Soli Deo Gloria

LOCAL ANESTHETICS USED FOR SPINAL ANESTHESIA

Lecture 9

Developing Countries Regional Anesthesia Lecture Series

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Disclaimer

- Doses are only general recommendations. There are several factors that may result in either an inadequate or high spinal.
- Every effort was made to ensure that material and information contained in this presentation are correct and up-to-date. The author can not accept liability/responsibility from errors that may occur from the use of this information. It is up to each clinician to ensure that they provide safe anesthetic care to their patients.

Factors in Spread of Spinal Anesthetics

- Every clinician must take into account the four categories of factors that may play a role in the spread of local anesthetics in the subarachnoid space.
- Factors include:
  - Characteristics of local anesthetic
  - Patient characteristics/medical conditions
  - Technique of injection
  - Characteristics of spinal fluid

Local Anesthetics in the US for Spinal Anesthesia

- Procaine
- Lidocaine
- Mepivacaine
- Tetracaine
- Levobupivacaine
- Bupivacaine

Categories of Local Anesthetics for Spinal Anesthesia

- Those used for procedures that are < 90 minutes (short acting).
- Those used for procedures that are > 90 minutes (long acting).
- All medications used for spinal anesthesia should be preservative free!
- Use medications specifically prepared for spinal anesthesia.

Short Acting Spinal Local Anesthetics

- Procaine
- Lidocaine
- Mepivacaine

Procaine

- Oldest local anesthetic that is still used for spinal anesthesia
- Ester
- Rapid onset 3-5 minutes
- Short duration approximately 60 minutes

Procaine Limitations

- Short acting (60 minutes)
- High frequency of nausea and vomiting
- Higher frequency of failed spinal anesthesia
- Despite short duration of action it has a slower time to full recovery
- Increasing popularity since it has a low frequency of Transient Neurological Symptoms

Procaine

Medication	Preparation	Dose Lower Limbs	Dose Lower Abdomen	Dose Upper Abdomen
Procaine	10% Solution	75 mg	125 mg	200 mg

Duration Plain	Duration Epinephrine
45 minutes	60 minutes

Lidocaine

- In the past was a popular spinal anesthetic for procedures < 1.5 hours.
- Is an amide
- Rapid onset of 3-5 minutes
- Duration of action 60-75 minutes
- Common preparation 5% solution in 7.5% dextrose

Limitations of Lidocaine

- High incidence of Transient Neurological Symptoms (TNS)
- Because of this complication the use of lidocaine has greatly declined.
- Using concentrations less than 5% have not been shown to reduce symptoms of TNS

Lidocaine

Medication	Preparation	Dose Lower Limbs	Dose Lower Abdomen	Dose Upper Abdomen
Lidocaine	5% Solution	25-50 mg	50-75 mg	75-100 mg

Duration Plain	Duration Epinephrine
60-75 minutes	60-90 minutes

5% concentration is no longer recommended due to risk of TNS...should be diluted to 2.5% or less. This may reduce the risk.

Mepivacaine

- Becoming a popular alternative to lidocaine.
- May have a lower incidence of TNS
- Used in doses of 30-60 mg in a 2% concentration (preservative free)
- Slightly longer acting than lidocaine
- Drug mass ratio of 1.3/1.0 when compared to lidocaine

Mepivacaine

- Current use of mepivacaine is “off label”. The FDA (United States) has not approved its use for spinal anesthesia.

Long Acting Spinal Local Anesthetics

- Tetracaine
- Bupivacaine
- Ropivacaine
- Levobupivacaine
- Bupivacaine

Tetracaine

- Long history of clinical use
- Is an ester
- Available as niphanoid crystals (20 mg) that requires reconstitution.
- First reconstitute the crystals with 2 ml of preservative free sterile water
- Mix the 1% solution with equal volumes of 10% of dextrose to yield a 0.5% solution

Tetracaine

- The final concentration will be 0.5% with 5% dextrose.
- Alternatively tetracaine will come as a 1% solution in a 2 ml vial.
- Once again mix it with an equal portion of 10% dextrose to yield a 0.5% concentration with 5% dextrose.

Tetracaine

- It is the longest acting spinal anesthetic
- Tetracaine plain will last 2-3 hours
- Addition of epinephrine or phenylephrine (0.5 mg) will make it last up to 5 hours for lower extremity surgical procedures
- Epinephrine can increase the duration of blockade by up to 50%.
- Compared to bupivacaine tetracaine produces a more profound motor block

Tetracaine

Medication	Preparation	Dose Lower Limbs	Dose Lower Abdomen	Dose Upper Abdomen
Tetracaine	1% Solution in 10% glucose or as niphanoid crystals	4-8 mg	10-12 mg	10-16 mg

Duration Plain	Duration Epinephrine
90-120 minutes	120-240 minutes

Bupivacaine

- Long acting amide
- Slow onset (5-10 minutes…isobaric may be longer)
- When compared to tetracaine a more profound motor blockade and a slightly longer duration of action are noted.
- Available in hyperbaric form in concentrations of 0.5-0.75% with 8.25% dextrose

Bupivacaine

- Isobaric concentrations range from 0.5% to 0.75%
- With isobaric formulations it appears that total mg dose is more important than the total volume

Bupivacaine

Medication	Preparation	Dose Lower Limbs	Dose Lower Abdomen	Dose Upper Abdomen
Bupivacaine	0.5-0.75% Isobaric Solution 0.5-0.75% Hyperbaric Solution in 8.25% Dextrose Hypobaric Solution	4-8 mg	10-12 mg	10-16 mg

Bupivacaine

Duration Plain	Duration Epinephrine
90-120 minutes	100-150 minutes

Ropivacaine

- Amide
- Less toxicity to CV than bupivacaine…important for epidural administration.
- For spinal anesthesia it takes 1.8-2 times the dose of bupivacaine for similar levels of blockade
- Subarachnoid block use is “off label” in the United States

Levobupivacaine

- Amide
- S isomer of bupivacaine
- Bupivacaine is a stereoisomer (racemic solution of S and R forms)
- Stereoisomer is a mirror image of the same compound…each exert some unique effects
- R isomer of bupivacaine is more cardiotoxic than the S form

Levobupivacaine

- For spinal anesthesia there are no additional benefits
- Same dosing as with bupivacaine

Hypobaric, Isobaric & Hyperbaric Spinal Anesthetic Solutions

Definitions

- Density- weight of 1 ml of solution in grams at a standard temperature
- Specific Gravity- density of a solution in a ratio compared to the density of water
- Baracity- ratio of comparing the density of one solution to another

Hypobaric Solution

- Must be less dense than CSF (1.0069)

Tetracaine as a hypobaric solution

- Mix 1% tetracaine with equal portions of preservative free sterile water.
- This will create a solution with a baracity of less than 0.9977
- For anorectal and hip repairs a dose of 4-6 mg is adequate.
- The “surgical site” should be positioned “up” as this is where the solution will gravitate

Bupivacaine as a hypobaric solution

- Isobaric bupivacaine should be warmed up to 37 degrees C.
- The solution will act hypobaric as opposed to isobaric

Isobaric Solutions

- Bupivacaine, ropivacaine & levobupivacaine in concentrations of 0.5-0.75% (plain solutions without dextrose)
- Tetracaine can be used as an isobaric solution. To create this solution the niphanoid crystals are mixed with cerebral spinal fluid (CSF) and the desired dose is administered.

Hyperbaric Solutions

- The most commonly used “type” of solution
- Height is affected by patient position during injection and after injection
- For a “saddle” block the patient should be kept sitting for 3-5 minutes to allow for “settling”.

Hyperbaric Solutions

- If patient is placed supine the medication will move cephalad to the dependent area of the thoracolumbar curve.
- Lateral position- the medication will move to the dependent area. If patient is left in this position for 5 minutes then turned supine the block will be higher and denser in the dependent side when compared to the non-dependent side.

Spinal Anesthetic Additives

- Epinephrine is generally added in doses of 01.-0.2 mg
- Phenylephrine is generally added in doses of 1-2 mg
- Additives may prolong the spinal block by decreasing uptake of the local anesthetic and weak analgesic properties (alpha 2 adrenergic effects)

Spinal Anesthetic Additives

- Unfounded concerns of spinal cord ischemia in normal patients when usual doses are administered

Epinephrine will prolong:

- Procaine
- Bupivacaine
- Tetracaine
- Lidocaine

Phenylephrine will prolong:

- Tetracaine
- Lidocaine

Medication	Preparation	Dose Lower Limbs	Dose Lower Abdomen	Dose Upper Abdomen
Procaine	10% Solution	75 mg	125 mg	200 mg
Lidocaine	5% Solution in 7.5% dextrose	25-50 mg	50-75 mg	75-100 mg
Tetracaine	1% Solution in 10% glucose or as niphanoid crystals	4-8 mg	10-12 mg	10-16 mg
Bupivacaine	0.5-0.75% Isobaric Solution 0.5-0.75% Hyperbaric Solution in 8.25% Dextrose Hypobaric Solution	4-10 mg	12-14 mg	12-18 mg

Summary

Medication	Duration Plain	Duration Epinephrine
Procaine	45 minutes	60 minutes
Lidocaine	60-75 minutes	60-90 minutes
Tetracaine	90-120 minutes	120-240 minutes
Bupivacaine	90-120 minutes	100-150 minutes

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