RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

School of Nursing

Neuraxial Anesthesia Refresher Workshop

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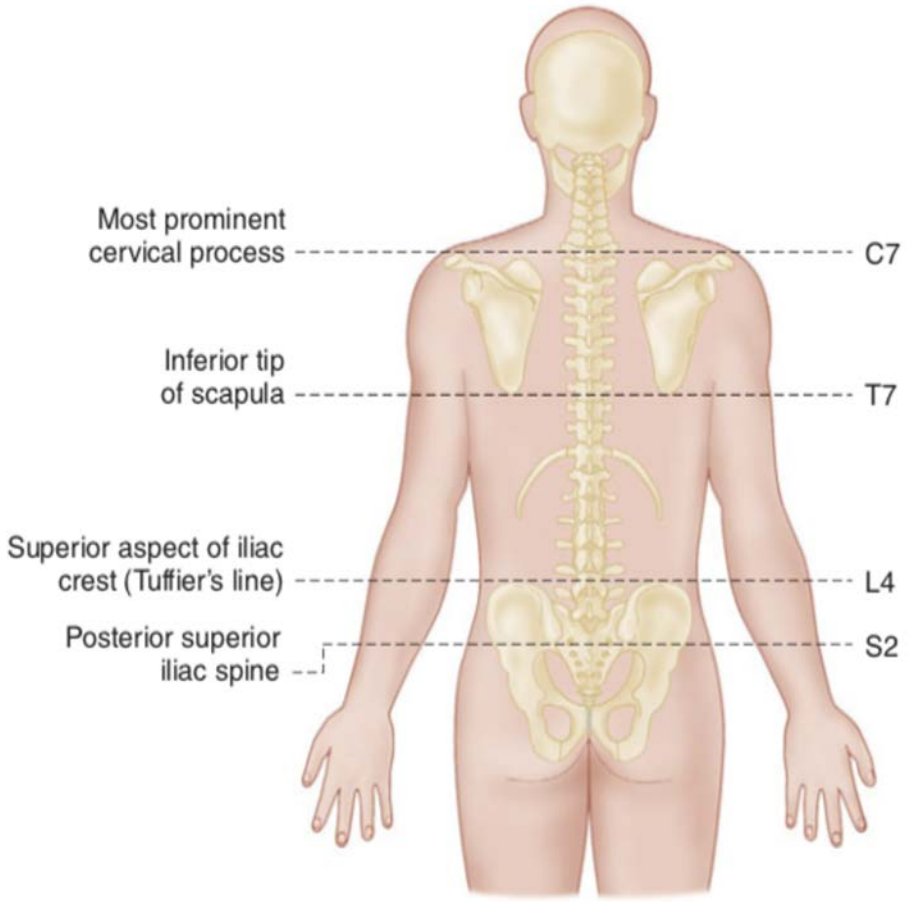
Objectives

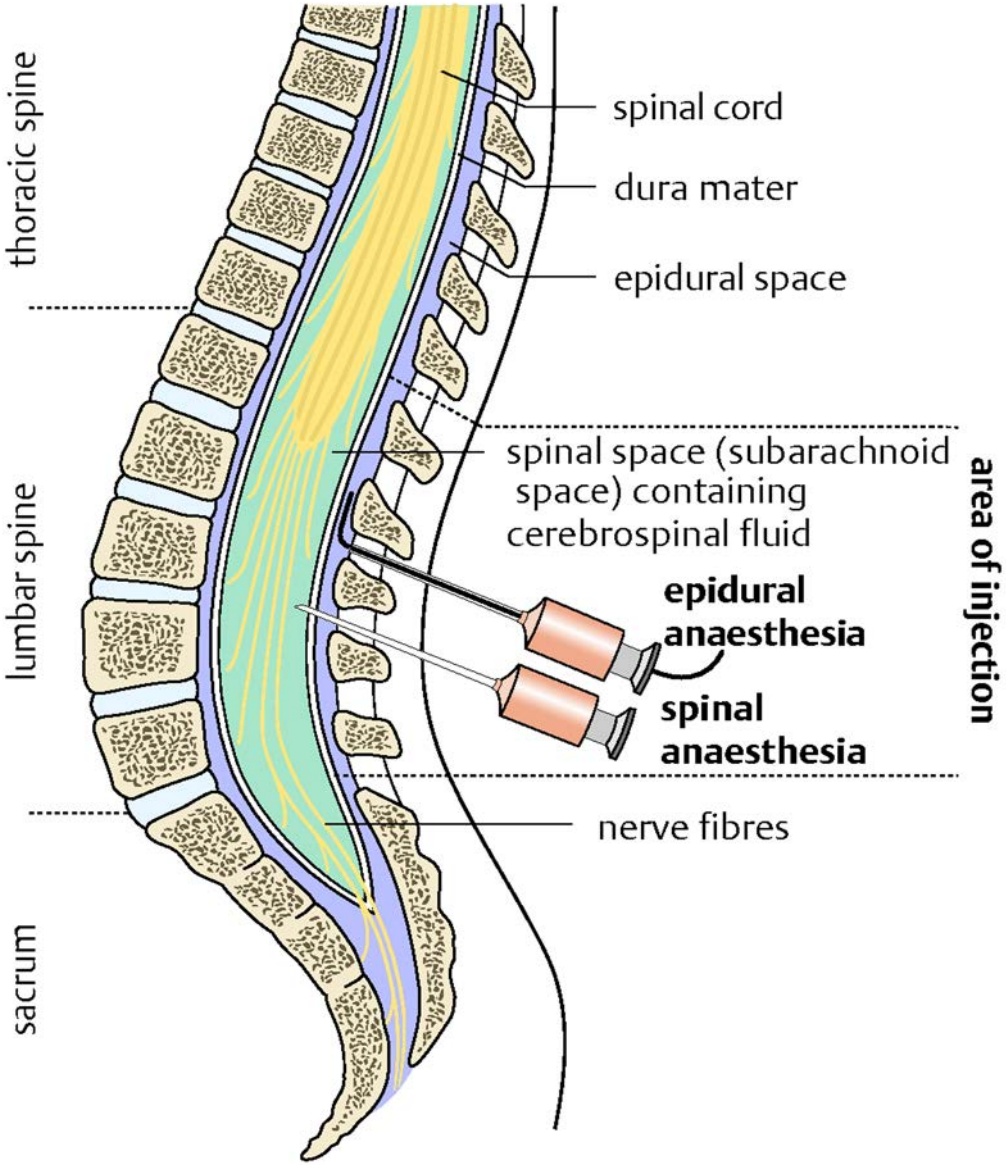
- Refresh knowledge in neuraxial anesthesia to:
  - Improve readiness and ability to perform Neuraxial Anesthesia techniques
  - Refresh knowledge for re-certification exam
  - Improve confidence levels

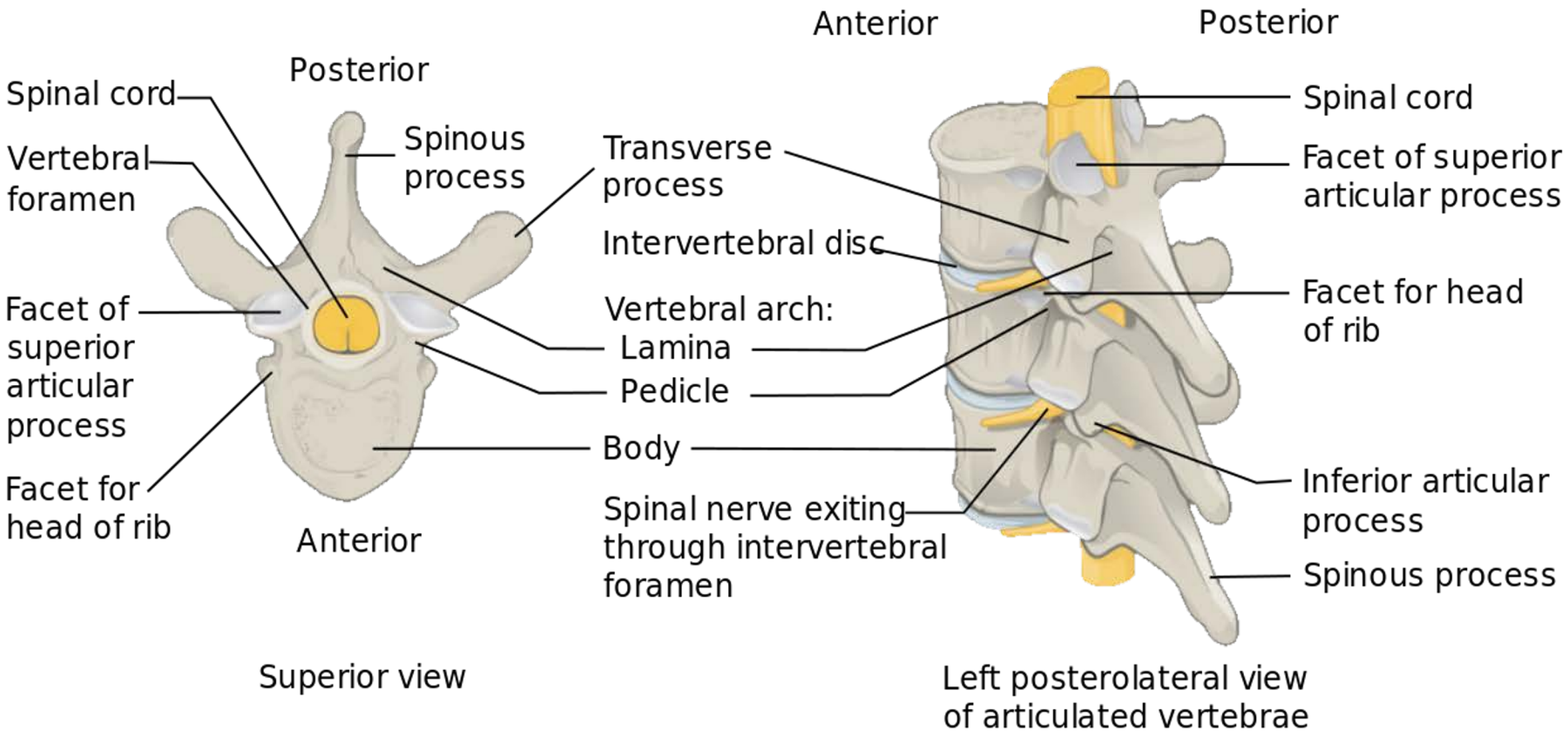
- Topics
  - Anatomy
  - Equipment
  - Spinal Anesthesia Procedure
  - Epidural Anesthesia Procedure
  - Local Anesthetics
  - Troubleshooting
  - Complications
  - Key concepts

Anatomy

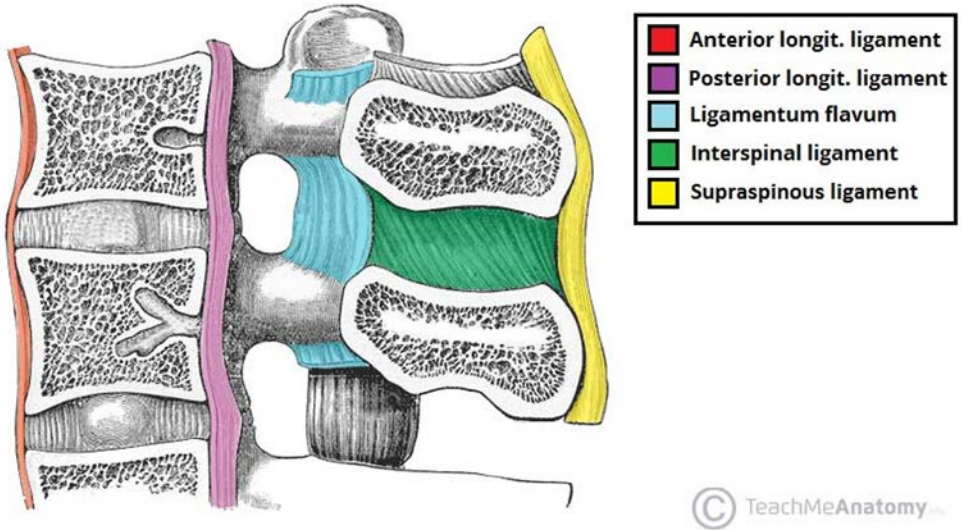
- Spinal Cord anatomy
  - 31 pairs of spinal nerves
  - Vertebrae (33)
    - Cervical: 7
    - Thoracic: 12
    - Lumbar: 5
    - Sacral: 5 (fused together)
    - Coccygeal: 4 (fused together)
  - Spinal cord ends at L1
  - Below spinal cord is the cauda equina
  - Dural sac ends at S2 (S3 in infants)
- Tuffier's line/iliac crest (L4)
- Epidural and Intrathecal spaces
- Veins, fat, ligaments surrounding vertebral column

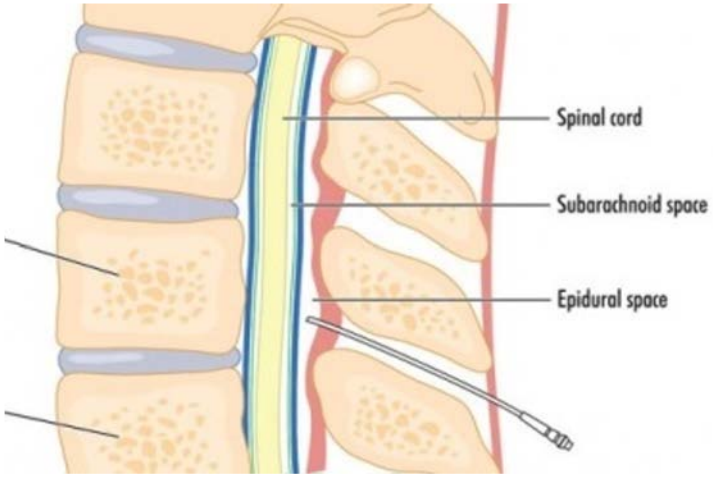



thoracic spine
lumbar spine
sacrum
spinal cord
dura mater
epidural space
spinal space (subarachnoid space) containing cerebrospinal fluid
epidural anaesthesia
spinal anaesthesia
nerve fibres
area of injection


Posterior
Spinal cord
Vertebral foramen
Spinous process
Facet of superior articular process
Facet for head of rib
Anterior
Superior view
Anterior
Posterior
Transverse process
Intervertebral disc
Vertebral arch:
Lamina
Pedicle
Body
Spinal nerve exiting through intervertebral foramen
Spinal cord
Facet of superior articular process
Facet for head of rib
Inferior articular process
Spinous process
Left posterolateral view of articulated vertebrae

Anatomy: Skin to Spinal Cord
Ligaments & Meningeal Spaces





SKIN
Subcutaneous tissue
Supraspinous ligament
Interspinous ligament
Ligamentum Flavum
*Epidural Space
Dura mater
*Subdural space
Arachnoid mater
*Subarachnoid space
Pia mater
SPINAL CORD

Preparation for the Block

- Labs
  - Ensure platelets are >100 and look at trends
  - Coagulation studies
- History
  - History of neuraxial, PDPH?
  - Allergies to local anesthetics or opioids?
  - Scoliosis? Hardware in spine?
  - Bruise easily, history of bleeding disorders?
  - Cardiac valve lesions?
- Medications
  - Blood thinners?
- Consent
  - Patient is aware of risks associated with procedure, explain chance of headache and mitigation strategies for PDPH
- Monitors
  - Spo2, BP, HR and ensure IV is working
- Hydration
  - Ensure patient has had adequate IV hydration
  - Sympathectomy from blockade of SNS fibers (T1-T4) will result in hypotension and subsequent nausea; 15 ml/kg IV hydration before block is useful in preventing hypotension and the associated symptoms

Absolute and Relative Contraindications

Absolute
- Infection at the site of injection
- Patient refusal
- Coagulopathy or other bleeding diathesis
- Severe hypovolemia
- Increased intracranial pressure
- Severe aortic stenosis
- Severe mitral stenosis

Relative
- Sepsis
- Uncooperative patient
- Preexisting neurological deficits
- Demyelinating lesions
- Stenotic valvular heart lesions
- Left ventricular outflow obstruction (hypertrophic obstructive cardiomyopathy)
- Severe spinal deformity

Controversial
- Prior back surgery at the site of injection
- Complicated surgery
- Prolonged operation
- Major blood loss
- Maneuvers that compromise respiration

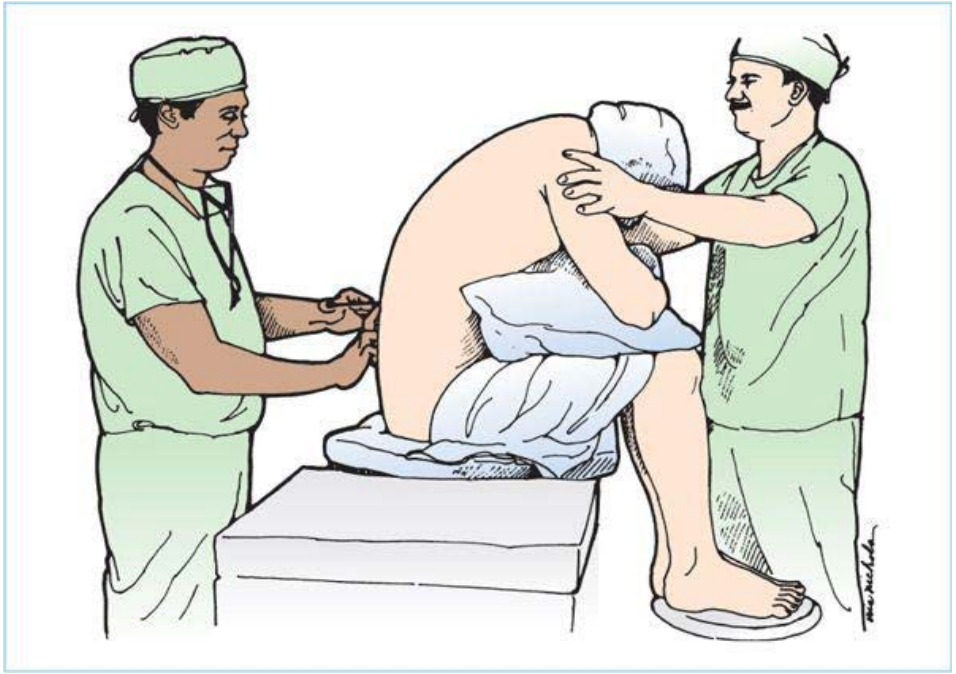
This list varies among resources but ultimately it is up to the judgement of the provider and what is best for the patient

Neuraxial Anesthesia and Anticoagulants

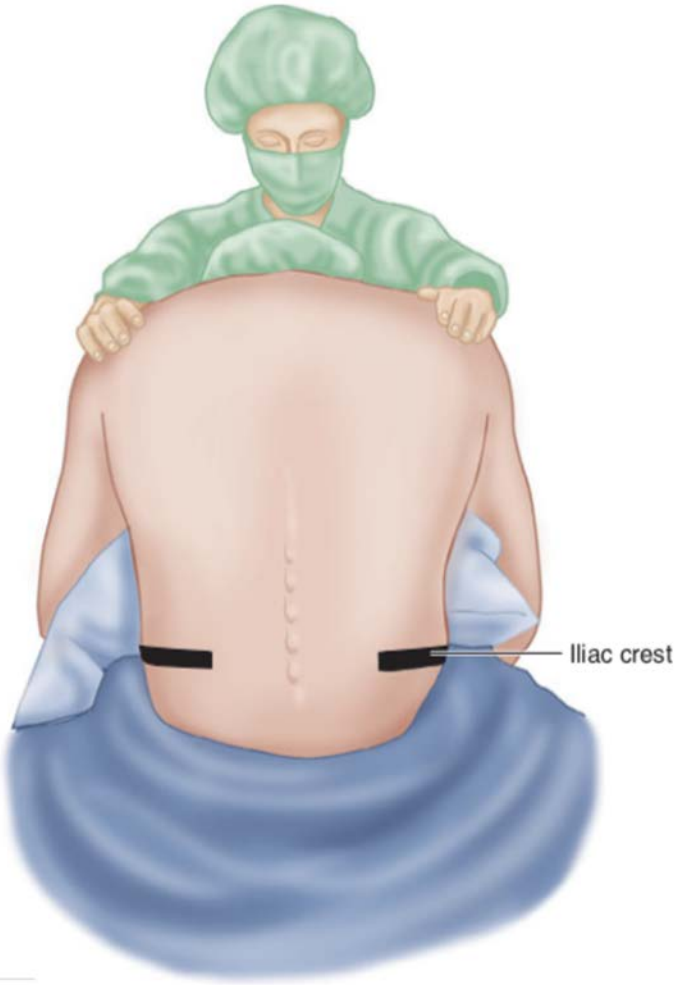
Drug	Time before Neuraxial procedure or catheter removal	Time after Neuraxial Procedure or catheter removal
Aspirin NSAIDS	None	None
Clopidogrel	7 days	After catheter removal
Prasugrel	7-10 days	6 hrs
Ticagrelor	5 days	6 hrs
Warfarin	5 days w/ normal INR	After catheter removal
Heparin (IV) Heparin (subcutaneous)	4-6 hrs None	1-2 hrs None
LMWH - Prophylactic (QD) - Therapeutic (BID)	 12 hrs 24 hrs	 4 hrs 4 hrs
Rivaroxaban	9-13 hrs	11-26 hrs
Apixaban	15 hrs	26-30 hrs

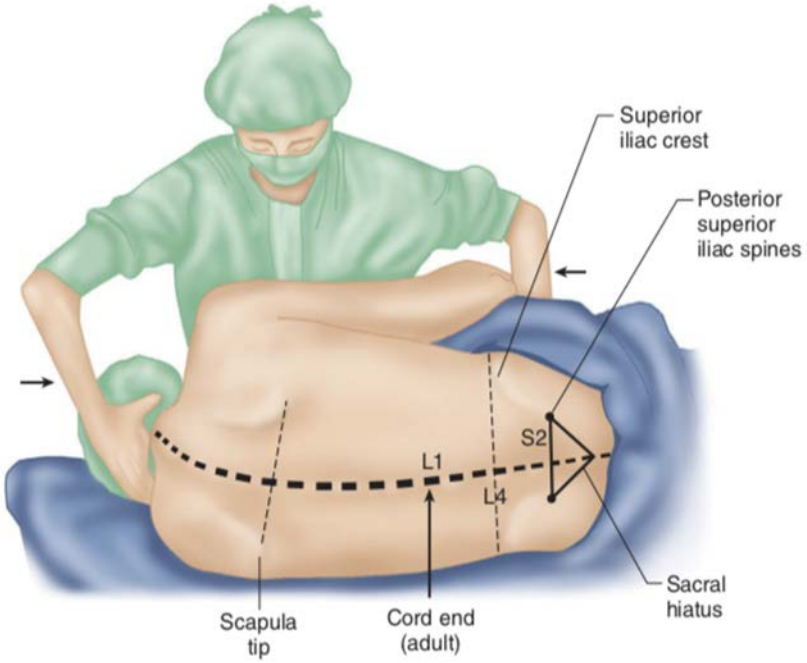
Position

- Sitting upright in bed or OR table
- Shoulders forward and relaxed
- Lower back curling out and patient should push out posteriorly
- Ensure patients hips are even and spine is aligned
  - *Inserting the needle midline is essential for successful neuraxial administration*
- This will open up the lumbar vertebral interspaces



Position: Sitting & Lateral





Patients can also be <u>lateral</u>. Ensure that:

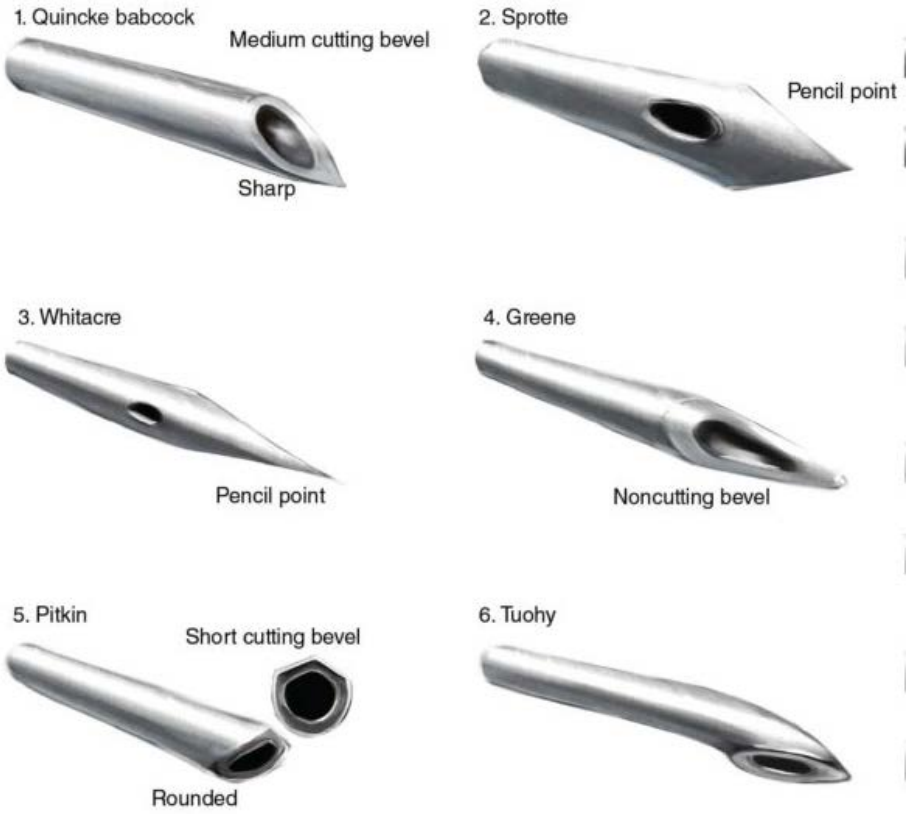
- Hips are vertical
- Back is straight and to the edge of the table
- Pillow can be placed between legs and knees drawn up to chest
- Shoulders are vertical
- Head in a comfortable position
- Vertebral axis is aligned

Equipment

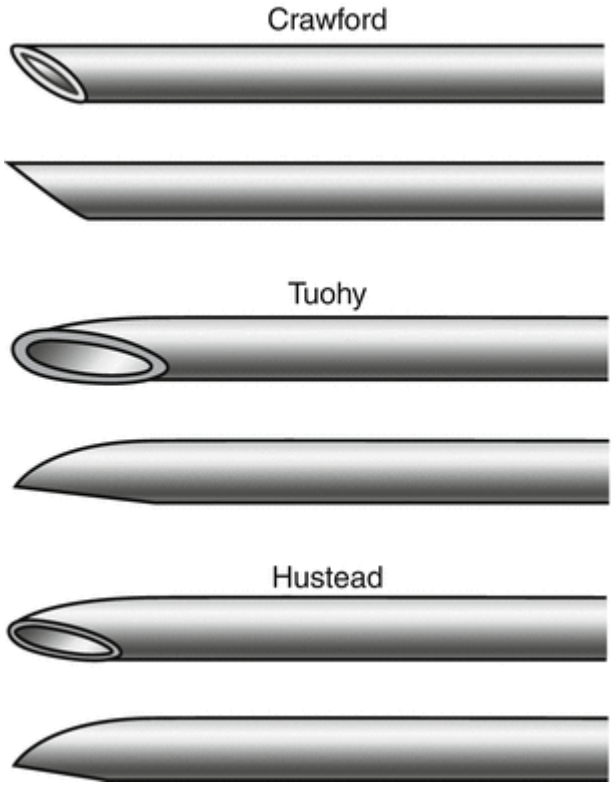
- Kits
  - Spinal
  - Epidural
  - CSE
- Needles
  - Cutting Tip
  - Non-cutting Tip
- Sterile gloves/mask
- Medications
  - Local Anesthetics
  - Adjuncts

SPINAL NEEDLES	Cutting Tip	Non-cutting tip (pencil point; Rounded bevel)
Examples	Quincke Pitkin	Sprotte (Pencil point) Whitacre (pencil point) Pencan (pencil point) Greene (rounded bevel tip)
Force	Requires less force	Requires more force
Tactile Feel	Less tactile feel	More tactile feel
Needle deflection	Needle more easily deflected	Less likely to deflect
PDPH Incidence	**Higher risk of PDPH**	Lower risk of PDPH
Cauda Equina incidence	More likely to cause cauda equina syndrome	Less likely to cause cauda equina syndrome

Types of Spinal Needles



Types of Epidural Needles



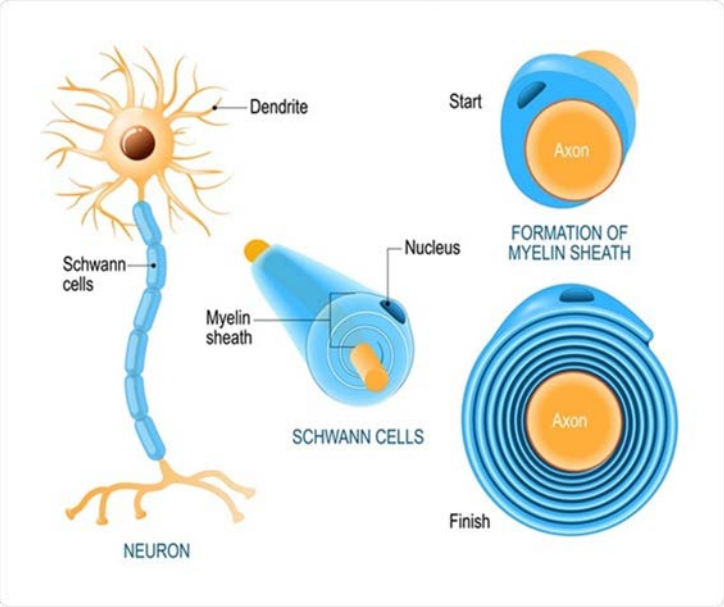
Differential Blockade

1st → Autonomic pre-ganglionic fibers
- ❖ B-fibers
  - ❑ Light myelination, small diameter
  - ❑ Effects = sympathectomy

2nd → Sensory
- ❖ C-fibers
  - ❑ Not myelinated
  - ❑ Dull and slow pain, temperature, touch
- ❖ A-delta fibers
  - ❑ Medium myelination
  - ❑ Fast pain, temperature, touch

3rd → Motor
- ❖ A-alpha fibers
  - ❑ Heavy myelination, large diameter
  - ❑ Skeletal muscle movement and proprioception
- ❖ A-beta fibers
  - ❑ Heavy myelination, large diameter
  - ❑ Touch, pressure

** Compared with the level of sensory block associated with a spinal, the motor blockade occurs 2-3 segments lower and sympathetic blockade 2-6 segments higher.



Local Anesthetic Properties

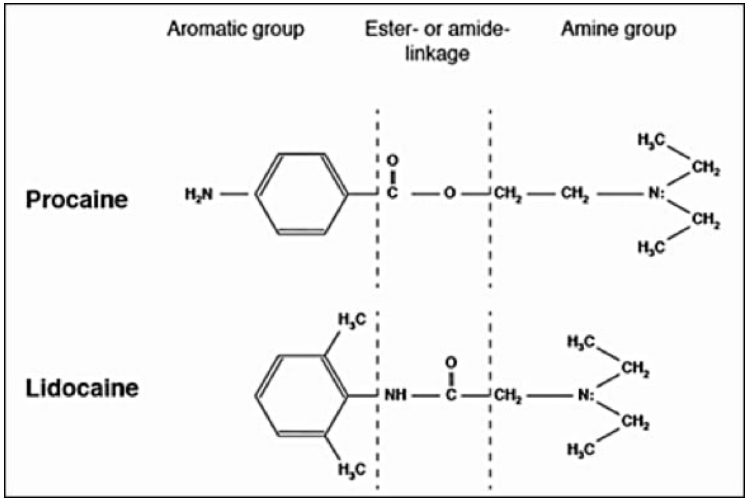
- Local anesthetics are weak bases
  - Un-ionized concentration remains higher when the pH is higher
  - The local anesthetic will dissociate based on the pKa of the drug and the pH of the solution that it is being injected into
- **MOA:** Unionized local anesthetic penetrates the lipid-bilayer of the nerve axon and then becomes ionized once inside the cell. The ionized form them binds to the sodium channels and blocks the conduction of nerve impulses (pain)
- Important properties of LAs to know:
  - High lipid solubility = more potent
  - High protein binding = longer duration of action

Commonly used Local Anesthetics

Esters	Max Dose (mg/kg)	Duration (h)
Chloroprocaine	12	0.5 – 1
Procaine	12	0.5 – 1
Cocaine	3	0.5 – 1
Tetracaine	3	1.5 – 6

Amides	Max Dose (mg/kg)	Duration (h)
Lidocaine	4.5/(7 with epi)	0.75 – 1.5
Mepivacaine	4.5/(7 with epi)	1 – 2
Prilocaine	8	0.5 – 1
Bupivacaine	3	1.5 – 8
Ropivacaine	3	1.5 – 8

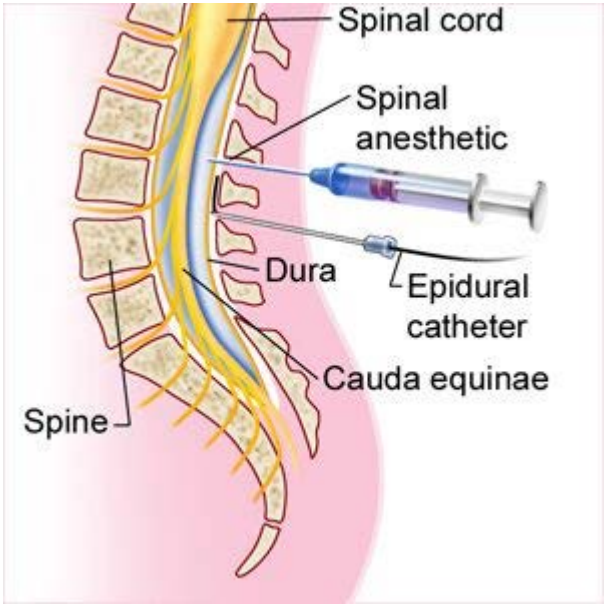
Amides vs. Esters



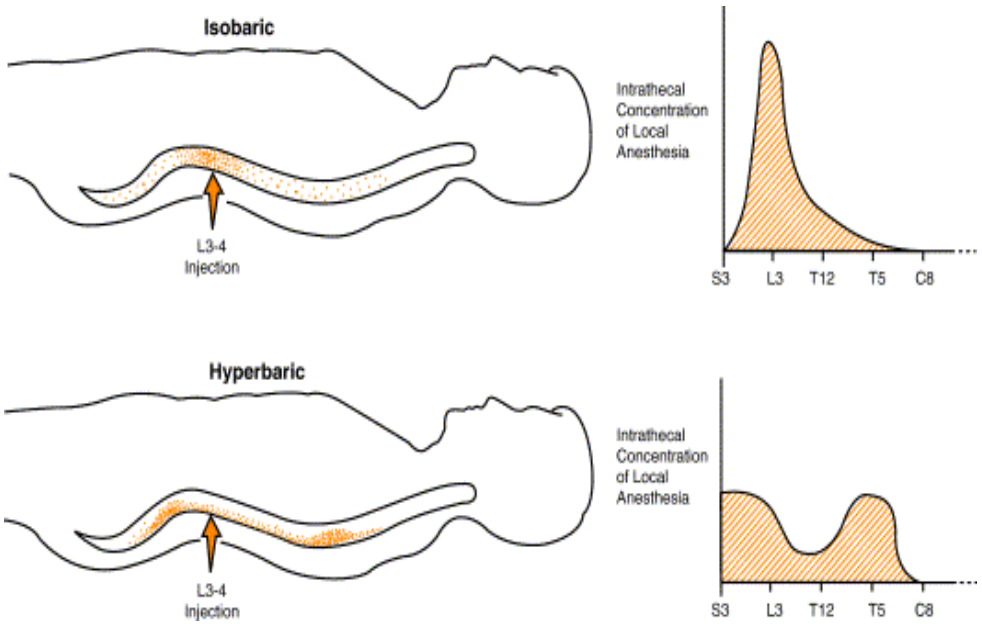
Characteristics	Drug (generic name)	Common Brand Name	Onset	Duration of Action (min)
Low potency, short duration of action	procaine	Novocaine	Slow	60-90
	chloroprocaine	Nesacaine	Fast	30-60
Intermediate potency, duration	mepivacaine	Carbocaine	Fast	120-240
	lidocaine	Xylocaine	Fast	90-120
High potency, long duration	tetracaine	Pontocaine	Slow	180-600
	bupivacaine	Marcaine, Sensorcaine	Slow	180-600
	ropivacaine	Naropin	Slow	180-600

Spinal Anesthesia

- Local anesthetics and adjuncts injected into the **intrathecal** space, providing a **dense** blockade of sensory, autonomic and motor fibers
- Primary site of action is on the myelinated preganglionic fibers of the **spinal nerve roots**
- Single shot injection with a rapid onset, lasting 2-4 hrs
- Small volume of medication
- Block is dependent upon:
  - *Drug concentration*
  - *Baricity*
  - *Patient position*



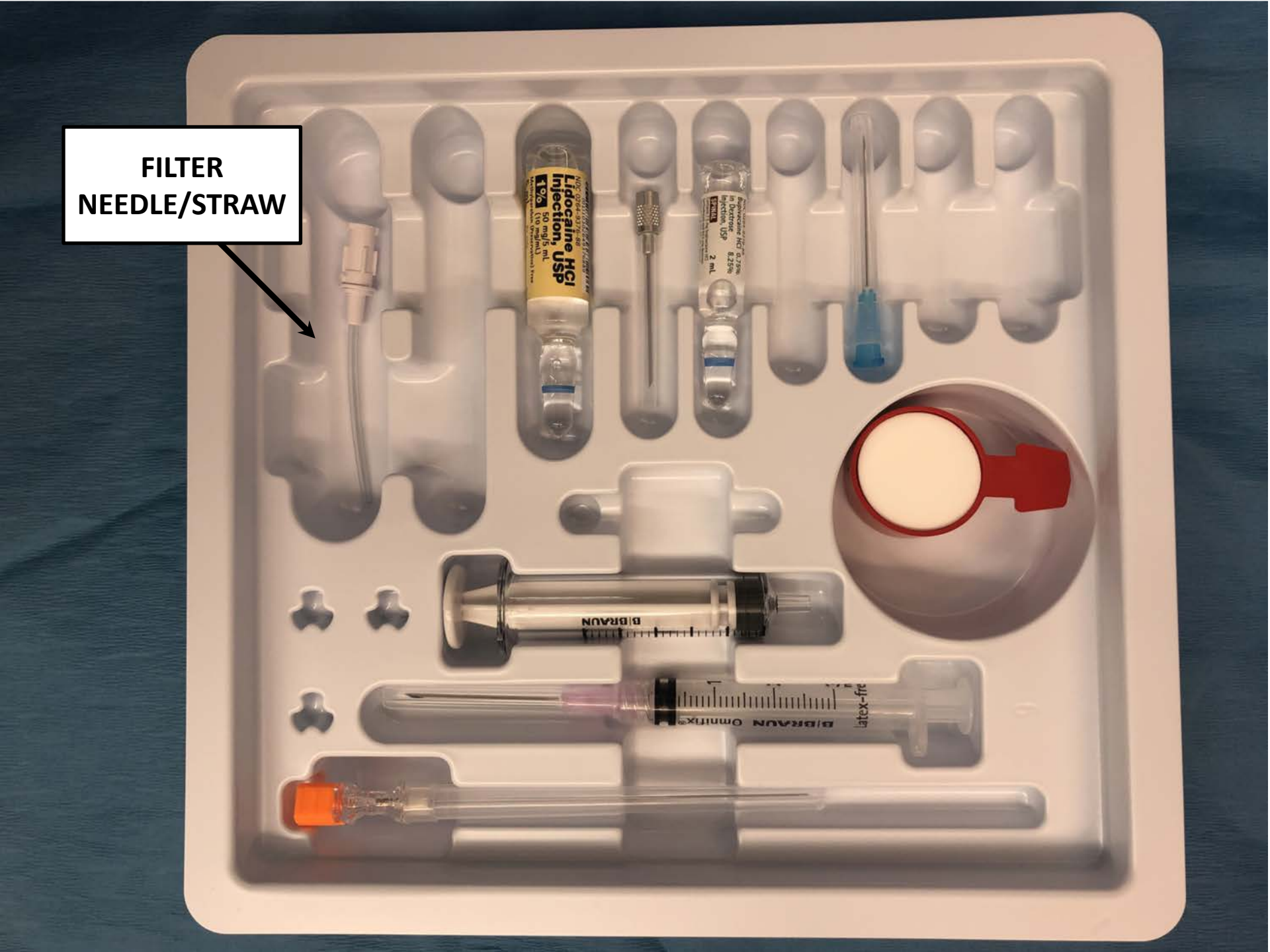
Baricity

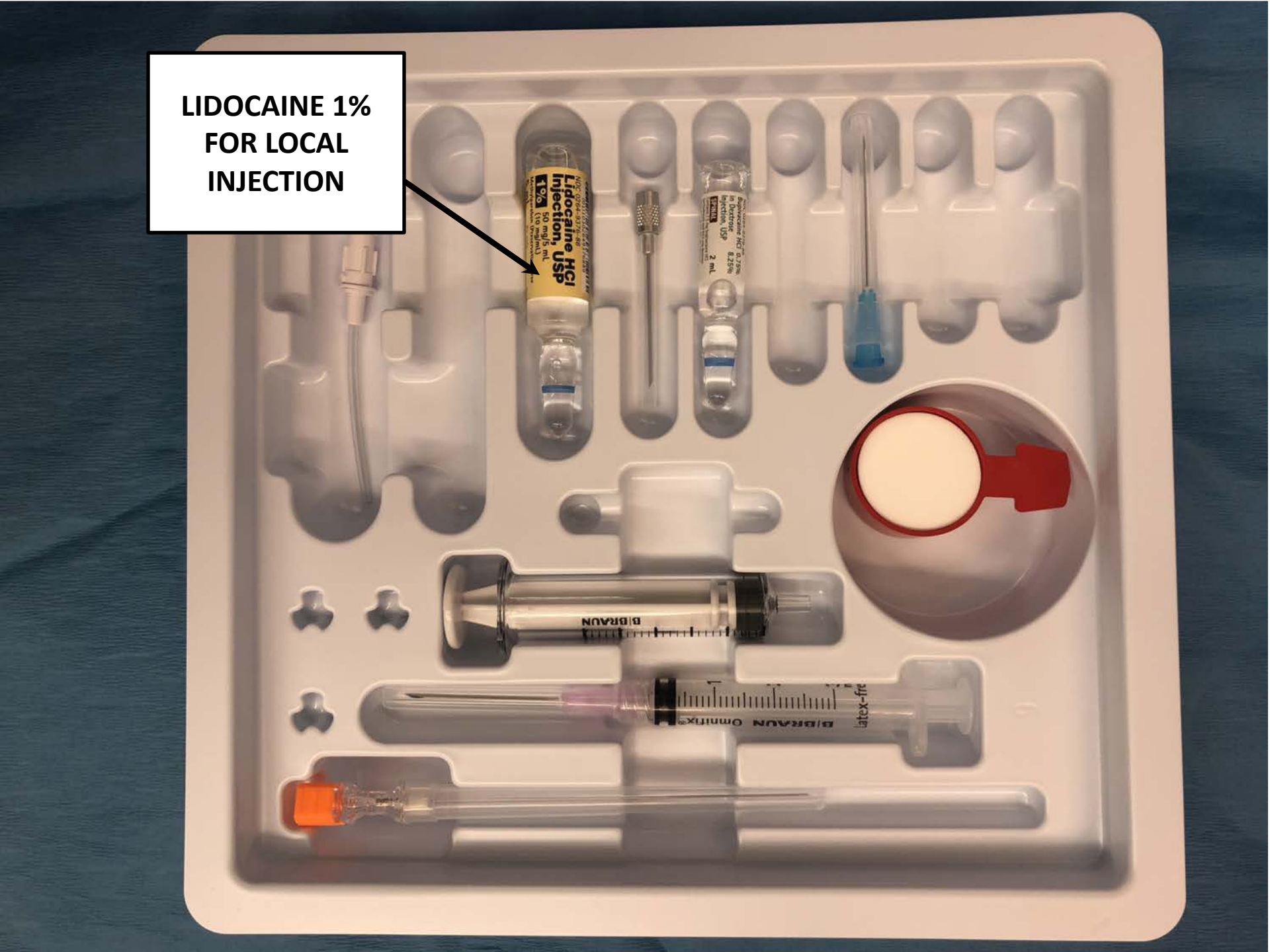


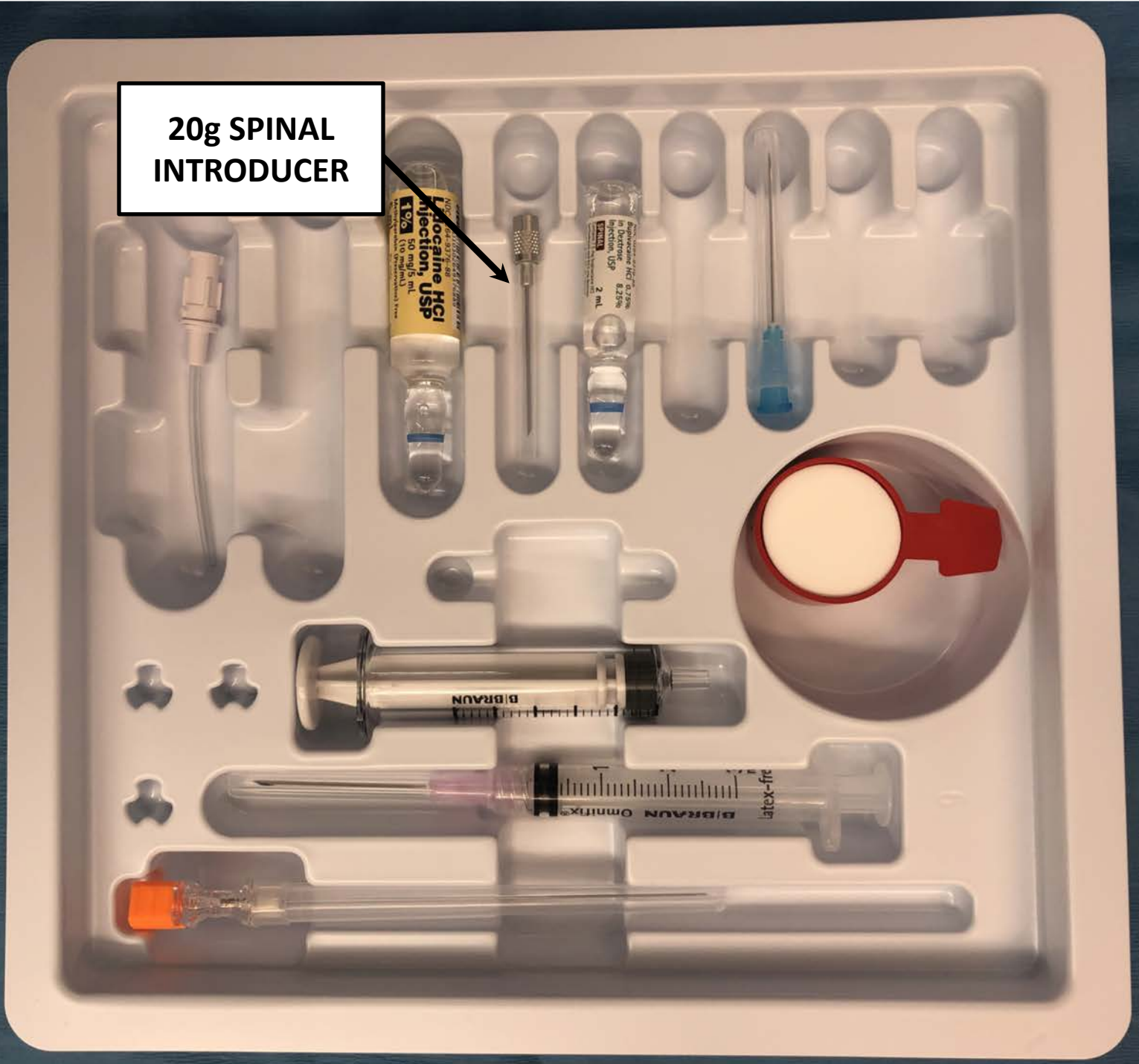
- Baricity is the density of the local anesthetic when comparing it to CSF
  - The specific gravity of CSF is 1.002-1.009
- Isobaric
  - Similar density to CSF, solution will not move
  - Saline is added to make a solution isobaric
- Hypobaric
  - Less dense than CSF, solution will rise
  - Water is added to make a solution hypobaric
- Hyperbaric
  - More dense than CSF, solution will sink
  - Dextrose is added to make a solution hyperbaric

Spinal Kit

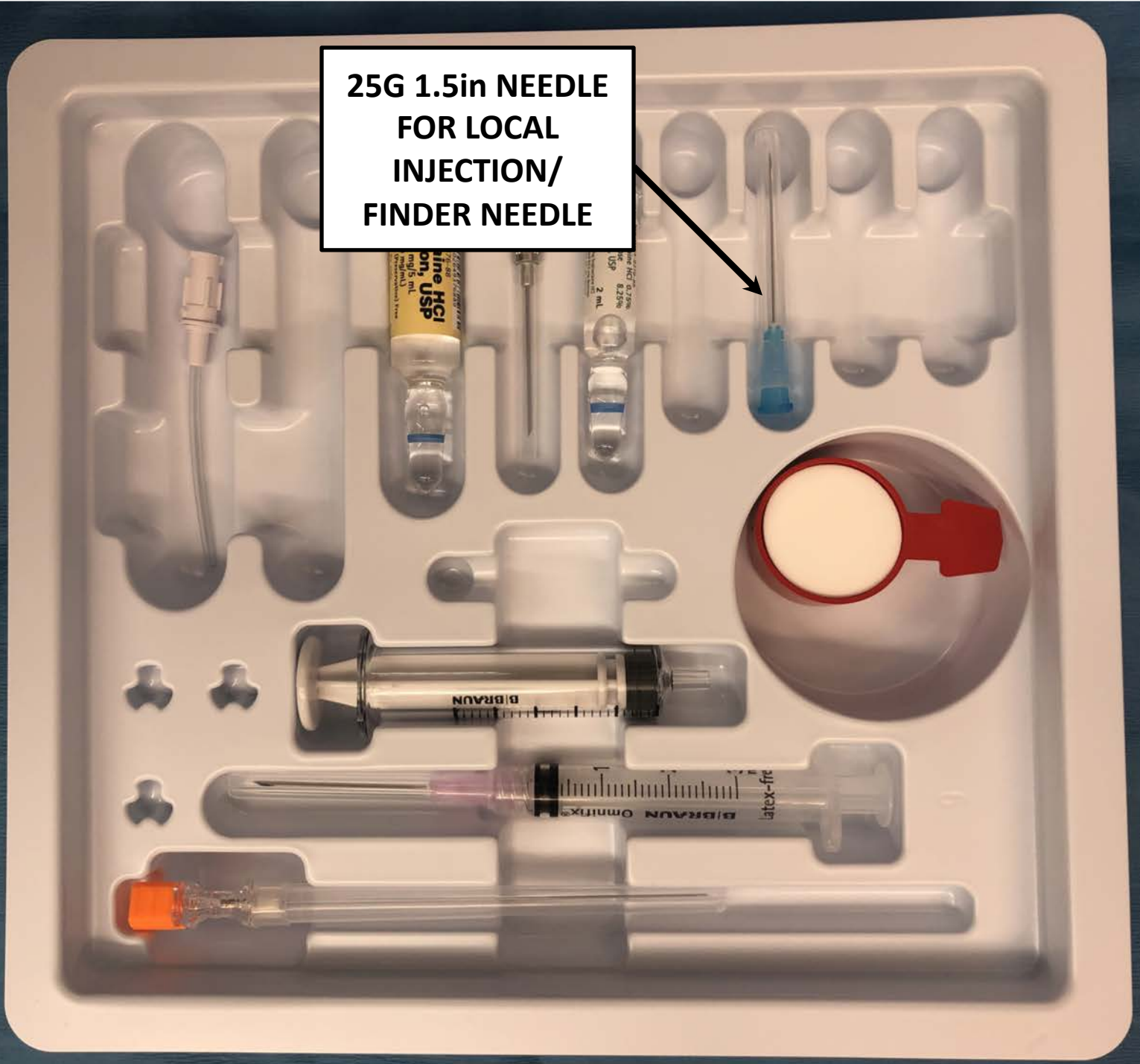
- ✓ Prep Solution
- ✓ 3 Prep Sponges
- ✓ Clear fenestrated drape
- ✓ Gauze sponges
- ✓ Spinal needle: 25g
- ✓ Needles:
  - 25g local needle
  - 20g Spinal Introducer Needle
  - Filter Needle/Straw
- ✓ Syringes
  - 3 mL (used for local)
  - 5 mL without luer lock (for spinal medication injection)
- ✓ Medications:
  - Local → lidocaine 1-2% 5ml vial
  - Block → 0.75% Bupivacaine with dextrose 8.25% (hyperbaric)
- ✓ Needle holder

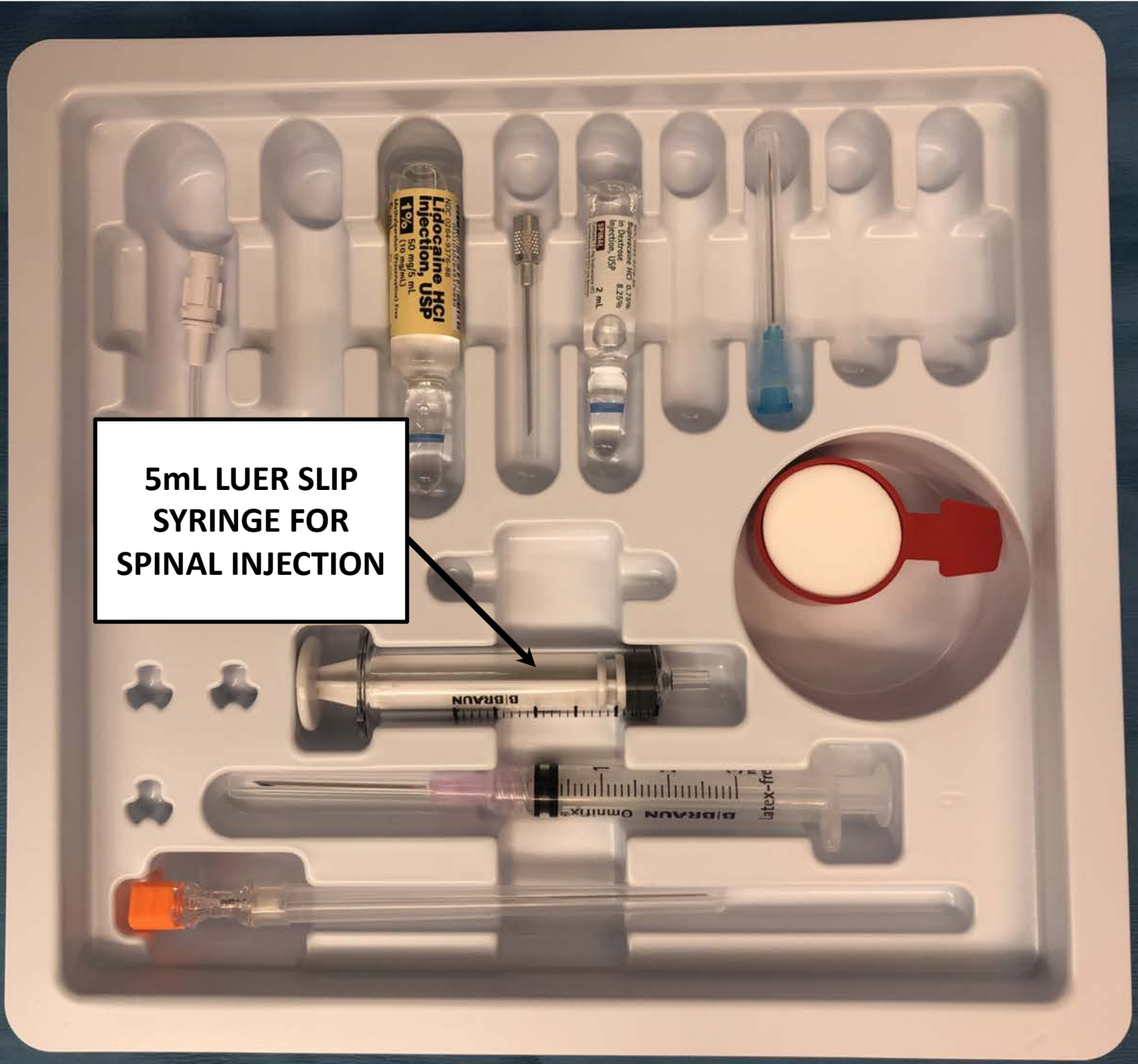

FILTER
NEEDLE/STRAW
Lidocaine HCl
Injection, USP
1%
50 mg/5 mL
2 mL
B|BRAUN
B|BRAUN Omnifix
latex-fre

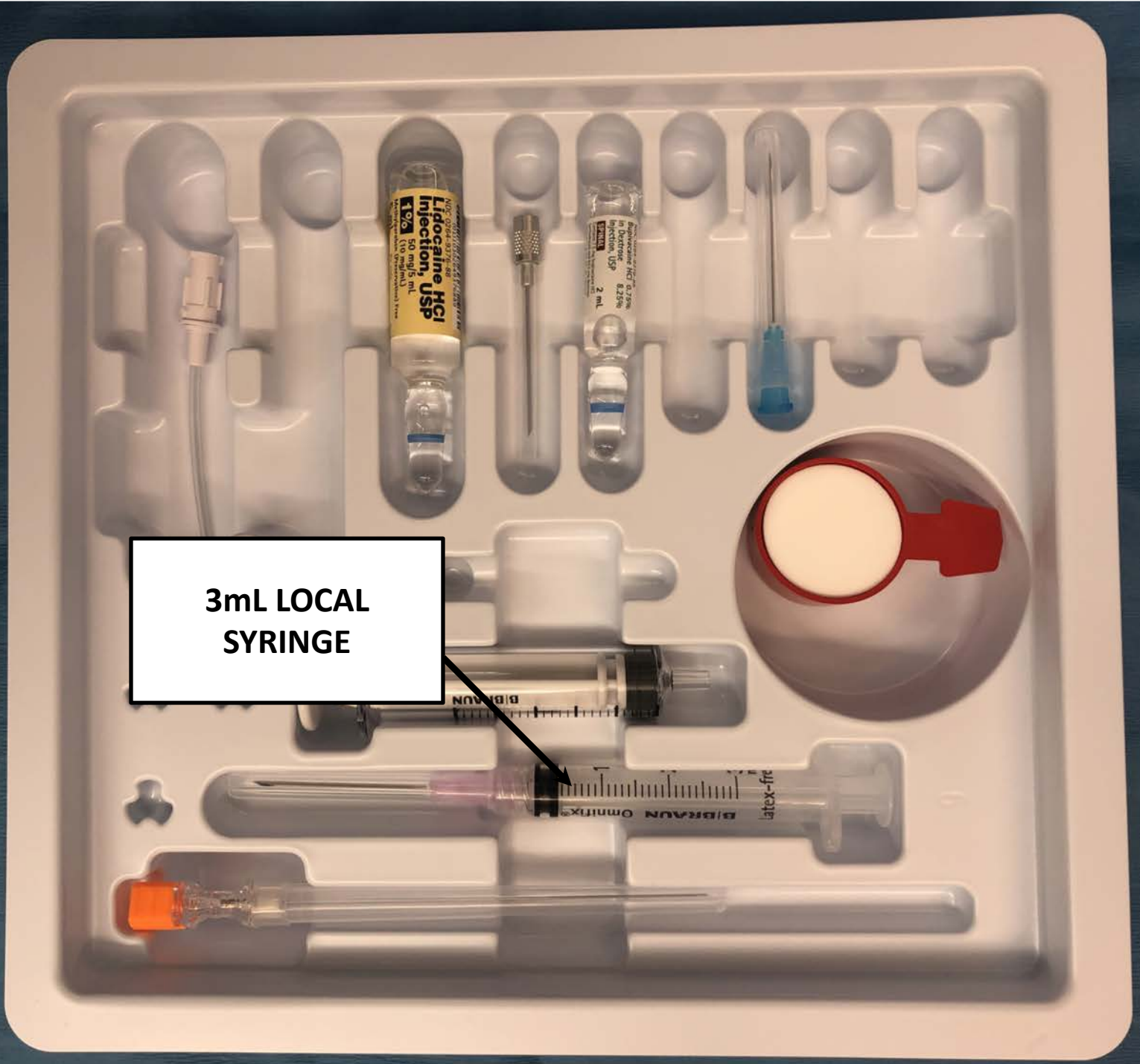

LIDOCAINE 1%
FOR LOCAL
INJECTION
Lidocaine HCl
Injection, USP
1%
50 mg/5 mL
B|BRAUN
B|BRAUN Omnifix
latex-fre

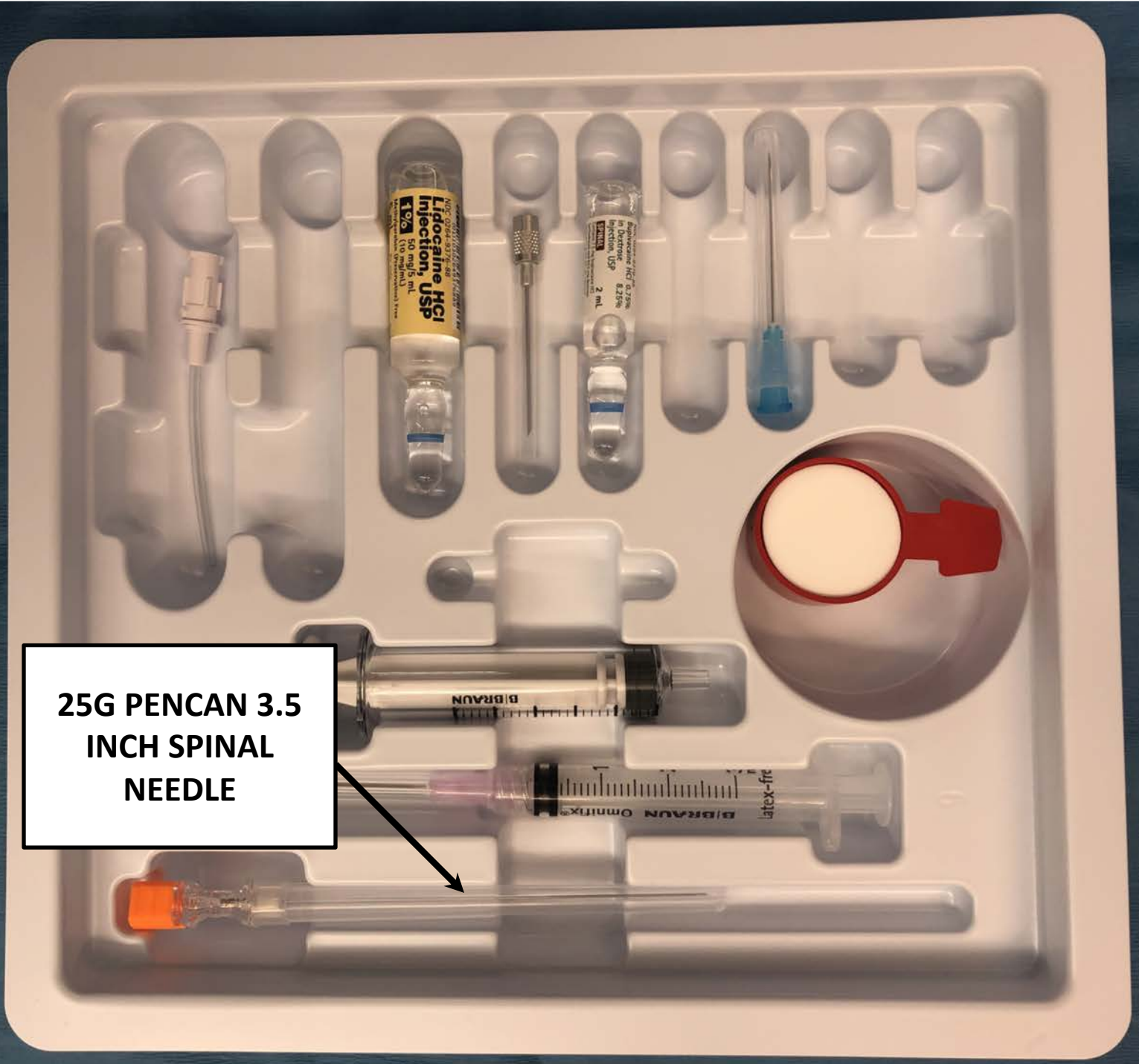

20g SPINAL
INTRODUCER
Lidocaine HCl
Injection, USP
1%
50 mg/5 mL
Bupivacaine HCl 0.75%
in Dextrose Injection, USP
0.25%
2 mL
B|BRAUN
B|BRAUN Omnifix
latex-free

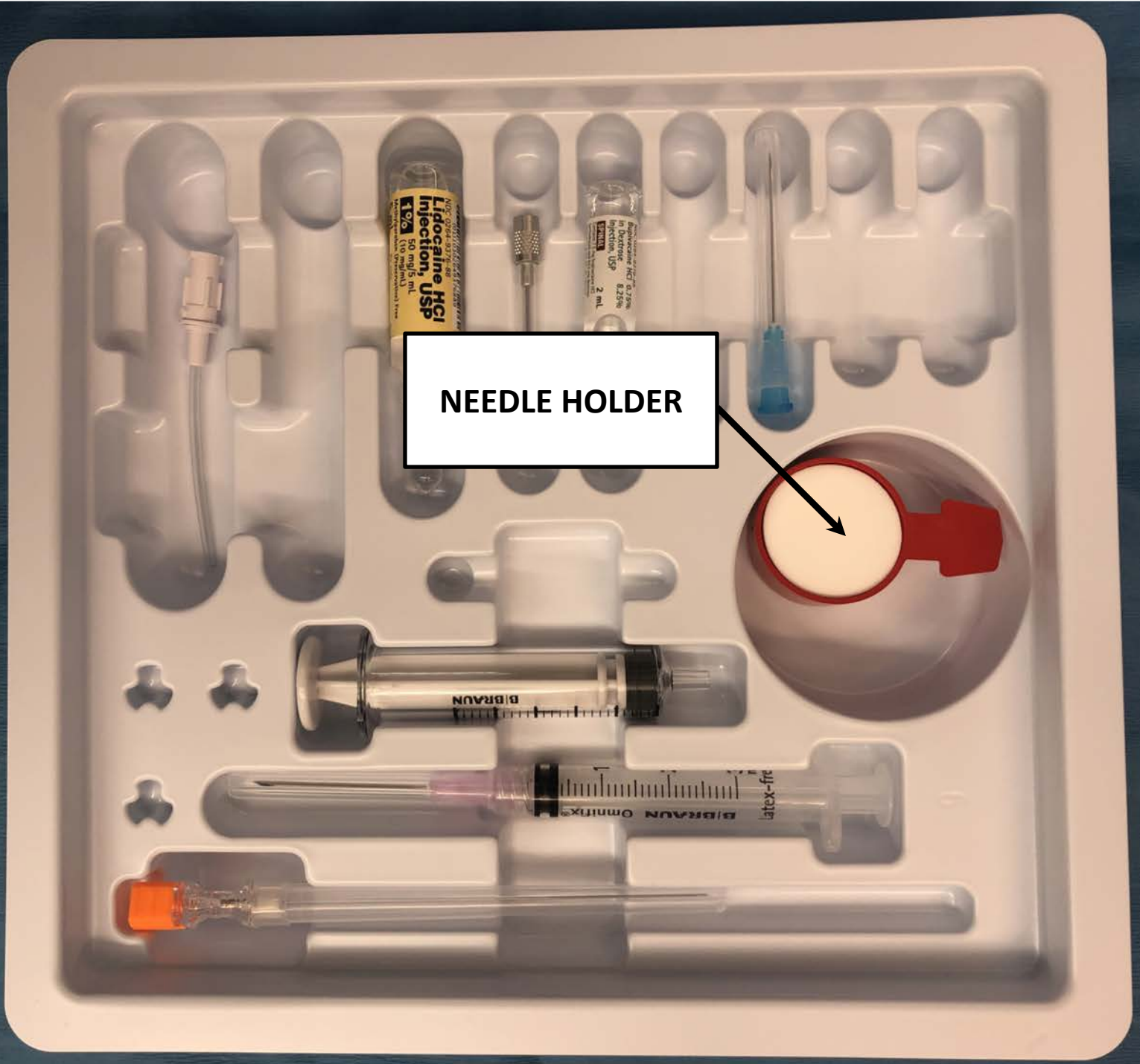

0.75% BUPIVACAINE WITH DEXTROSE FOR SPINAL INJECTION
B|BRAUN
B|BRAUN Omnifix
latex-fre


25G 1.5in NEEDLE
FOR LOCAL
INJECTION/
FINDER NEEDLE


5mL LUER SLIP SYRINGE FOR SPINAL INJECTION
Lidocaine HCl Injection, USP
1%
50 mg/5 mL
B|BRAUN
B|BRAUN Omnifix
latex-free


3mL LOCAL SYRINGE
Lidocaine HCl Injection, USP
1%
50 mg/5 mL
2 mL
B/BRAUN
Omnifix
latex-free


25G PENCAN 3.5 INCH SPINAL NEEDLE
Lidocaine HCl Injection, USP
1%
50 mg/5 mL
B|BRAUN
B|BRAUN Omnifix
Latex-Free


NEEDLE HOLDER
Lidocaine HCl Injection, USP
1%
50 mg/5 mL
2 mL
B|BRAUN
B|BRAUN Omnifix
latex-fre

Spinal Anesthetic Steps

- Ensure patient is in the optimal position
- Locate iliac crest and palpate L3-L4 interspace. Make mark on skin
- Hand hygiene, open kit, place sterile gloves on
- Clean back with betadine or chlorhexidine
  - Wait for back to dry completely, these agents can be neurotoxic if not fully dried and inadvertently injected into the intrathecal space
- Put up sterile drape
- While betadine is drying, prepare the items in your sterile kit
  - Lidocaine 1-2% in a 3mL syringe and 25g needle for local infiltration
  - Dose of spinal medication
    - Example: 1.5 mL of 0.75% Bupivacaine + 20 mcg Fentanyl + 100 mcg Duramorph (preservative free Morphine)
    - Example: 1.7 mL of 0.75% Bupivacaine + 250 mcg Duramorph
- While maintaining sterility, find the spot that you will be placing the introducer

Spinal Anesthetic Steps (cont.)

- Administer the local anesthetic by placing a wheal in the skin; use the local needle as a "finder" to ensure that you are midline and between two spinous processes. There are no sensory nerves in the ligaments so once the skin is numb, the patient should just feel pressure
- Place introducer through skin wheal, perpendicular to the back
- Place spinal needle through introducer, continue advancing until you feel a pop
- The pop represents the dural puncture. Remove stylet and watch for backflow of CSF
- Attach syringe and aspirate, looking for the barbotage of CSF and then inject the medication. You can inform the patient that they will feel a warm sensation in their legs and buttocks
- At this point, you can either aspirate again, or just remove everything from the back in one swift motion and quickly lay the patient flat so the medication spreads

Spinal Video

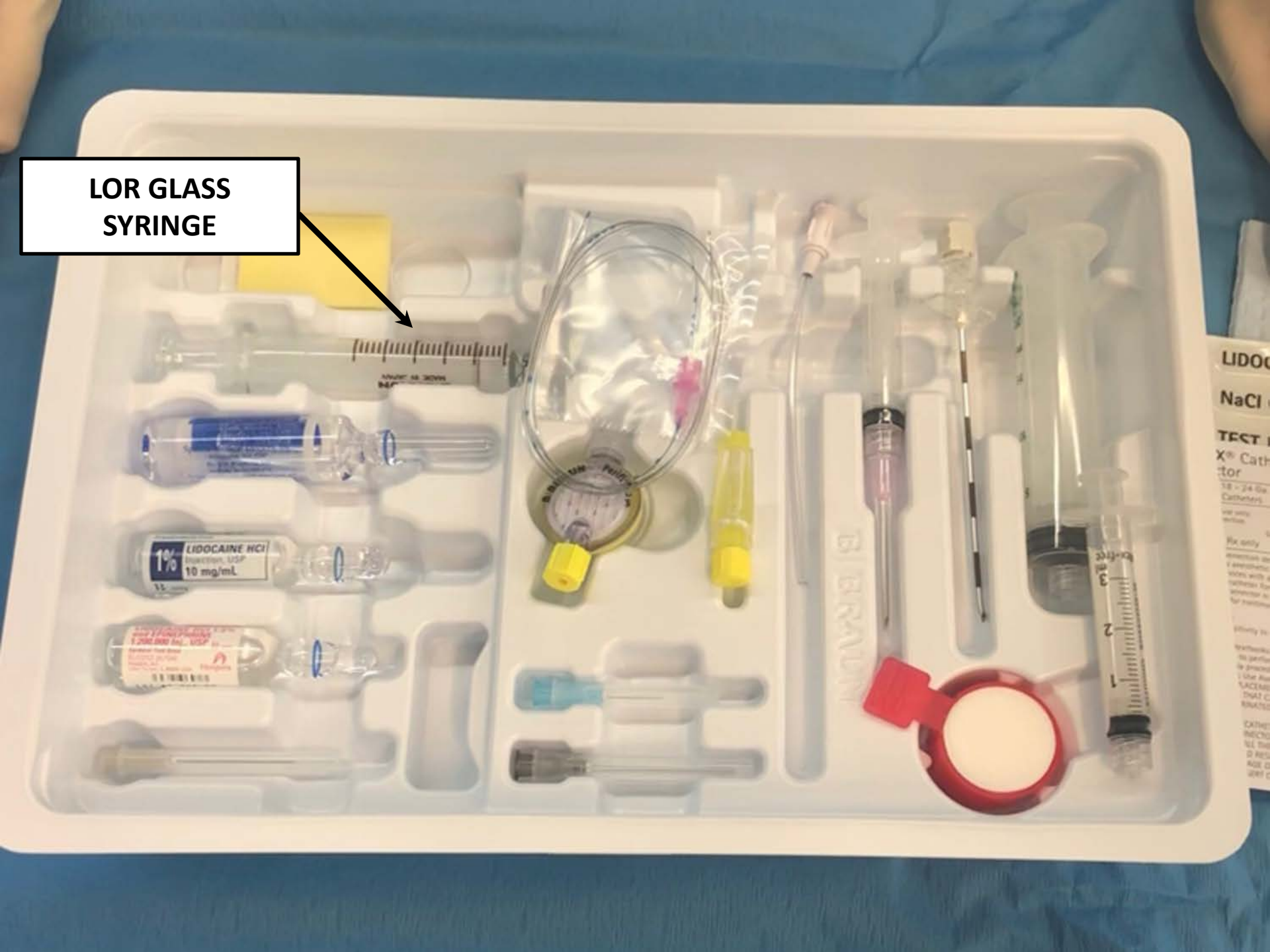
https://www.youtube.com/watch?v=b8BzdTinUvs&feature=youtu.be

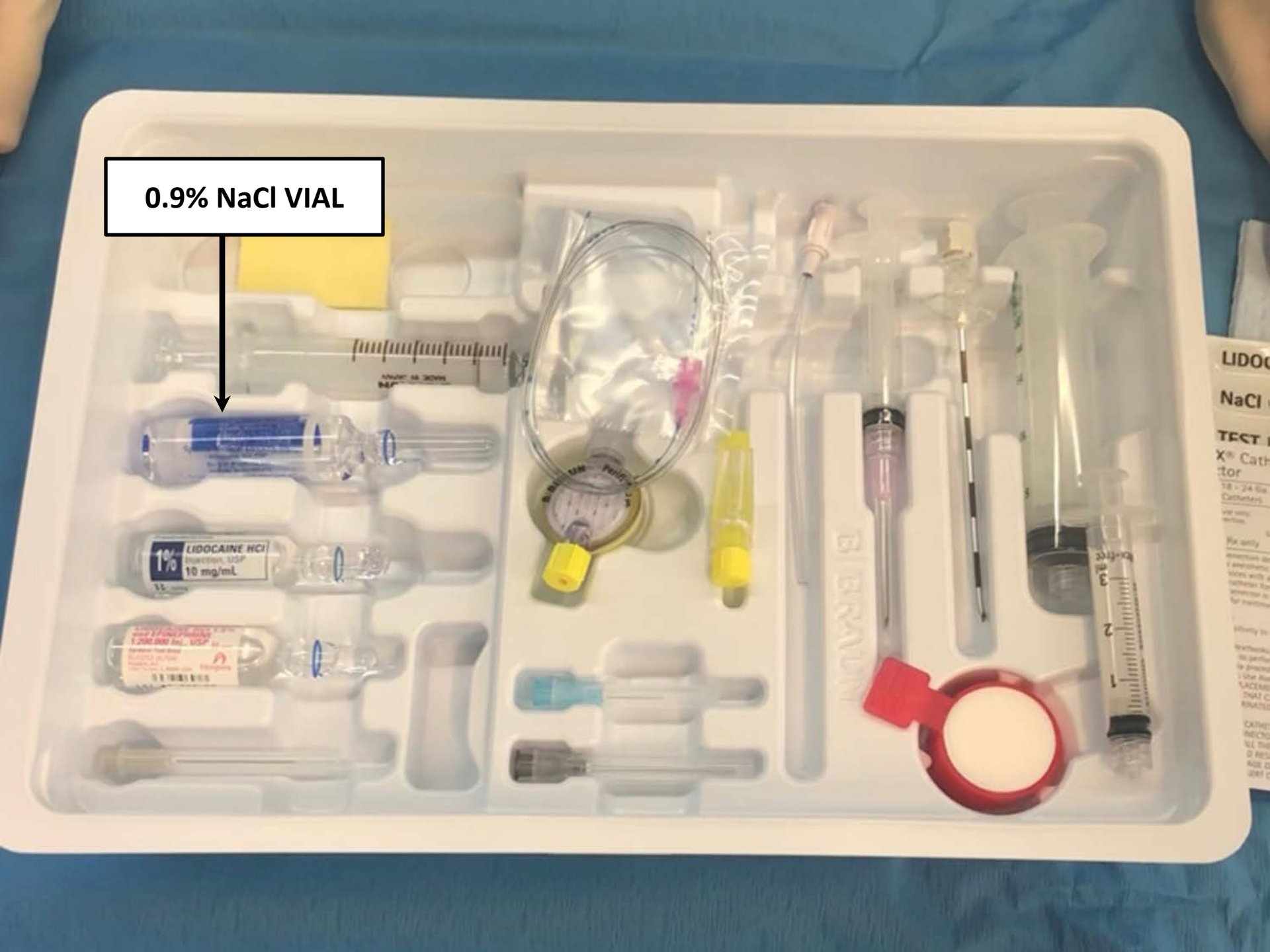
Epidural Anesthesia

- Local anesthetics and adjuncts injected into the **epidural** space via an epidural catheter, providing a **slower onset, less dense** blockade of sensory, autonomic and motor fibers then compared with single-shot spinal injection.
  - Local anesthetics in the epidural space must first diffuse through the dural cuff before they can block the nerve roots
- Epidural catheter remains in place
  - Continuous infusion
  - Bolus doses (Top Offs)
- Spread of Local Anesthetic relies on the **volume** injected into the epidural space
  - Can use a lower concentration of LA
  - Must provide 2–3 mls per level
- Advantageous for:
  - Laboring parturient –
    - Provides analgesia without a dense motor blockade so the individual has the ability to push during labor
  - Can be used for surgical anesthesia at higher doses with more volume for a c-section
  - Perioperative analgesia
    - Can be used intra-op for many procedures to provide analgesia that can be continued into the postoperative period for several days

Epidural Kit

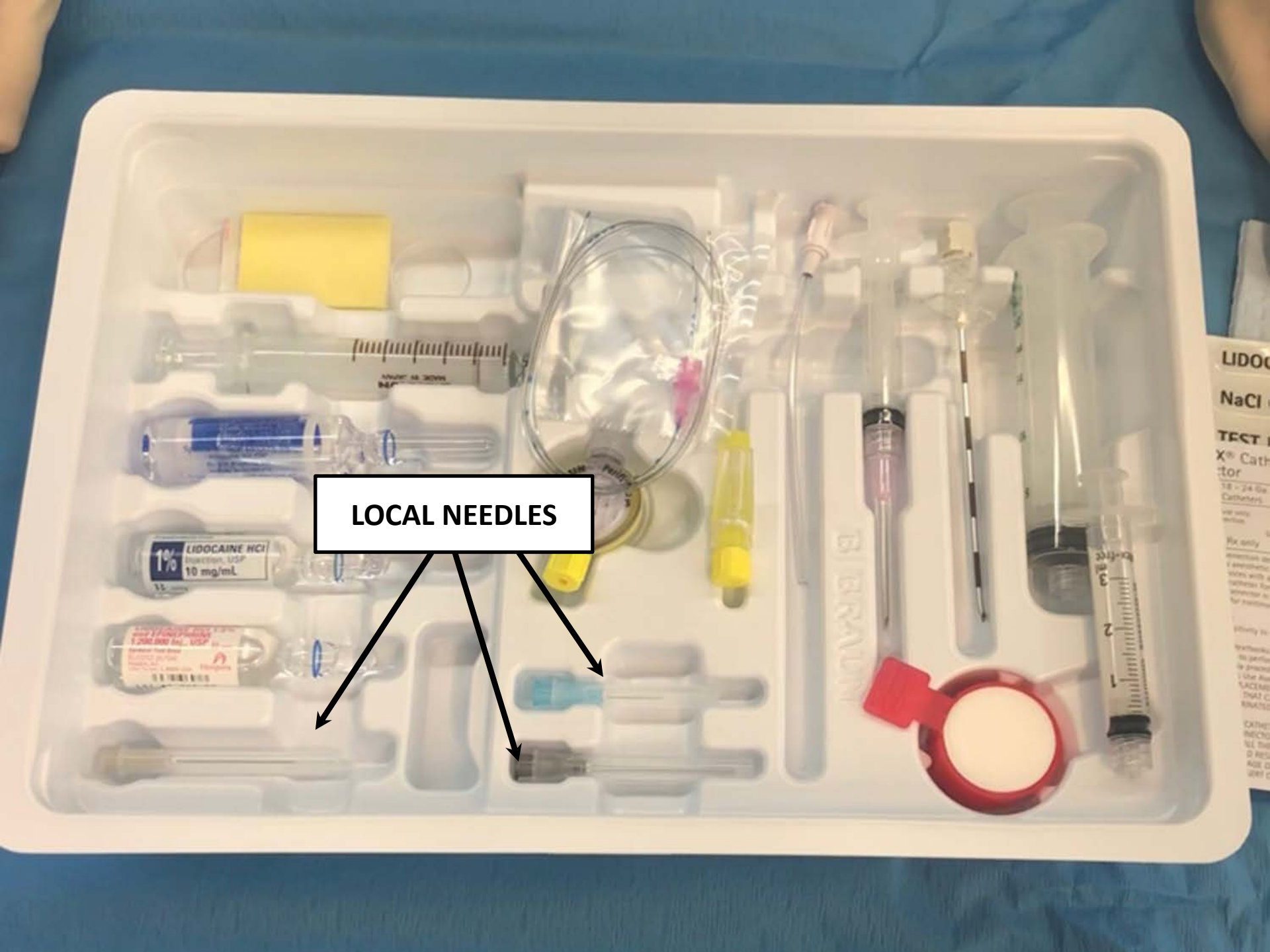
- Prep Solution
- 3 Prep Sponges
- Clean fenestrated drape
- Additional non-fenestrated drape
- Gauze sponges
- Needles:
  - 22g, 25g, 27g Local needle
  - Filter needle/straw
- Syringes
  - 3 mL (used for local)
  - 5 mL glass LOR syringe
  - 20 mL medication syringe
- Tuohy needle
- Catheter connector/Filter
- Threading assist guide
- Epidural Catheter
- Medications:
  - Local → 1% Lidocaine 5 mL vial
  - Test dose → 1.5% Lidocaine with Epi 1:200,000 5 mL vial
  - 0.9% NaCl 10 mL vial
- Needle holder

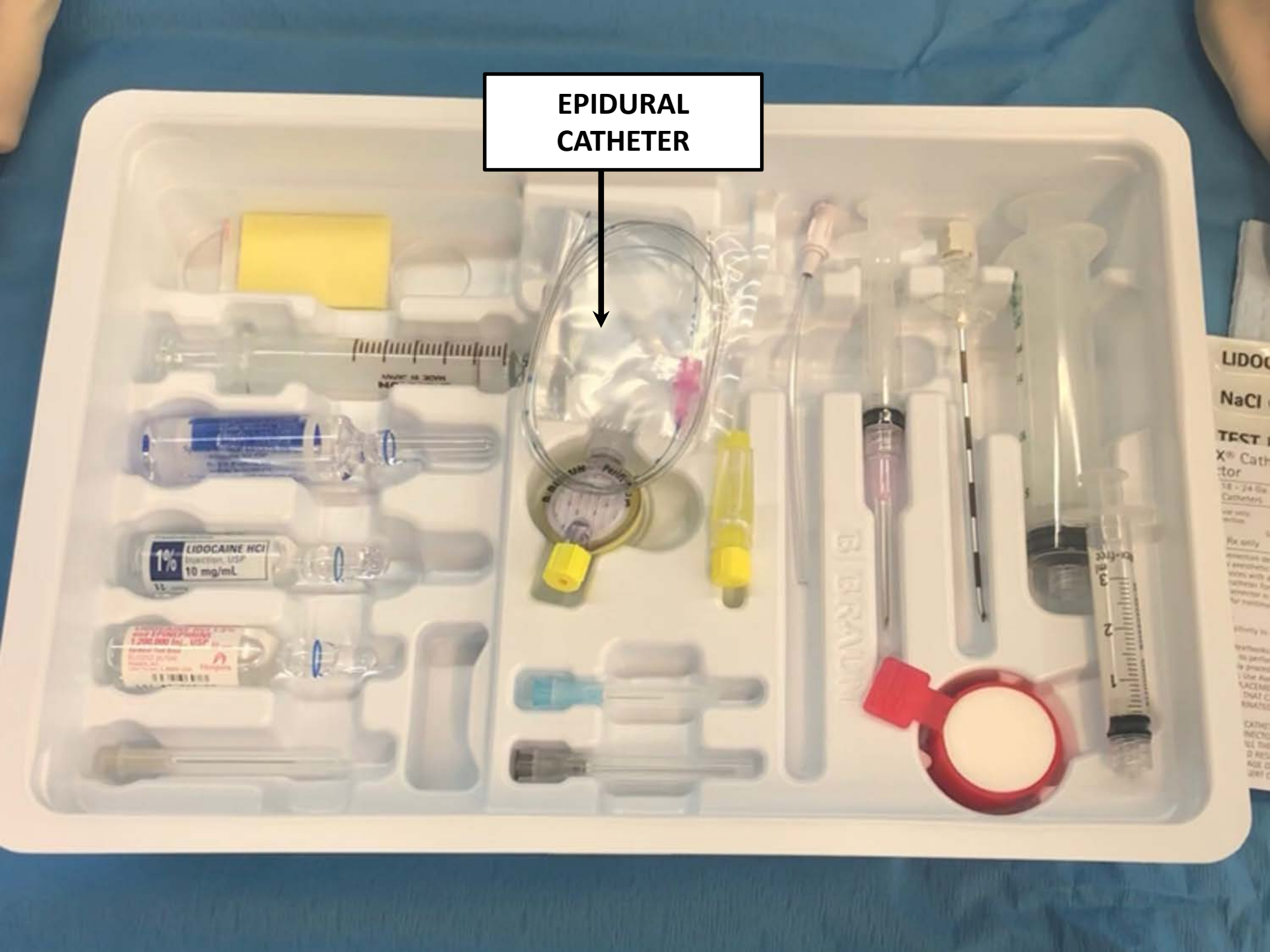

LOR GLASS SYRINGE
1%
LIDOCAINE HCl
10 mg/mL

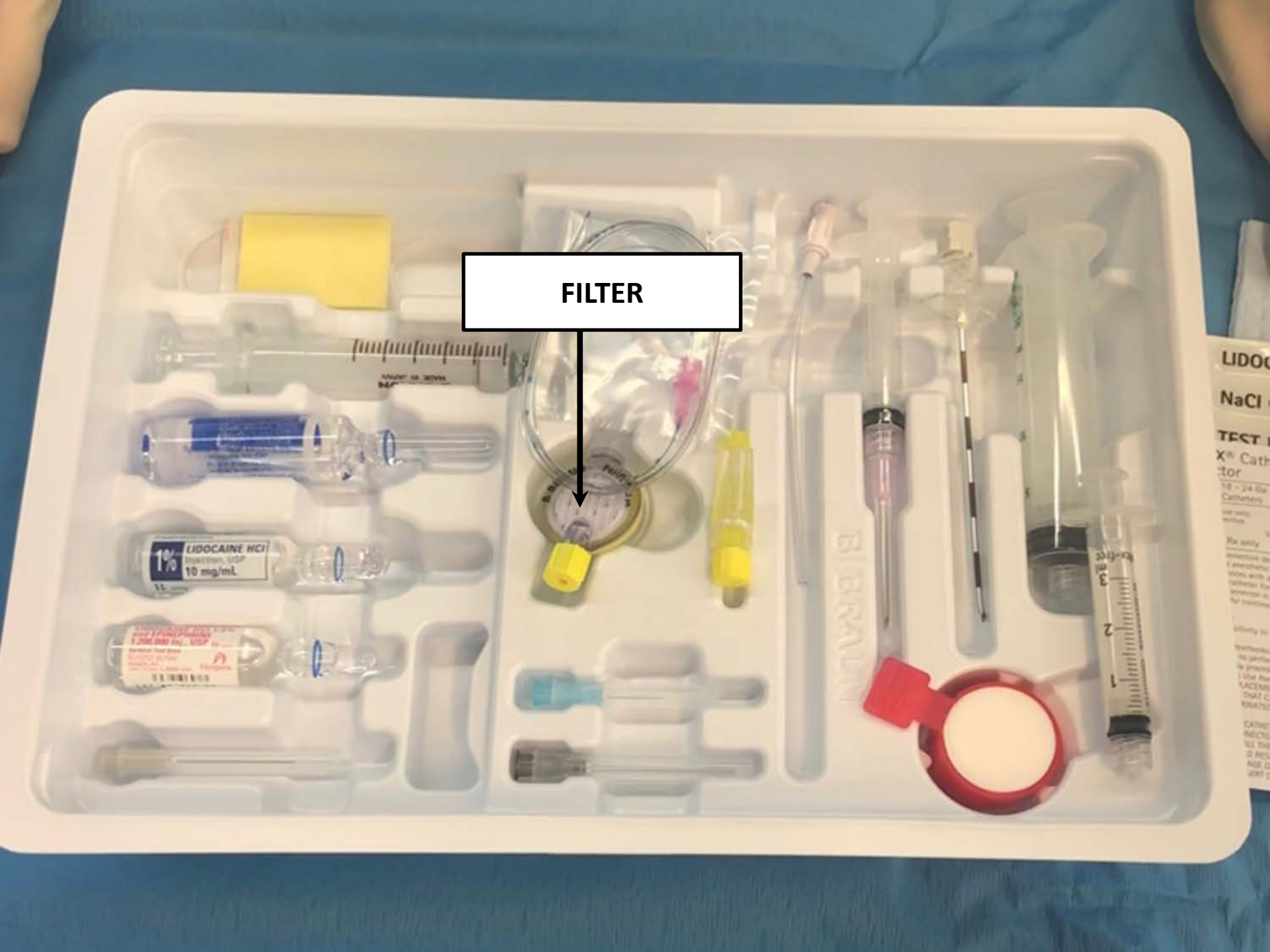

0.9% NaCl VIAL
1%
LIDOCAINE HCl
Injection, USP
10 mg/mL

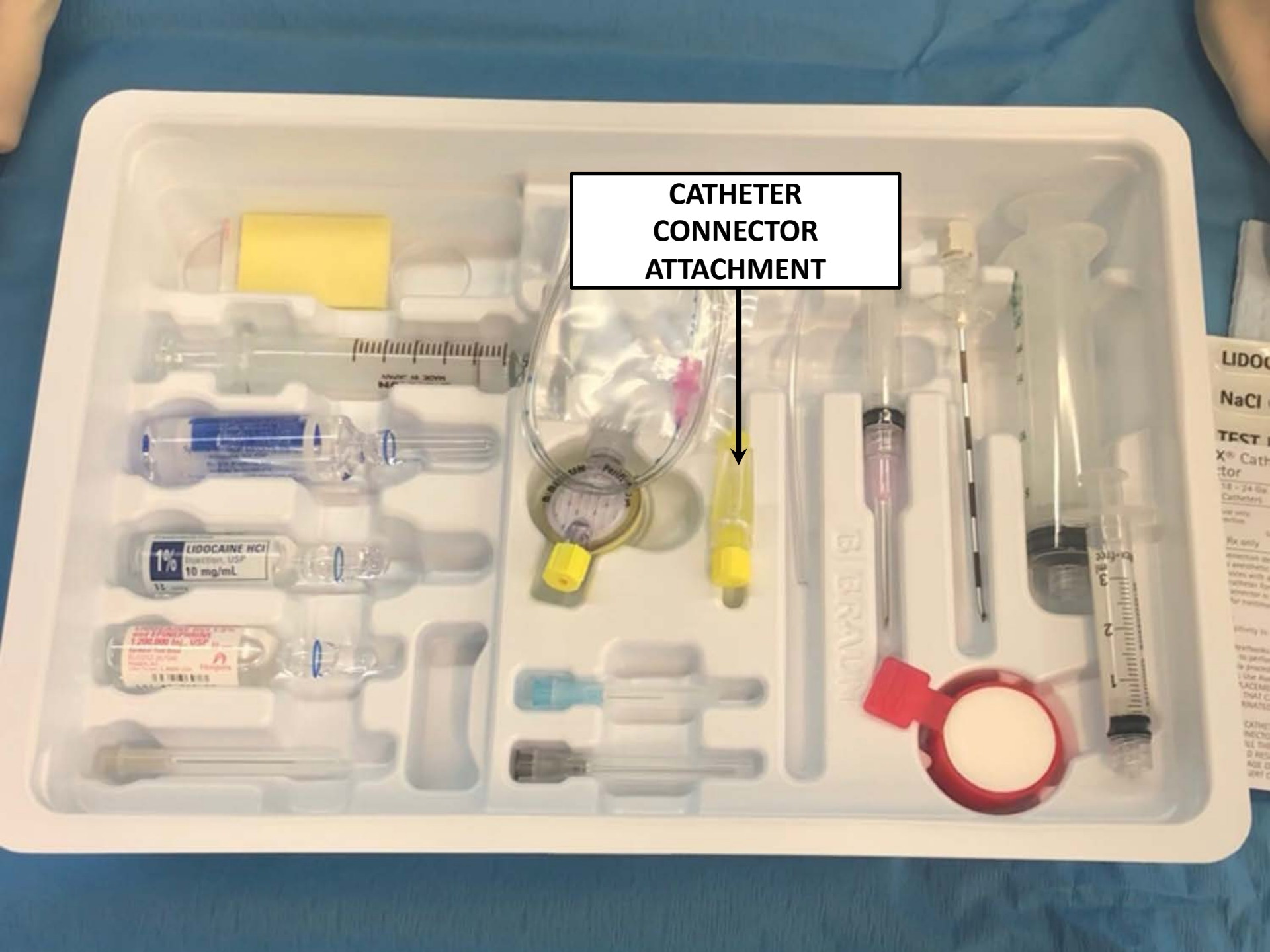

5 mL 1%
LIDOCAINE FOR
LOCAL
1%
LIDOCAINE HCl
10 mg/mL

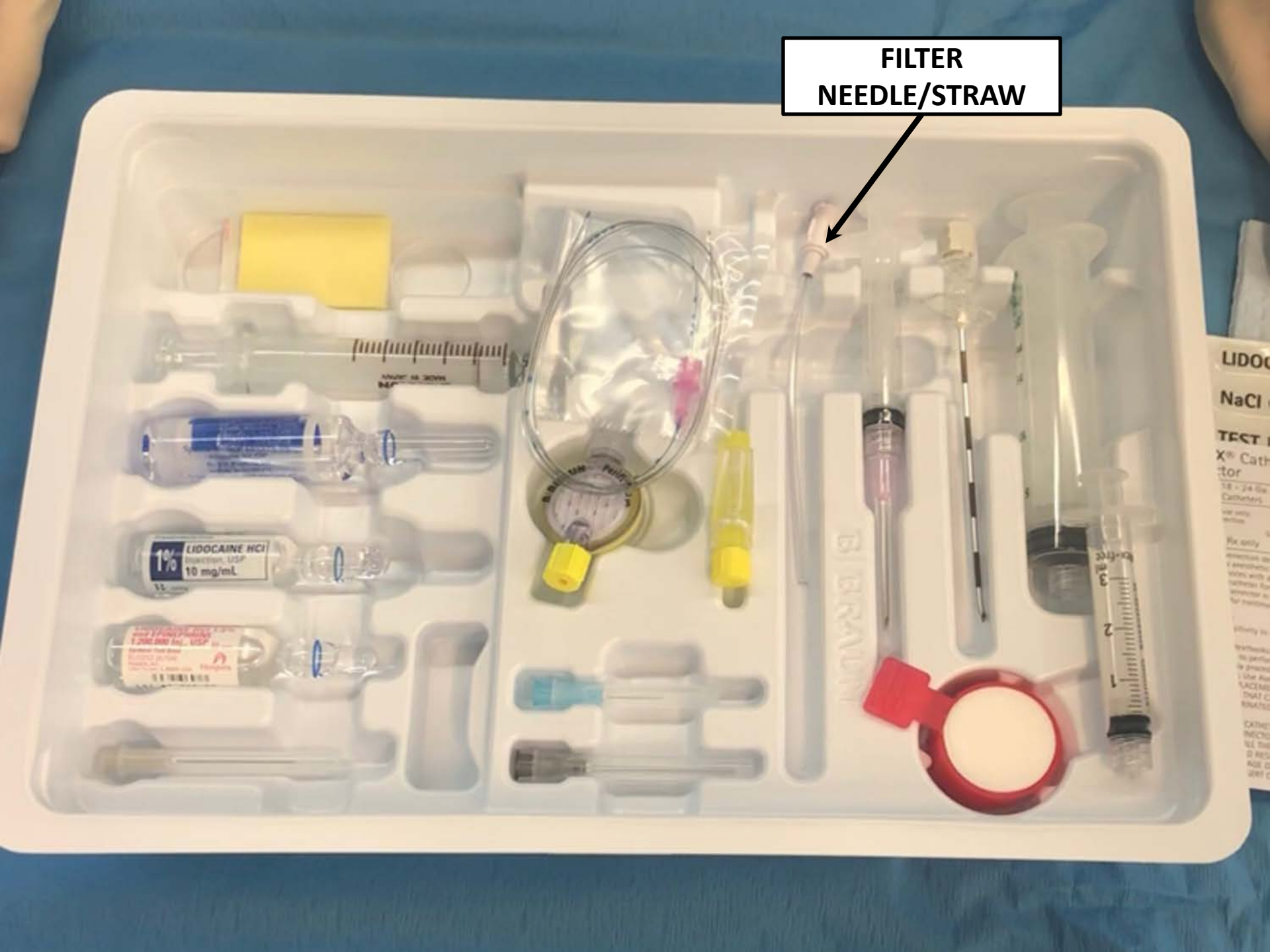

5 mL 1.5% LIDO W/ EPI FOR TEST DOSE

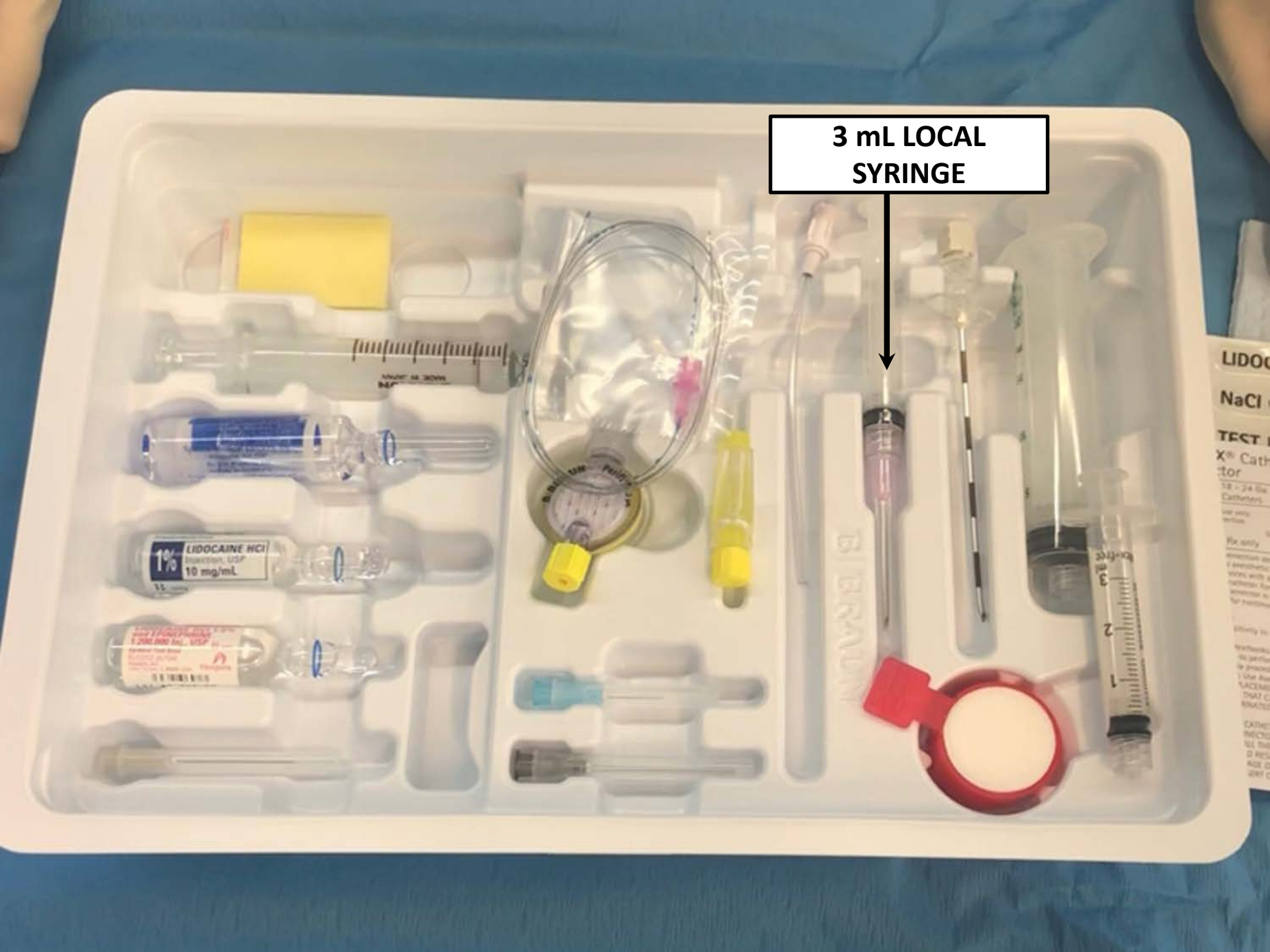

LOCAL NEEDLES
1%
LIDOCAINE HCl
Injection, USP
10 mg/mL

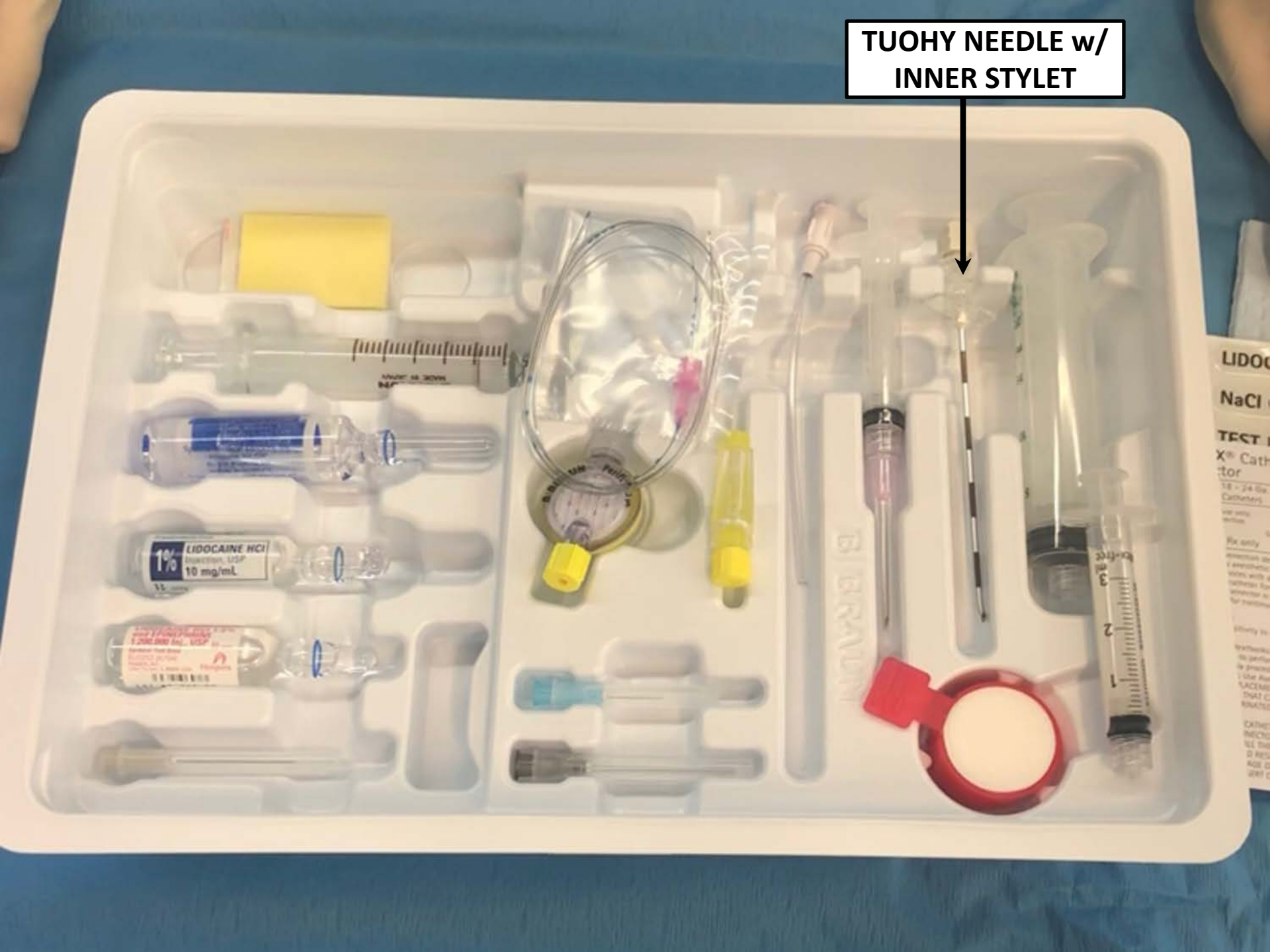

EPIDURAL
CATHETER
1%
LIDOCAINE HCl
10 mg/mL

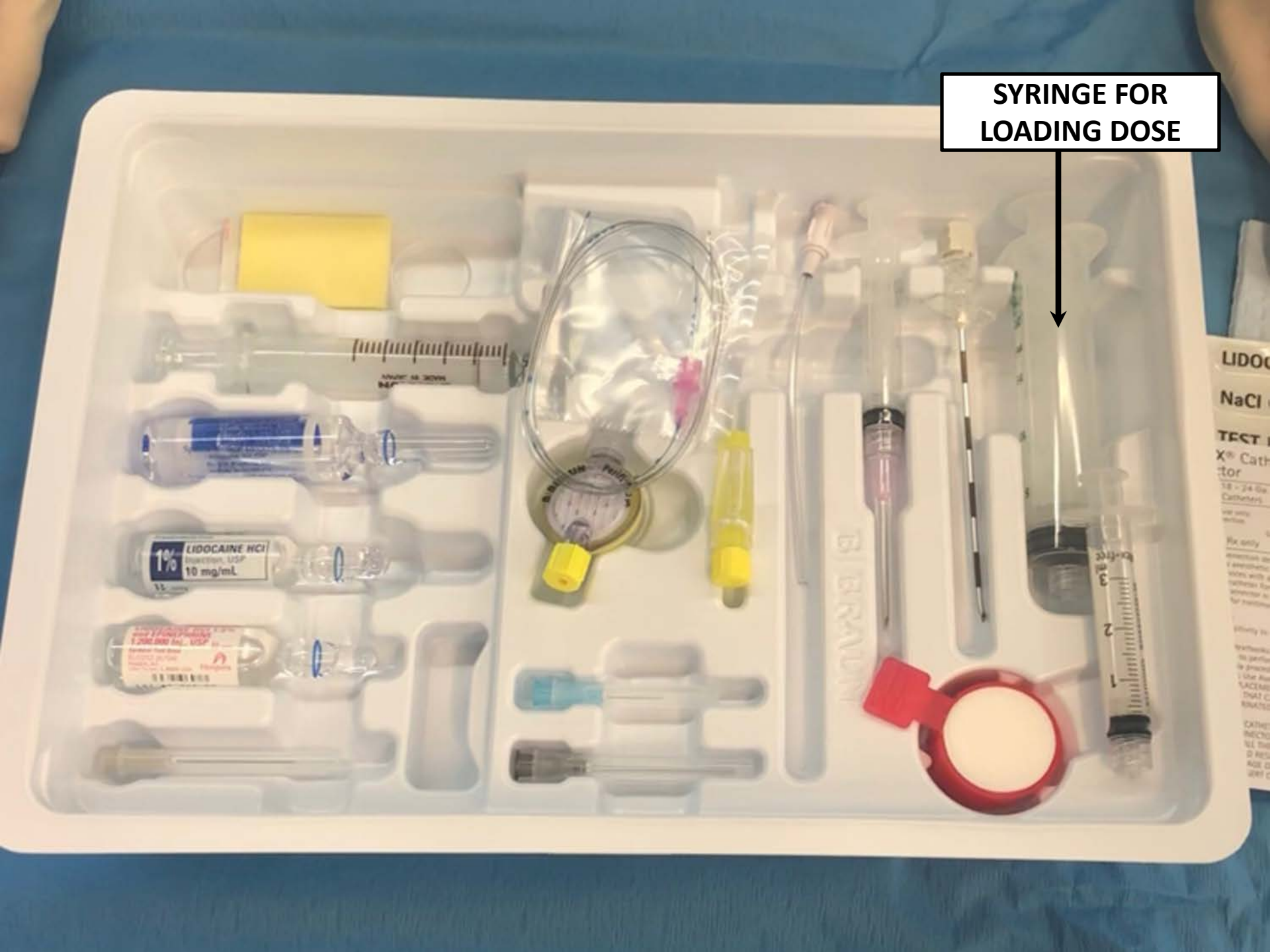

FILTER
1%
LIDOCAINE HCl
10 mg/mL


CATHETER
CONNECTOR
ATTACHMENT
1%
LIDOCAINE HCl
10 mg/mL


FILTER
NEEDLE/STRAW
1%
LIDOCAINE HCl
Injection, USP
10 mg/mL


3 mL LOCAL SYRINGE
1%
LIDOCAINE HCl
10 mg/mL


TUOHY NEEDLE w/
INNER STYLET
1%
LIDOCAINE HCl
Injection, USP
10 mg/mL


SYRINGE FOR
LOADING DOSE
1%
LIDOCAINE HCl
10 mg/mL


NEEDLE HOLDER
1%
LIDOCAINE HCl
10 mg/mL

Epidural Anesthetic Steps

- Ensure patient is in the optimal position
- Locate iliac crest and palpate L3-L4 interspace. Make mark on skin
- Hand hygiene, open kit, place sterile gloves on
- Prep and drape the back as you would for a spinal
- While prep is drying, prepare the items in your sterile kit
  - Lidocaine 1% in a 3 mL syringe and 25g needle for local infiltration
  - Lidocaine 1.5% with Epi for test dose; draw up 3 mL's and label TEST DOSE
  - Prepare LOR syringe with air or saline or both
- Inject the local into the back creating a wheal at the skin and advancing your needled forward as a finder needle to ensure proper placement
- Advance Tuohy needle into the skin until you become engaged into the ligament
- Remove the inner stylet and attach the LOR syringe to the end of the Tuohy needle

Epidural Anesthetic Steps (cont.)

- Advance the Tuohy needle a few millimeters at a time, tapping on the plunger of the syringe each time until you get the loss of resistance
- Remove the LOR syringe and count the marks on the Tuohy needle to identify at what centimeter you lost resistance
- Insert the epidural catheter to the desired length and then slowly remove the Tuohy needle from the skin while the catheter remains in place
- If the catheter was inserted too far into the skin you can slowly pull back on the catheter to the desired marking at the skin after the Tuohy needle has been removed
- Attach the catheter connector clamp and filter - aspirate to ensure there is no CSF, and give your test dose
  - *Be sure to communicate with the patient at this time on s/sx of intrathecal/intravascular injection*
- Properly secure the catheter to the patient

Epidural Video

https://www.youtube.com/watch?v=b8BzdTinUvs&feature=youtu.be

Epidural Test Dose

- Common: 1.5% Lidocaine with 1:200,000 Epinephrine
- Administering the test dose in the epidural catheter to ensure that the catheter is in the epidural space and is not intrathecal or intravascular
- Catheter is **intrathecal**
  - Patient will get immediate dense block
- Catheter is **intravascular**
  - Patient will get ringing in ears, numbness in fingers, and HR will increase by 10-20 bpm due to the epinephrine
- When administering the test dose, it is important to **communicate** with the patient and staff that is assisting
  - What is the patient baseline heart rate before test dose
  - What is the patient feeling? Experiencing any symptoms of an intrathecal injection?

Thoracic Epidurals

Benefits:

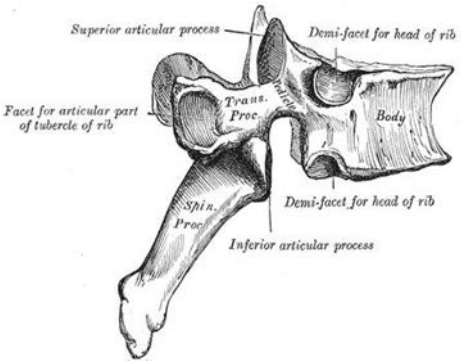
- Postoperative analgesia
- Decreased incidence of postoperative nausea and vomiting, decrease incidence of post-op ileus
- Improved patient satisfaction
- Avoiding tracheal intubation in patients with moderate-to-severe comorbidities or decreasing the duration of mechanical ventilation

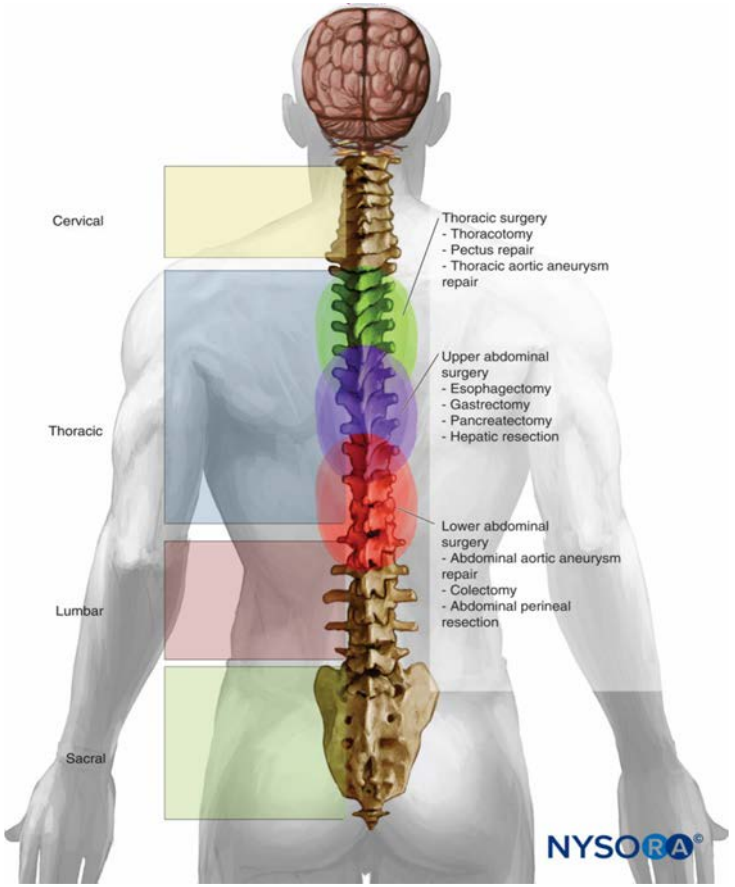
Useful for the following procedures:

- Thoracotomy, VATs
- Esophagectomy
- Hepatic resection
- Gastrectomy
- Aortic aneurysm repair
- Colectomy, Bowel resection
- Nephrectomy
- TAH
- Abdominal tumor debulking
- Any abdominal procedure with a large open incision

Procedural Differences:

- Angle of Tuohy needle will be more cephalad thoracic vertebrae spinous processes are more sharply angled
- Increased risk of nerve injury because the needle is at the level of the spinal cord (not at cauda equina) and risk for pneumothorax because the needle is at the thoracic level



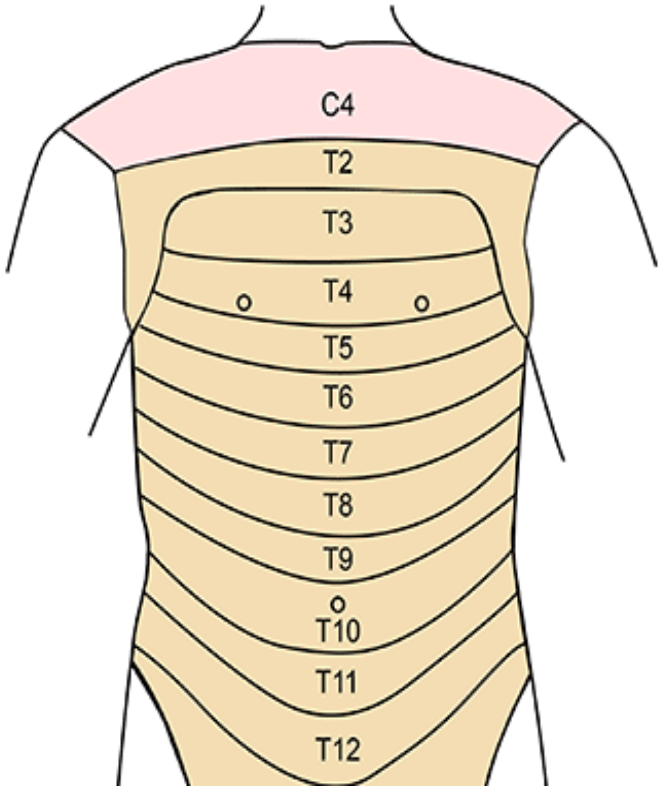


Top offs

Common Tops offs:

- 5-8 mls of 0.25% Bupivacaine
- 3-5 mls of 0.5% Bupivacaine
- 5-8 mls of 1.5-2% Lidocaine
  - Quick onset
- 5-8 mls of 0.2% Ropivacaine
  - less dense motor blockade; good for when a parturient is close to pushing
- +/- 50-100 mcg Fentanyl
  - can give fentanyl with plain saline

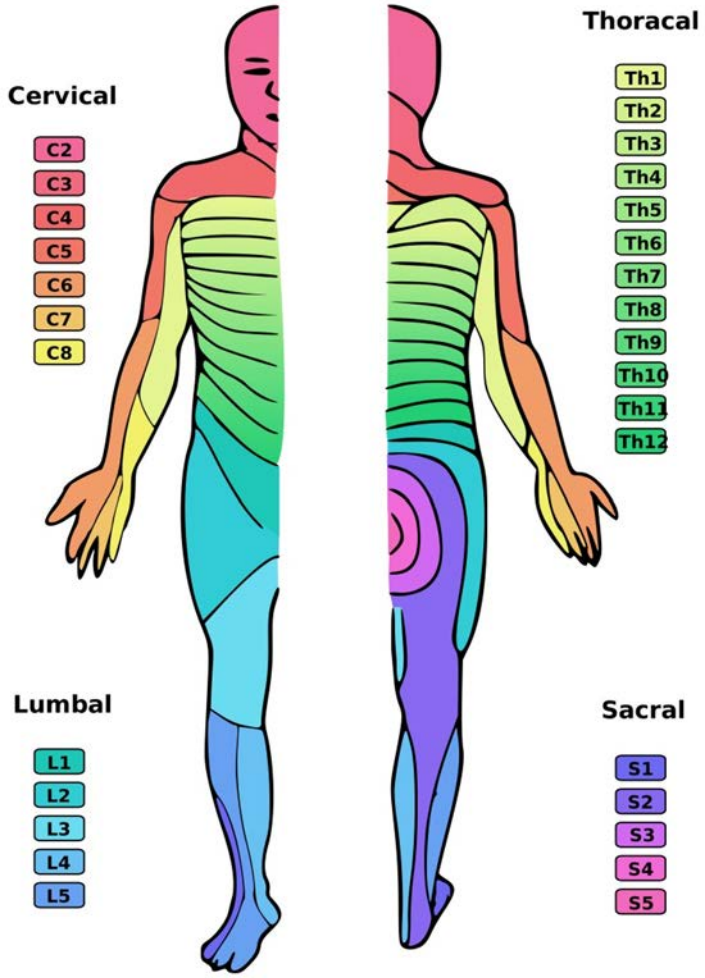
Assessing the Level of the Block



- After the block is complete, use an alcohol wipe to assess the patient's perception of temperature
- Use on face and arms to establish baseline feeling, and then use on abdomen and lower extremities to assess temperature perception and subsequently the level of the block
- For C-section, surgeon will perform "Allis test" before proceeding with incision
  - Surgeon uses a clamp to pinch skin, if patient does not react then it is safe to proceed with incision

Levels for Procedures

Procedure	Level
Knee arthroscopy	T10
Hip Fracture	T10
TURP	T9/T10
C-Section	T4
ESWL	T6
Open prostatectomy	T8
Cystoscopy	T9
Gynecologic (epidural)	T10



Complications of Neuraxial Anesthesia

Minor	Moderate	Major
Nausea and vomiting	Failed spinal	Direct needle trauma
Hypotension	Post dural-puncture headache	Infection/abscess
Shivering		Meningitis
Itching		Spinal cord ischemia
Urinary retention		Cauda equina syndrome
		Total Spinal
		Peripheral nerve injury
		CV collapse
		Bleeding/hematoma

Common Side Effects

Hypotension

- Sympathectomy causes arterial and venous vasodilation (predominantly venous)
  - Leads to a decreased venous return (preload), CO, and blood pressure
- Bradycardia
  - Caused by the blockage of the pre-ganglionic cardiac accelerator fibers T1-T4
  - Bezold-Jarisch reflex
- Treatment
  - Pre-procedure volume loading, IV hydration
  - Use a vasopressor to increase BP

Nausea & Vomiting

- Due to hypoperfusion of the brainstem
  - Use a vasopressor to increase BP → Phenylephrine

Shivering

Itching

- Due to neuraxial opioid administration
- Can administer diphenhydramine or nalbuphine to mitigate symptoms

High/Total Spinal

- Occurs from inadvertent injection of local anesthetics into the intrathecal space
  - Higher volume of LA meant for the epidural space
- Can also occur if too much medication is injected into the intrathecal space
  - Local anesthetic moves upward and blocks:
    - Sympathetic fibers (T1-T4)
    - Fibers that control respiration (C3-C5)
- Symptoms:
  - Agitation
  - Profound hypotension
  - Dyspnea
  - Inability to speak
  - Loss of consciousness
    - Usually results from hypoperfusion of the brain and brainstem, not from brain anesthesia
- Treatment:
  - Place patient into Reverse Trendelenburg (head up) so the medication moves away from these fibers
  - Support hemodynamics and ventilation, intubation may be necessary if the patient cannot maintain SpO2

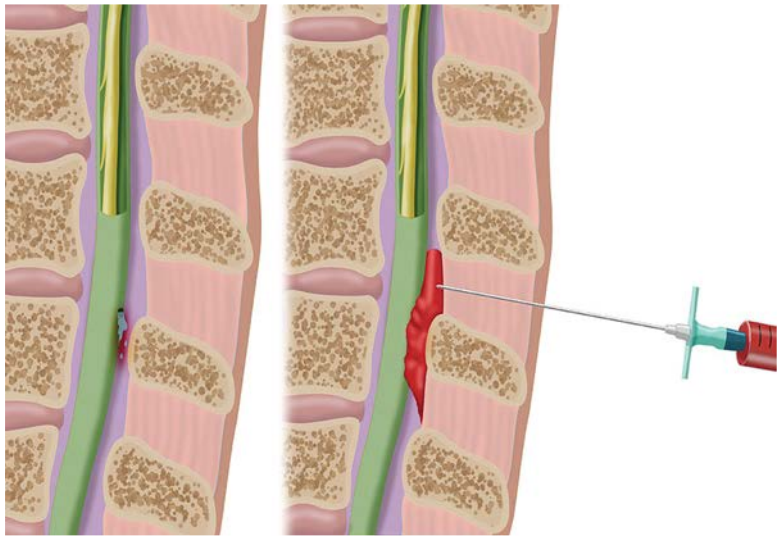
Inadvertent Dural Puncture & PDPH

- Also known as a “wet tap” and occurs when attempting to find the epidural space
  - 18g Tuohy needle goes through the dura and creates a hole which subsequently causes a CSF leak
    - Headache can also occur with spinal administration but is less common (spinal headache)
    - Can also be caused by epidural catheter migration through the dura
- 70% chance that the patients develops a Post Dural-Puncture Headache within the next week
  - Onset 12-48 hrs but can be up to 5 days
- Signs and Symptoms
  - Headache that is relieved by lying down flat
  - Photosensitivity
  - Tinnitus
  - Neck stiffness
  - Nausea

Inadvertent Dural Puncture & PDPH

Treatment:

- **Gold standard:** Epidural Blood patch is 90% effective
  - Sterilely draw 20 mL of peripheral venous blood and inject into the epidural space to create a “patch” that blocks the hole in the dura
  - ** *Fast symptom relief*
- Supportive/adjunct for symptom relief
  - Hydration
    - IV hydration, Gatorade, Mountain Dew
  - Caffeine (300 mg PO)
  - Analgesics (acetaminophen, NSAIDs, opiates)



Adjuncts

Opioids

- *No sympathectomy* → provide excellent pain relief
- Fentanyl
  - Lipophilic, quick onset and shorter duration, provides profound analgesia
  - Can be placed into epidural for labor analgesia or can be used in spinal for a c-section or other surgical procedure. Also used in a combination with a local anesthetic for continuous epidural infusions (labor epidural, PCEA for post-op analgesia)
- Morphine
  - Hydrophillic, slower acting but longer duration, excellent for post-operative pain.
  - May spread rostrally and cause delayed respiratory depression
- Side effects → *pruritus, urinary retention, respiratory depression*

Drug	Intrathecal	Epidural
Morphine	0.1-0.25 mg	1-5 mg
Fentanyl	10-25 mcg	50-100 mcg
Sufentanil	3-10 mcg	10-30 mcg
Meperidine	10-20mg	100mg

Adjuncts

- *Bicarbonate*
  - Changes the pH of the local anesthetic (more alkaline) which keeps more drug in the un-ionized form
  - The more un-ionized drug, the more penetration through the lipid bilayer of the cell
  - Speeds up the onset of action
    - *Useful with Lidocaine 2% for STAT C-Sections*
- *Epinephrine*
  - Will vasoconstrict surrounding vessels and decrease the rate of systemic absorption which subsequently prolongs the duration of action
  - 1:200,000 (5 mcg/ml) is a commonly used concentration
- *Alpha-2 Agonists*
  - Rare, lack of data and not approved by the FDA
  - Dose Precedex: 2-3 mcg intrathecal
  - Dose Clonidine: 15 mcg intrathecal, 2 mcg/kg epidural

Troubleshooting

Midline approach is not working…

- Alternative technique: **paramedian** approach
  - useful in patients with:
    - Excessive lumbar lordosis (spinous processes are very close together)
    - Elderly - may have calcified interspinous ligaments and osteophytes on vertebrae
  - Practitioner will bypass the supraspinous and interspinous ligaments, will only go through ligamentum flavum with this approach
  - Needle is angled and advanced at a 15 degree cephalad angle directly into flavum

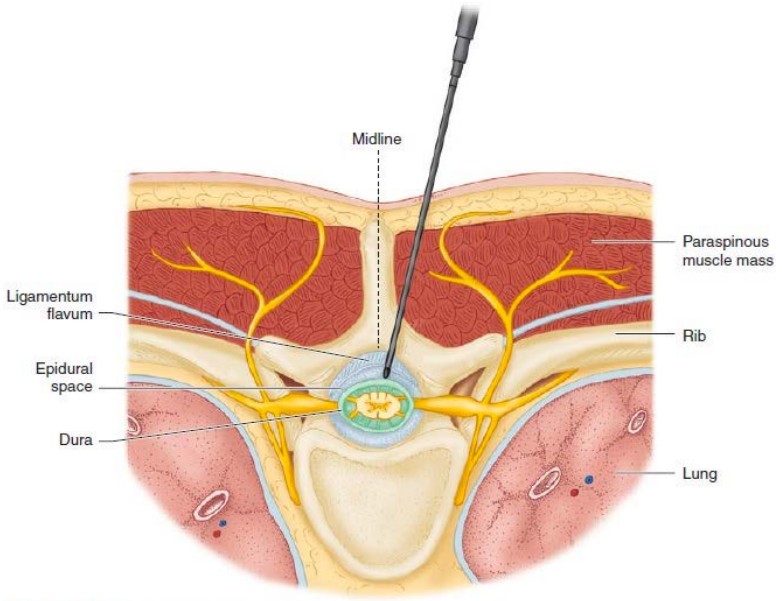


FIGURE 45–14 Paramedian approach.

Patient is morbidly obese or has very tight tissue….

- Use alternate needle
  - When doing a spinal, you can switch to a longer and lower gauge needle without using the spinal introducer
  - Use a longer Tuohy needle for obese patients if needed

Troubleshooting (cont.)

One sided analgesia from epidural…..

- Have patient turn to side where the pain is so the medication in the epidural space will flow with gravity and reach those nerve roots
- Ensure there is enough volume in the epidural space; need 2-3 mL per level
- Ensure that the epidural catheter is not too far in. The catheter is more likely to migrate to a paravertebral space on one side if it is inserted too far.
  - Ensure the catheter is only 4-6 cm past where LOR occurred and try pulling back on the catheter if need be

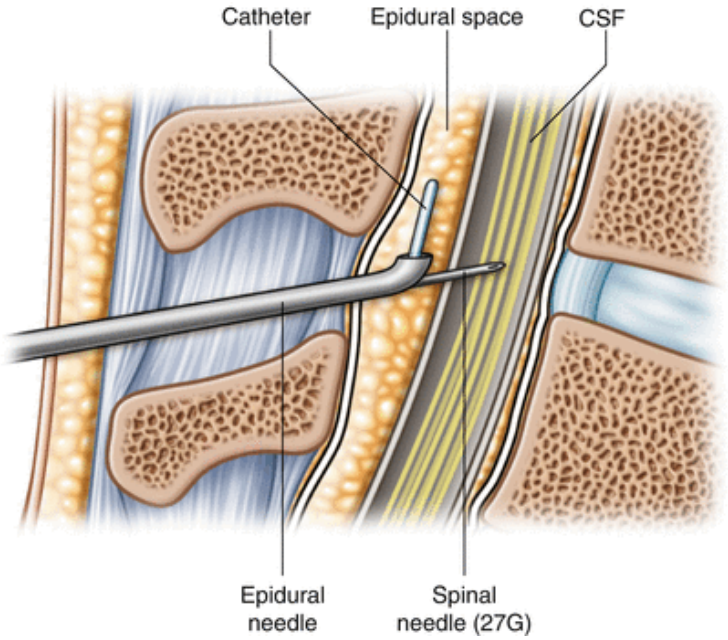
False loss of resistance with epidurals….

- Feels like you have loss of resistance but you don't think you are in far enough or didn't feel the Tuohy going through the ligaments
- You can add small amount of saline into this space. If you are not in the epidural space, you will tighten the tissue that your needle is in and you will get the resistance/bounciness back on the syringe
- If the saline goes in smoothly and there is still a loss of resistance, you are in the epidural space and can place your catheter through the Tuohy needle

Additional Neuraxial Techniques

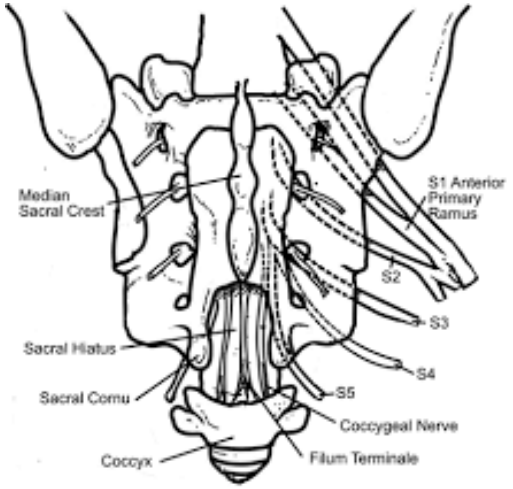
Combined Spinal-Epidural

- Epidural space is found with Tuohy needle and then a longer spinal needle is inserted through the Tuohy and through the dura into the intrathecal space where medication is injected
  - The spinal needle is then removed and an epidural catheter is placed
- Used frequently for labor at some institutions
  - Provides quick onset analgesia
  - Also provides continuous analgesia throughout labor
- *Downfalls* → inability to test if epidural catheter is in the correct location and risk of enhanced spread of medication into epidural space (there is a hole in the dura that epidural medication can escape through and into the intrathecal space



Caudal Block

- Sacral approach to epidural analgesia/anesthesia
- Commonly used in pediatric anesthesia
- Useful for procedures requiring up to a T10 block



Questions?

Post-survey

THANK YOU!!

Resource Sheet QR Code

- Will also be available on the NJANA website

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