxicity

Due to excess plasma concentrations of local anesthetics

Etiology:
1. Intravascular injection
   • Immediate symptoms
2. Absorption of local anesthetic from injection site
   • Delayed symptoms (10-20 minutes after block)
Symptoms of Local Anesthetic Toxicity

Lightheadedness/tinnitus/perioral numbness

Visual changes

Seizure activity

Unconsciousness

Coma

Respiratory Arrest

Cardiovascular collapse
Nerve Anatomy

dkimages.com
Anatomy of a Nerve

Figure 1

Epineurium

Fascicle

Blood vessels

Perineurium

NYSORA
Mechanisms of Nerve Injury

- Mechanical
- Stretch
- Pressure/compression
- Chemical
- Vascular

• Most injuries involve multiple mechanisms
Incidence of Neurologic Complications for PNB

- Prospective study of 3,996 patients undergoing fem-sciatic, axillary, and interscalene with multiple injection stimulation technique
- 1.7% developed neurologic dysfunction of the blocked/operated limb
- Complete recovery within 4-12 weeks for all but one patient (7 and 30 day check)
- One patient required 25 weeks for complete recovery
- Tourniquet pressure was only variable showing association with post-op neurologic dysfunction, OR 2.9

Incidence of Neurologic Complications for PNB

• Meta-analysis looking at 32 studies between 1995 and 2005
• Neurologic injury ranged from 0.02-2.84/100
• Interscalene highest risk of transient neurologic deficit 2.84/100
• 16 studies looked at neuropathy after 12 months-- only one case of permanent neuropathy
• **Neuropathy after PNB is less than 3%**
• **Permanent neurological injury after RA is rare**

Causes of Peripheral Nerve Injury (Not Related to PNB)

- Nerve injuries of the axillary, suprascapular, and musculocutaneous nerves reported in 1.8% of patients undergoing rotator cuff repair, shoulder stabilization, and shoulder arthroplasty under general anesthesia.

Complications of Peripheral Nerve Blocks

- Remember that a nerve injury following a peripheral nerve block may not be from the peripheral nerve block! (Pre-existing causes, intra-op causes, post-op causes)
- Always rule out reversible processes such as a bandage that is too tight, a hematoma compressing a nerve
- Always follow blocks until sensory and motor function return!!
Tools for finding & blocking nerves

Nerve Stimulation

Ultrasound
Nerve Stimulator

- The current necessary to observe muscle response correlates with the distance of the needle tip from the nerve.

http://www.bbraunusa.com/stimuplex/pens2.html
Ultrasound

- Uses high-frequency sound waves to create images of structures
- Advantage of visualizing nerves, surrounding structures, and watching spread of local around nerves
Ultrasound Guided Peripheral Nerve Blocks

- Anesthesia first started using ultrasound for peripheral nerve blocks in the mid-1990’s.
- Adds an additional sense of real-time visualization of nerves and surrounding structures
Advantages of Ultrasound-Guided Peripheral Nerve Blocks

- Improved success rates and decreased number of failed blocks
- Faster onset of block
- Improved quality and duration of block
- Reduction in mean required volume of local anesthetics
Advantages of Ultrasound-Guided Peripheral Nerve Blocks

• Allows for patient anatomic variations
Commonly Performed Peripheral Nerve Blocks

- Upper Extremity
  --Interscalene
  --Supraclavicular
  --Infraclavicular
  --Axillary
  --Paravertebral

- Lower Extremity
  --Femoral
  --Sciatic
INTERSCALENE → SHOULDER, UPPER ARM

SUPRACLAVICULAR

INFRACLAVICULAR → ARM, FOREARM, HAND

AXILLARY
Peripheral Nerve Blocks: Upper Extremity
Interscalene
Supraclavicular
Axillary
Infraclavicular
Roots
Trunks
Cords
Branches

Netter
Brachial Plexus

http://www.hssanes.org/for-professionals/blocks-and-hss-special-techniques.htm
Interscalene Block

• **Indications**
  
  – Surgical anesthesia
    • Orthopedic surgery of the upper extremity above the elbow
    • Vascular access
  
  – Post-operative analgesia
    • Shoulder surgery
    • Orthopedic surgery of the upper extremity above the elbow

http://www.hssanes.org/for-professionals/blocks-and-hss-special-techniques.htm
Interscalene Nerve Block
Interscalene Approach to the Brachial Plexus
Interscalene Block Complications

- Blocks the phrenic nerve, hence the diaphragm; Patients present with subjective shortness of breath or difficulty breathing
- 25-30% reduction in pulmonary function volumes (FVC, FEV1) which can be significant in a pulmonary “cripple”.
- Intravascular injection
- Intrathecal injection
- Spares the lower nerve roots and hence the ulnar nerve
Interscalene Block Complications

• Recurrent laryngeal nerve blockade—presents as hoarseness
• Horner syndrome—due to blockade of cervical sympathetic plexus; occurs > 5% of the time; patients present with an injected conjunctiva, constricted pupil, and ptosis of eyelid
Brachial Plexus

http://www.hssanes.org/for-professionals/blocks-and-hss-special-techniques.htm
Supraclavicular

• Indications
  – Surgical Anesthesia of the upper extremity
  – Post-operative analgesia
  – Fastest onset

http://www.hssanes.org/for-professionals/blocks-and-hss-special-techniques.htm
Supraclavicular

- Used less commonly with stimulation due to fear of pneumothorax
- More common with the advent of ultrasound
- Nerves can be visualized lateral to the subclavian artery, above the first rib (and pleura!)
Supraclavicular
Supraclavicular Block Complications

- Pneumothorax—incidence ranges from 0.5-5% (highest incidence of all blocks)—usually seen within several hours but may take 12 h to manifest symptoms
- Subclavian artery hematoma or injection
- Complications
  - PTX
  - IV injection
  - Intraneural injection
  - Failure
Brachial Plexus

Intraclavicular

http://www.hssanes.org/for-professionals/blocks-and-hss-special-techniques.htm
Intraclavicular Block

• Indications
  – Surgical anesthesia of the upper extremity
  – Post-operative analgesia

• Complications
  – IV injection
  – Intraneural injection
  – Failure

• Disadvantages
  – Slow onset
  – Harder to image with US due to depth

http://www.hssanes.org/for-professionals/blocks-and-hss-special-techniques.htm
Infraclavicular Nerve Block

- Level of the cords
- Less Risk of Pneumothorax compared to a Supraclavicular N. block
Brachial Plexus

http://www.hssanes.org/for-professionals/blocks-and-hss-special-techniques.htm
Axillary

• **Indications**
  – Surgical Anesthesia of the upper extremity

• **Complications**
  – Hematoma
  – Intravascular injection
  – Nerve injury
  – Sparing of musculocutaneous nerve

http://www.hssanes.org/for-professionals/blocks-and-hss-special-techniques.htm
Axillary Nerve Block
Axillary Block

- Ultrasound-guided relies on identifying the axillary artery and injecting local anesthesia around the vessel.

http://www.hssanes.org/for-professionals/blocks-and-hss-special-techniques.htm
Peripheral Nerve Block -- Lower Extremity

• Unlike the upper extremity, to block the lower extremity in its entirety, two blocks must be performed
Femoral Nerve Block

- Surgery on the knee
- Surgery on the anterior thigh
- Leg tourniquet

Sciatic Nerve Block

- Surgery on the foot
- Surgery on the toes
- Posterior knee pain
Femoral Nerve Block

- **Indications**
  - Surgery of knee (TKA, ACL, PCL, etc)

- **Landmarks**
  - Inguinal Crease
  - Femoral Artery
  - Stimulating needle inserted one cm lateral to artery

- **Nerve Stimulation**
  - Patella snap
Femoral Nerve Block
PNB: Sciatic Nerve

SCIENTIFIC NERVE
Motor innervation

- Peroneal division
- Tibial division

- Tibial division
  1. Biceps femoris (long head)
  2. Semitendinosus
  3. Semimembranosus
  4. Adductor magnus

- Peroneal division
  5. Biceps femoris

Common Peroneal Nerve

Tibial nerve

Common peroneal nerve

DORSIFLEXION

EVERSION

PLANTAR FLEXION

INVERSION

www.nysora.com
Sciatic - Posterior Popliteal and Lateral Approach

- Indications
  - Foot and ankle surgery
  - Toe surgery and amputations
  - Procedures on the knee such as ACL repair with hamstring tendon grafts
Sciatic - Lateral Popliteal

• Indications
• Landmarks
  – Vastas Lateralous
  – Biceps Femurus
  – Joint space
  – Femur
• Nerve stimulation
  – Peroneal – dorsal flexion, eversion
  – Posterior Tibial – plantar flexion, inversion
Sciatic - Lateral Popliteal
Sciatic - Posterior Popliteal

• **Indications**

• **Landmarks**
  – Popliteal fossa crease
  – Biceps Femoris
  – Semitendinosis

• **Nerve stimulation**
  – Peroneal – dorsal flexion, eversion
  – Posterior Tibial – plantar flexion, inversion
Sciatic Nerve – Popliteal Approach
Paravertebral Block

• Indications: breast surgery, rib fractures, thoracic surgery
• Goal of anesthetizing thoracic spinal nerves exiting intervertebral foramen
• Complications: pneumothorax, hematoma
Paravertebral Block

- **Landmarks:** Spinal process at the desired thoracic dermatomal levels
- **Needle insertion:** 2.5 cm lateral to midline with needle insertion 1 cm past the transverse process
- **Can do multiple levels**

http://www.uam.es/departamentos/medicina/anesnet/journals/ija/vol3n1/block.htm
Post-operatiave Concerns for Patients with Peripheral Nerve Blocks or Catheters

• Protect desensate limb at all times
• Take P.O. meds before block wears off
• Continue to follow patients until sensory and motor block have totally resolved and catheter is removed!!!
Concerns for Patients Going Home with Peripheral Nerve Catheter (or Block)

- Use a sling for upper-extremity blocks
- Use a knee immobilizer and/or crutches for lower extremity blocks
- Instruct patients about appropriate padding and positioning of the desensate limb
- Instruct patients on checking limb for color, perfusion

**FOLLOW UP** **FOLLOW UP** **FOLLOW UP** **FOLLOW UP**
Peripheral Nerve Catheters

Going Home with a Catheter
Going Home with a Peripheral Nerve Catheter

Stryker Pain Pump

Accufuser

On-Q Bloc
Choose the Appropriate Patient!!!

- Geographic location
- Access to caregiver
- Education and support
- Communication with healthcare provider
- Access to 24 hour help
Going Home with a Peripheral Nerve Catheter

- **Patient education** is primary concern
- Who will pull the catheter?
- What to look for in case of an allergic reaction, intravascular catheter, infection
- Need daily calls, follow-up for catheter pulls, and access to 24 hour emergency information
Going Home with a Peripheral Nerve Catheter—What Pump?

- Pumps vary in their technical characteristics
- Programmability
- Bolus capacity
- Alarms for occlusion, pump malfunction
- Disposability and cost
Concerns for Patients Going Home with Peripheral Nerve Catheter

- Movement, malposition, or accidental removal of catheter
- Kinking or knotting of catheter
- Nerve injury when removing catheter
- Infection
- Local anesthetic toxicity or allergic reaction
- Injury to desensate extremity
Infection from Peripheral Nerve Block Catheter

- 28-57% of catheters have bacterial colonization when pulled
- Coagulase-negative staphylococcus, gram-negative bacillus, and staphylococcus aureus are common
- No reports of bacteremia/sepsis from catheter, though there have been reports of an abscess from catheters
Going Home with Peripheral Nerve Catheters

- Study of 620 orthopedic outpatients discharged home with peripheral nerve catheters
- 26 patients - 4.2% required intervention after discharge—most commonly-bolus of local anesthetic 1 patient required help pulling catheter
- One long-term nerve injury from pressure injury to peroneal nerve

Liu et al
Conclusion

• Regional Anesthesia
  – Safe
  – Effective
    • Surgical
    • Post-operative analgesia

• Goals
  – Know your anatomy
  – Know your landmarks
  – Know the benefits of regional anesthesia
References

References


References

- www.NYSORA.com.