

Spinal and Epidural Anesthesia in Children

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Pediatric regional anesthesia

- Provides analgesia and relaxation in surgery and pain therapy
- Largely used in ped anesthetic protocols
- Development; safety.
- Complementary to general anesthesia, not an alternative
- Practiced under general anesthesia or heavy sedation

Specific in Children

- Lower clearance of local anesthetics (LA) , in free forms require dosage adjustment
- Poor adherence of muscular sheaths - better diffusion of the AL

Specific in Children (cont)

- Incomplete myelination - diluted solutions
- CNS immaturity,

- low systemic vascular resistance,

- lower limbs volemic territory

} better hemodynamic stability

Specific in Children (cont)

- The brain at birth is 1/10 the body weight
- Neuronal development finishes at age 12
- Myelination is not complete until age 3
- Autonomic nervous system is developed at birth, though immature
- Parasympathetic system is intact and fully functional

Specific in Children (cont)

- Distances between the skin and perineural or epidural spaces vary
- Bone growth occurs at different rates throughout the body
 - This affects anatomical landmarks
- Incomplete ossification of vertebrae; sacrum is not fused normally at birth

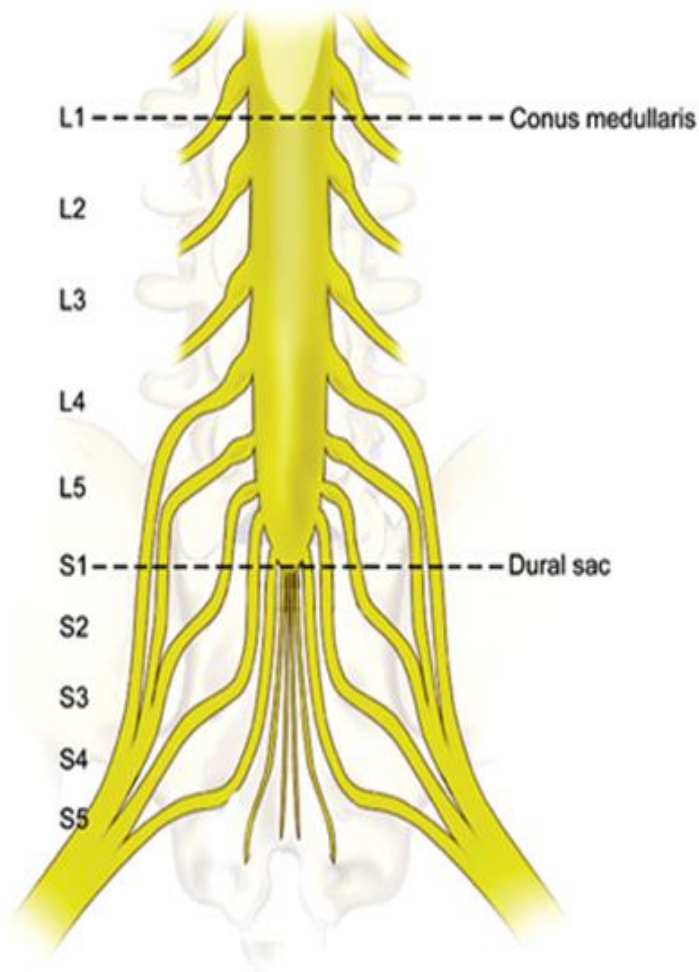
Specific in Children (cont)

- Higher dilutions of AL limit motor block
- Spinal curvatures evolve; only anterior curvature at birth
- Children do not cooperate

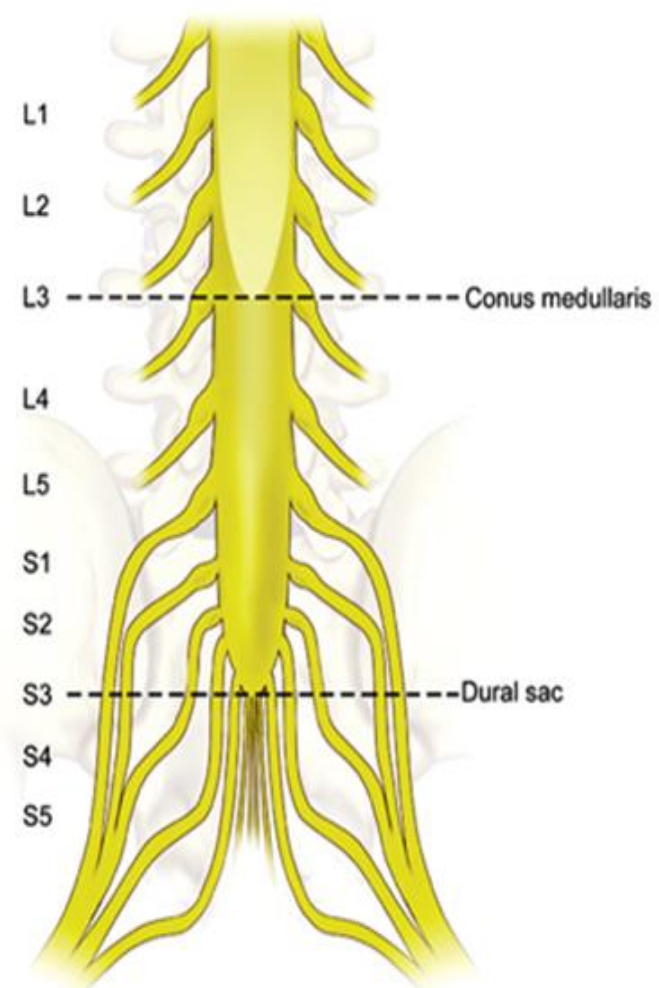
Specific in Children (cont)

- Lower limits of spinal cord and meninges:
 - Lower end of the cord is at L3 at birth
 - Dural sac shortens from S3 to S1

Comparisons between levels of the conus medullaris and the dural sac in the infant versus the older child or adult.



Adult



Infant

Echography

- Recognising and guiding, appreciating the diffusion AL in the target area.
- Linear probes 8 - 13 Hz
- Fine and superficial structures
- Vessels can be easily compressed
- Aponeuroses - more echogenic
- Incomplete ossification of the newborn makes him "transparent" to ultrasound.

Local anesthetics frequently used in children; doses

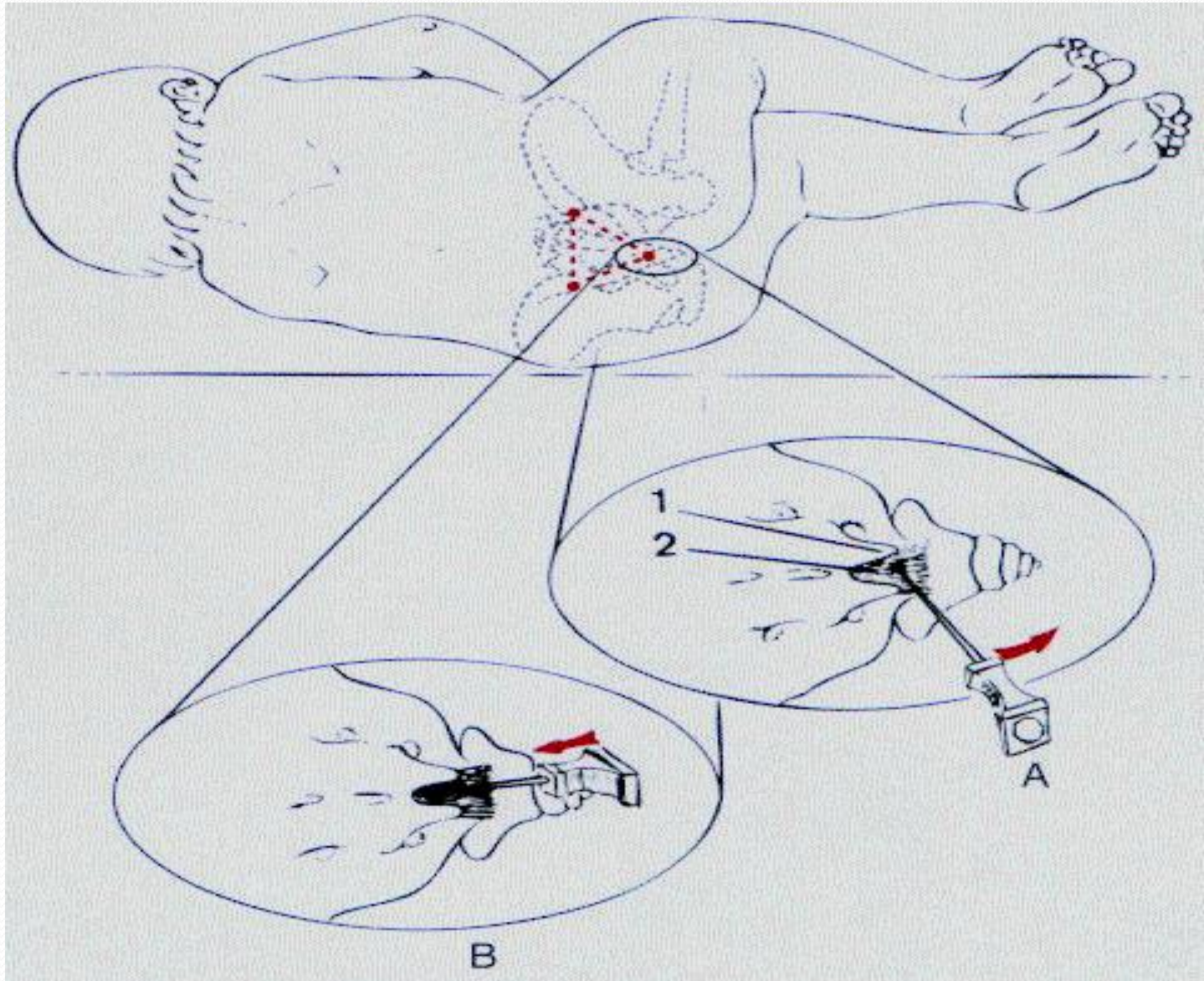
LOCAL ANESTHETIC	Concentration (%)	Usual doses (mg/kg)	Maximal doses (mg/kg)	Maximal adrenergized doses (mg/kg)	Onset time (minutes)	Duration of analgesia (hours)
Lidocaine	0.5-2	5	7.5	10	5-15	0.75-2
Mepivacaine	0.5-1.5	5-7	8	10	4-10	1-1.25
Bupivacaine	0.25-0.5	2	2.5	3	15-30	2.5-6
Levobupivacaine	0.25-0.5	2	2.5	3	15-30	2.5-6
Ropivacaine	0.2-1	2-3	3.5	Not used	5-12	2.5-5

TECHNIQUES

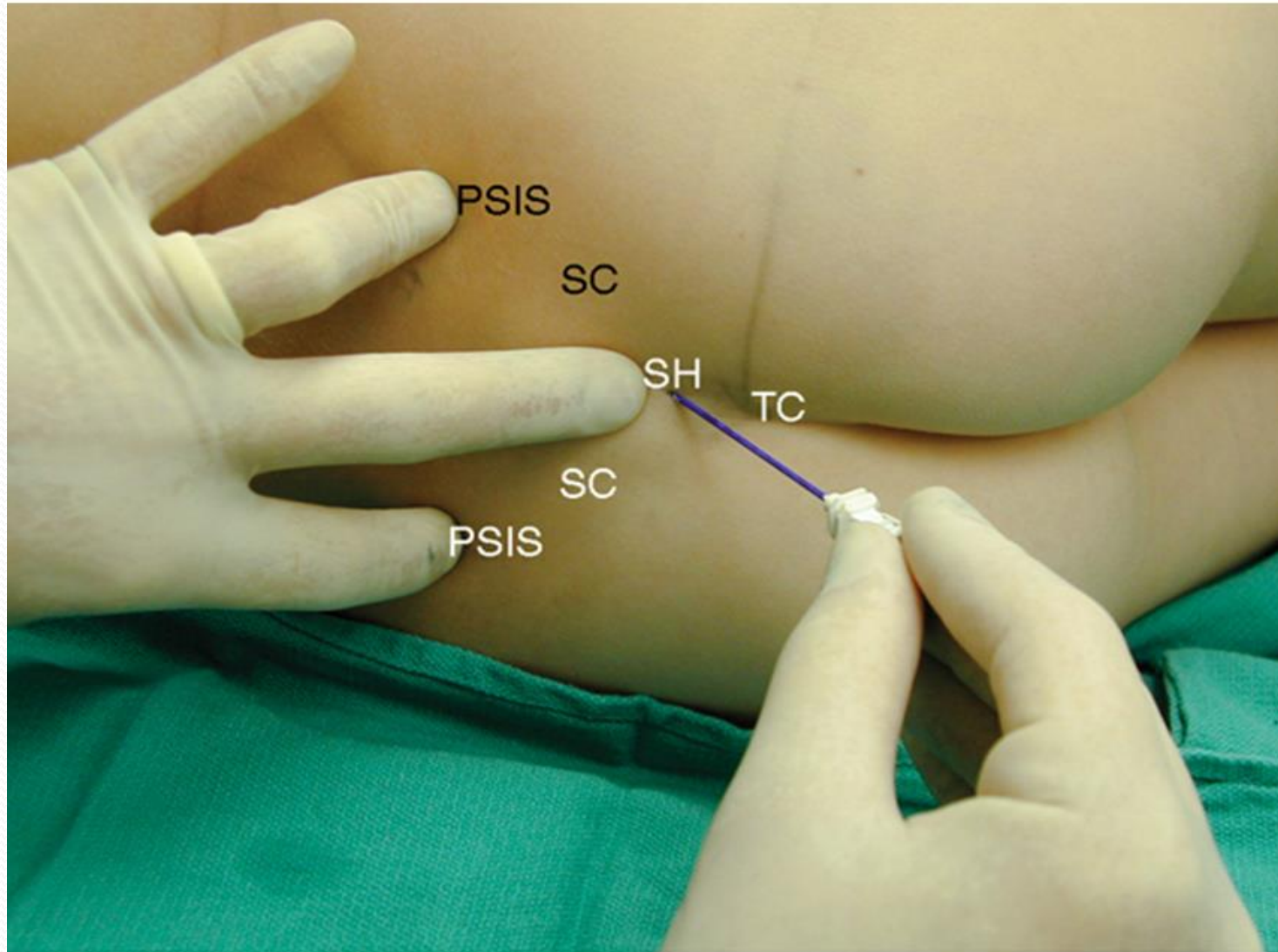
Caudal block

- *Most used technique*
- Adapted needles
- Flexible connection tubes
- Bupivacaine 0.25%, ropivacaine 0.2%, 1 ml/kg (inguinal incisions)
- Children less than 25 – 30 kg

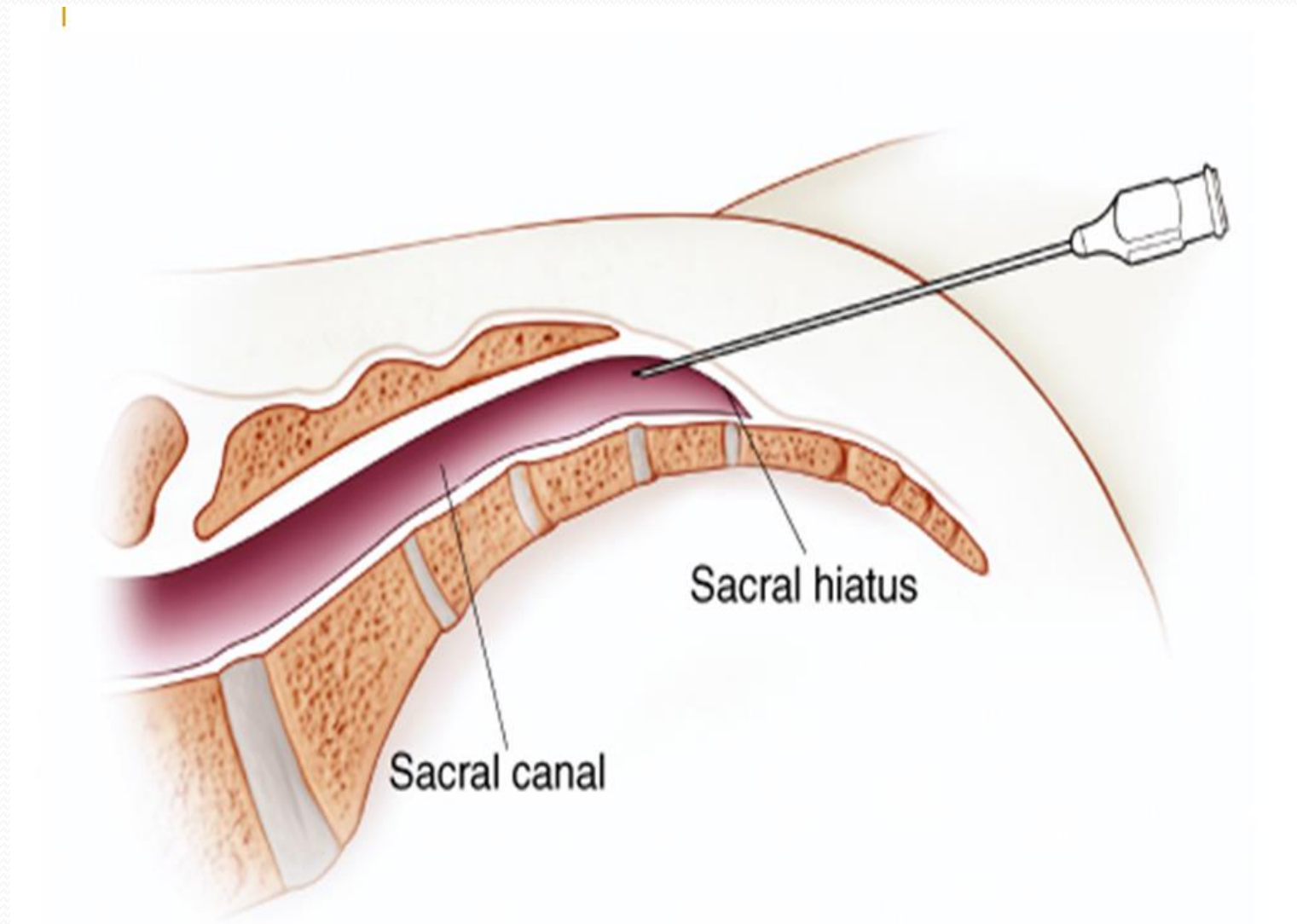
Caudal block



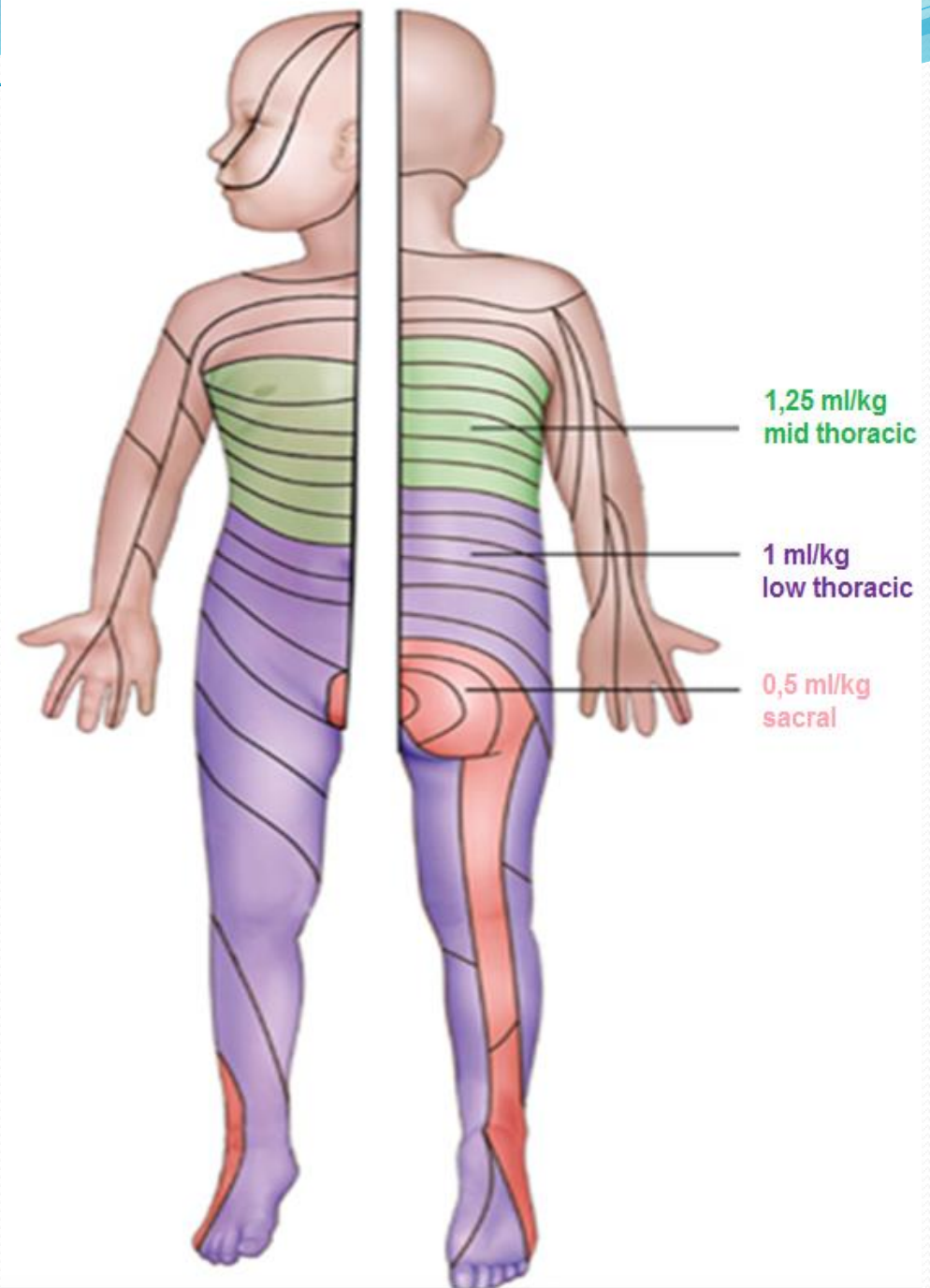
Performance of caudal block. SC, sacral cornua; PSIS, posterior superior iliac spine; SH, sacral hiatus; TC, tip of coccyx. Note that an equilateral triangle is formed with the fingertips from PSIS to PSIS to needle insertion at SH.



Lateral view of the caudal space and needle insertion.



Dermatomal
distribution of
different volumes of
local anesthetic for
single-shot caudal
block.





Epidural anaesthesia

Equipment

Tuohy needles

0 - 1 year: 22 G, 30 mm.

1 - 8 years : 20G, 50 mm.

> 8 years : 18G, 90 mm.

Catheters

23 or 24G for 19 or 20G needles.

20G for 18G needles.

Epidural anesthesia

Technique

- Identical to that of the adult.
- 0-1 year, the iliac crests line crosses L5-S1, and not L4-L5
- Distance of the epidural space:
 - in mm: $(\text{age in years} \times 2) + 10.2$
 - in cm: $0.8 + (0.05 \times \text{Weight in kg})$ for Japanese children
 - 1 mm / kg of weight from 6 months to 10 years (African children).

Epidural anesthesia

Posology

Initial intraoperative dose:

Ropivacaine 0.2% (+ sufentanil 0.25 µg / ml in children over 6 months):

- <20 kg = 0.70 ml / kg.
- 20 and 40 kg: 0.5 ml / kg.
- >40 kg = as in adults (10 to 20 ml).

(Rhythm, T-wave or ST-segment changes!).

Epidural anesthesia

Posology

Continuous infusion dose :

- start 30 to 60 minutes after the initial injection.

- 3 to 12 months: 0.3 mg / kg / h (0.3 ml / kg / hr of ropivacaine 0.1 %).
- 1 - 4 years: 0.4 mg / kg / h (ie 0.2 ml / kg / hr of ropivacaine 0.2%).
- > 4 years: 0.4 - 0.5 mg / kg / h (0.2 - 0.25 ml / kg / Ropivacaine 0.2%).
- > 40 kg (adult): 6 to 12 ml / h.

Epidural anesthesia

Posology

Post-operative phase - continuous flow:

■ Day 0:

- Ropivacaine 0.2% + sufentanil 0.25 µg / ml (child over 6 month)
- 0.3 mg / kg / h = 0.15 ml / kg / h without exceeding 10 ml / h.

■ Days 1 + 2

- Ropivacaine 0.2% **alone**
- 0.3 mg / kg / h = 0.15 ml / kg / h without exceeding 10 ml / h.

PCEA

PCEA (in children over 7 years and PCA ability) :

- Day 0

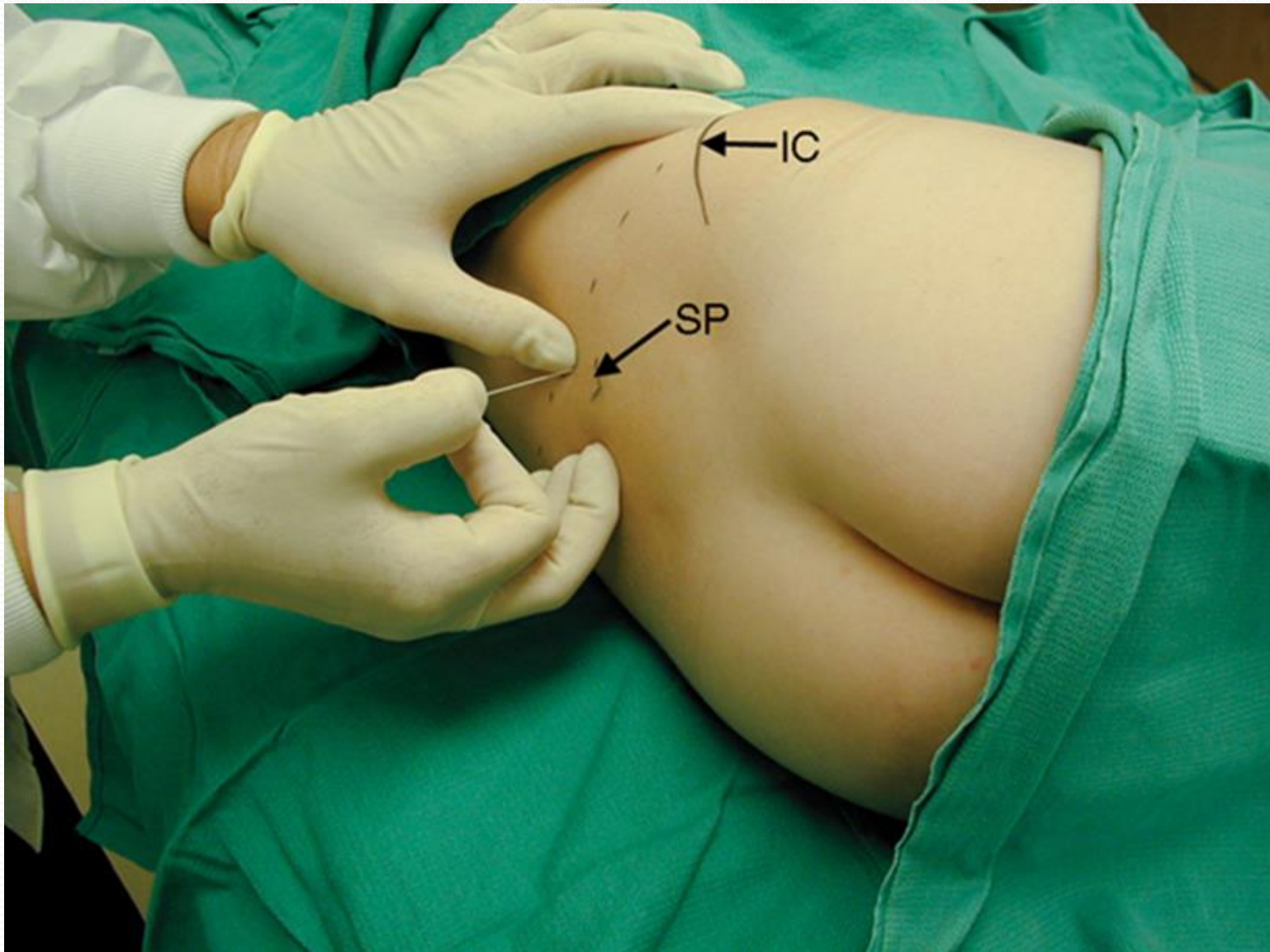
Ropivacaine 0.2% + sufentanil 0.25 µg / kg.

- Continuous flow rate: 0.075 ml / kg / hr (1.5 to 5 ml / hr).
- Bolus: 0.075 ml / kg (1.5 to 5 ml).
- Refractory period: 10 minutes.
- Max hourly dose: 0.2 ml/kg, without exceeding 10 ml/h.

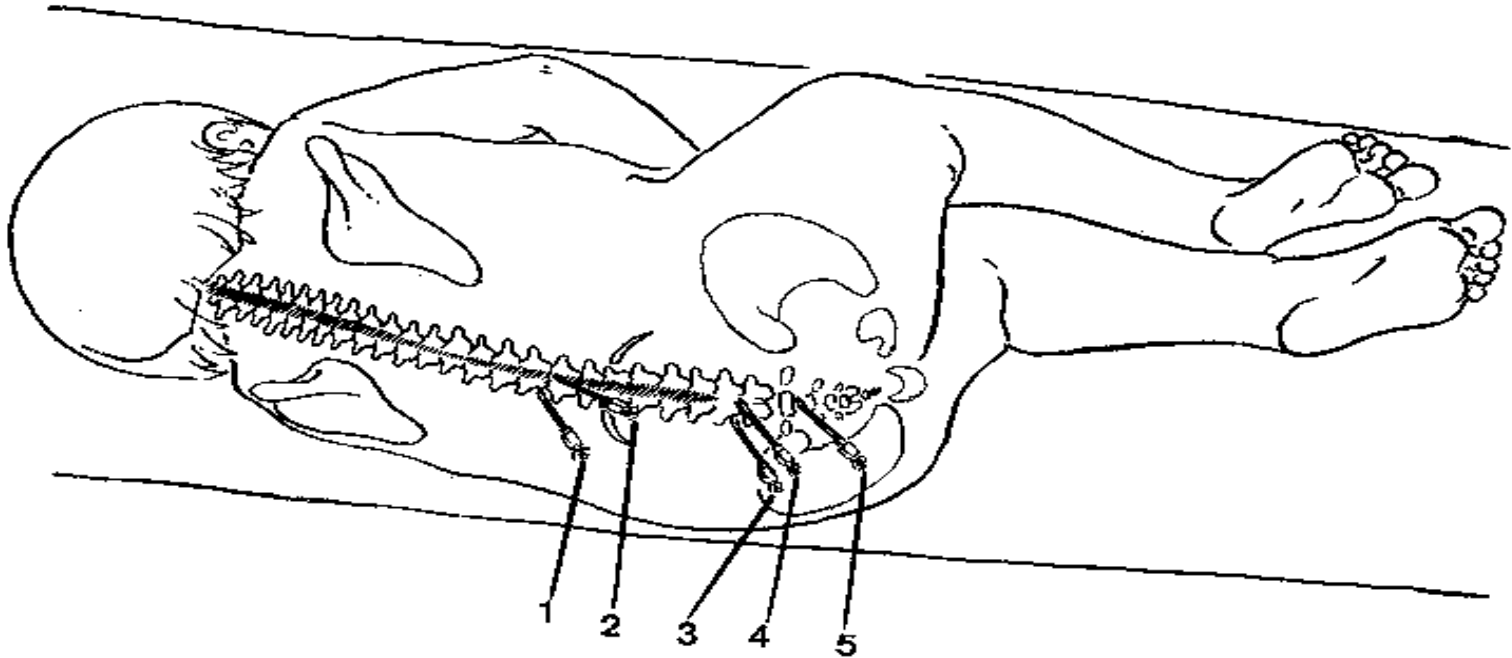
PCEA (cont)

- Days 1 - 2:
 - Ropivacaine 0.2% alone.
 - Continuous flow: 0.075 ml / kg / h (1.5 to 5 ml / h).
 - Bolus: 0.075 ml / kg (1.5 to 5 ml).
 - Refractory period: 10 minutes.
 - Maximum hourly dose: 0.2 ml / kg without exceeding 10 ml / h.

Performance of the **epidural block**. IC, iliac crest; SP, spinous process.



Thoracic epidural block



- Thoracic surgery (T2-T4), surgery of superior (T6-T8), respectively inferior abdomen (T10-T12).
- Touhy needles 22 G (0-1 years), 20 G (1-6 years) 18-19 G (>7 years), catheters as thin as 24 G

Spinal blocks

- Prems (less than 32 weeks), with inguinal hernia, operated until 44 weeks
- General anesthesia can lead to respiratory disfunctions
- Technically difficult, sometimes less satisfactory results

Performing spinal anesthesia in the neonate.



Note how the back is flexed, but the neck remains extended for airway patency. IC, iliac crest. Sitting position is another possibility





Spinal anesthesia with morphine

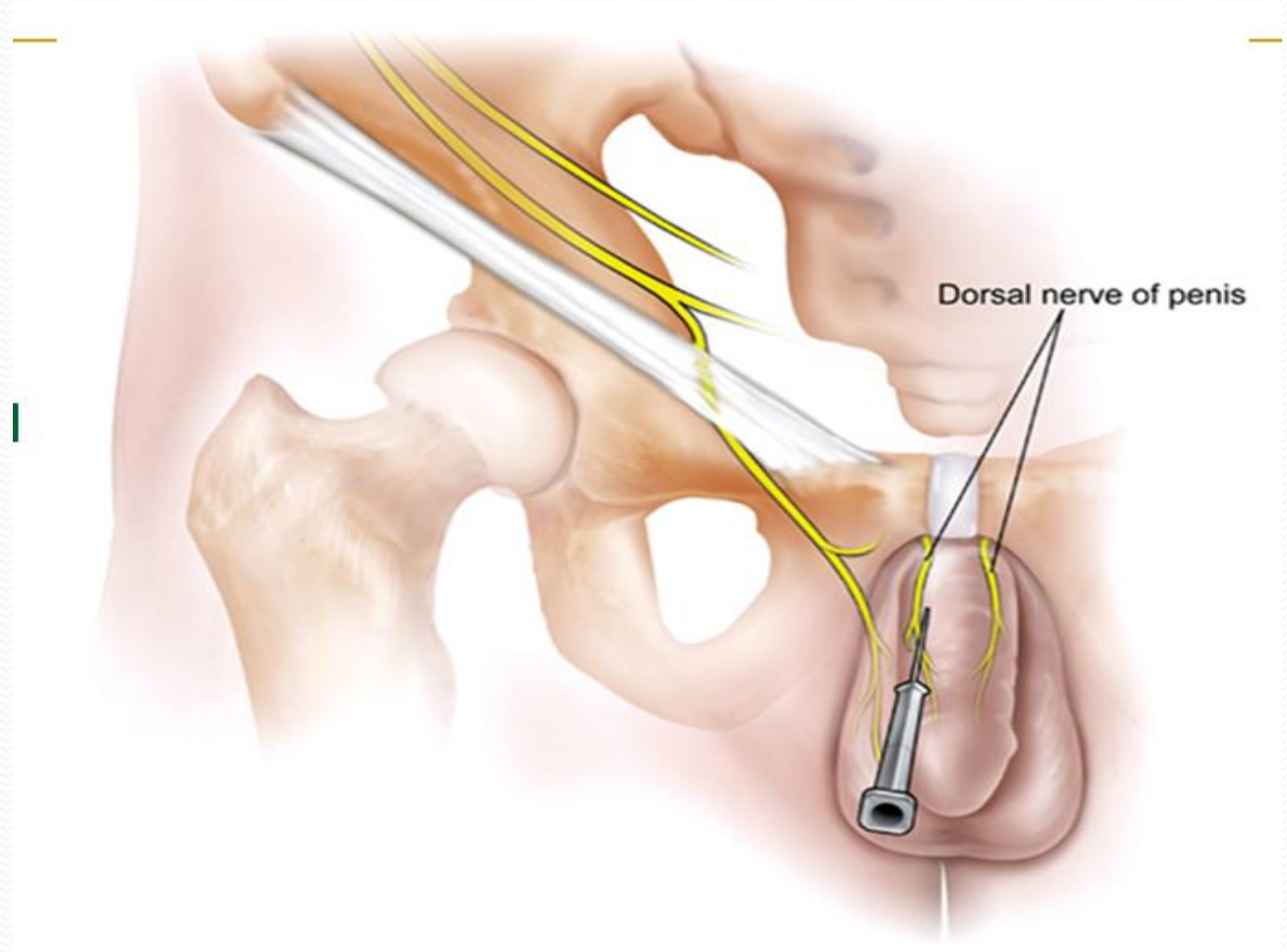
- Excellent postop analgesia
- Indicated in heavy surgery (thoracic, scoliosis, extensive tumors).
- Duration and level varies; effective one hour after administration.
- Puncture under GA, lateral position
- For posterior arthrodesis, the surgeon can inject

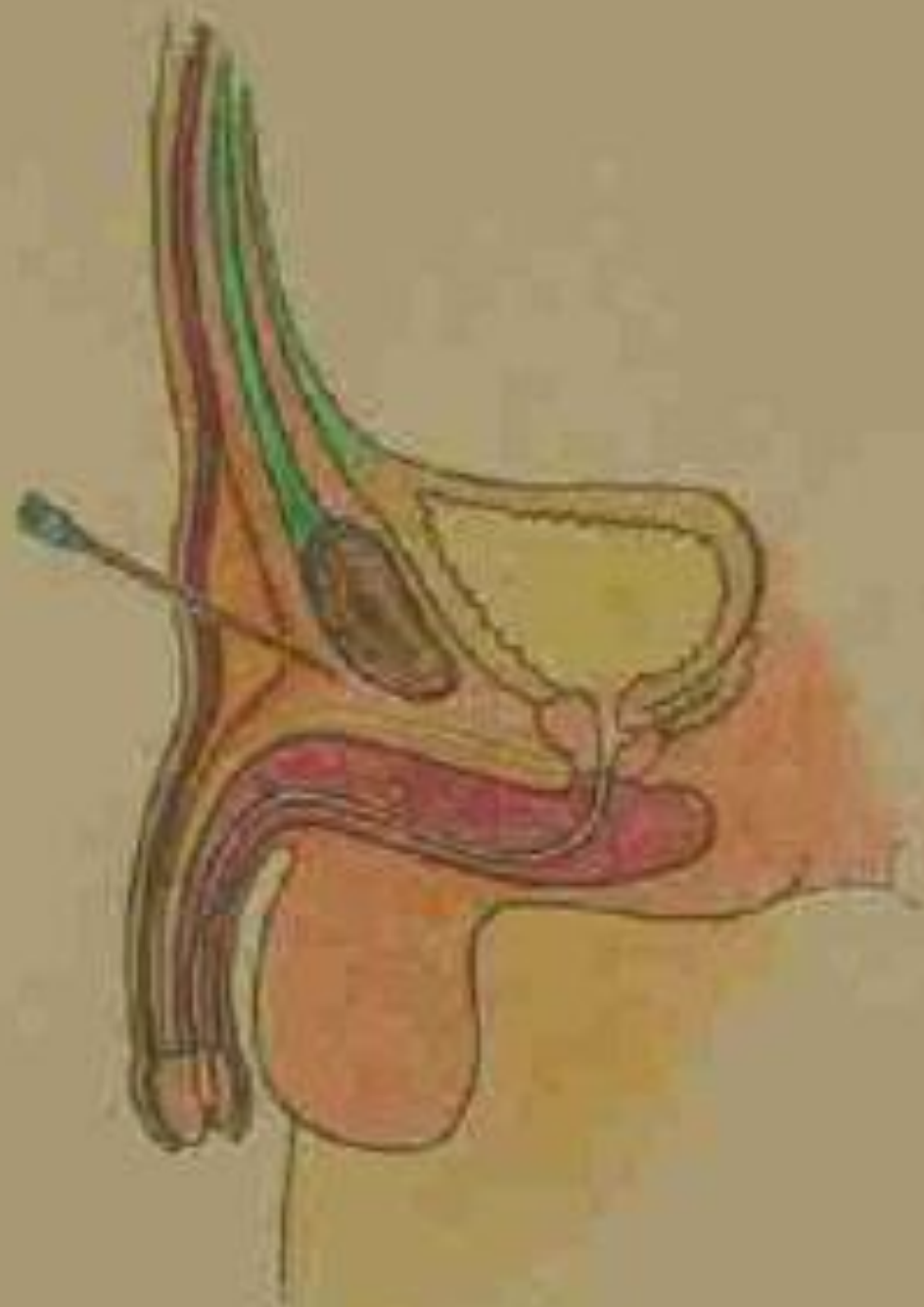
Spinal anesthesia with morphine (cont)

- Preservative free morphine (1 mg = 1 ml)
- 5 to 8 µg/kg
- Postop monitoring for oversedation or incomplete analgesia; PCA recommended

Penile block

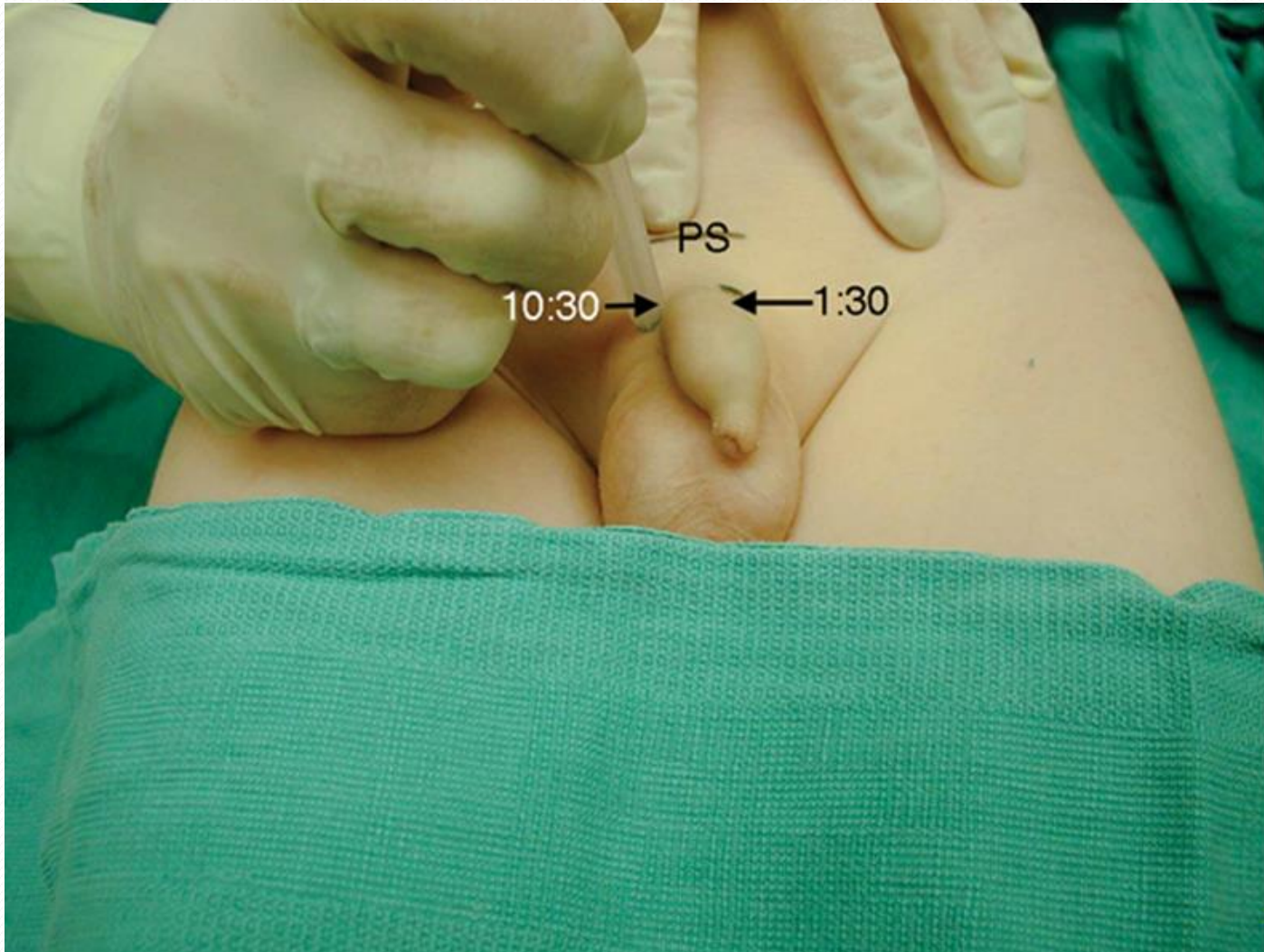
- Anatomy for dorsal nerve penile block.





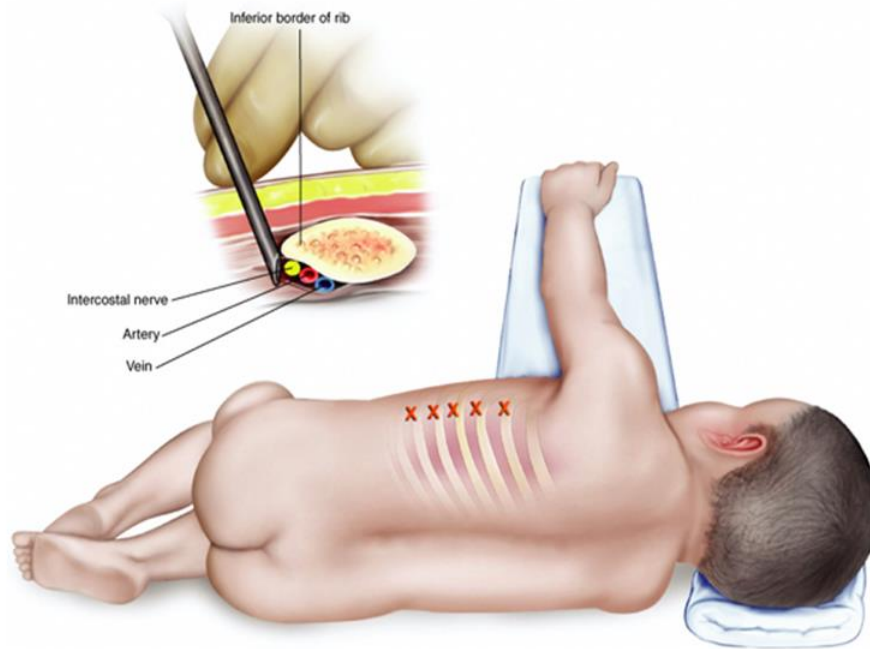


Performance of dorsal nerve block. PS, pubic symphysis. Point of needle insertion is at 10:30 and 1:30 o'clock at the base of the penis.



Anatomy of intercostal nerves.

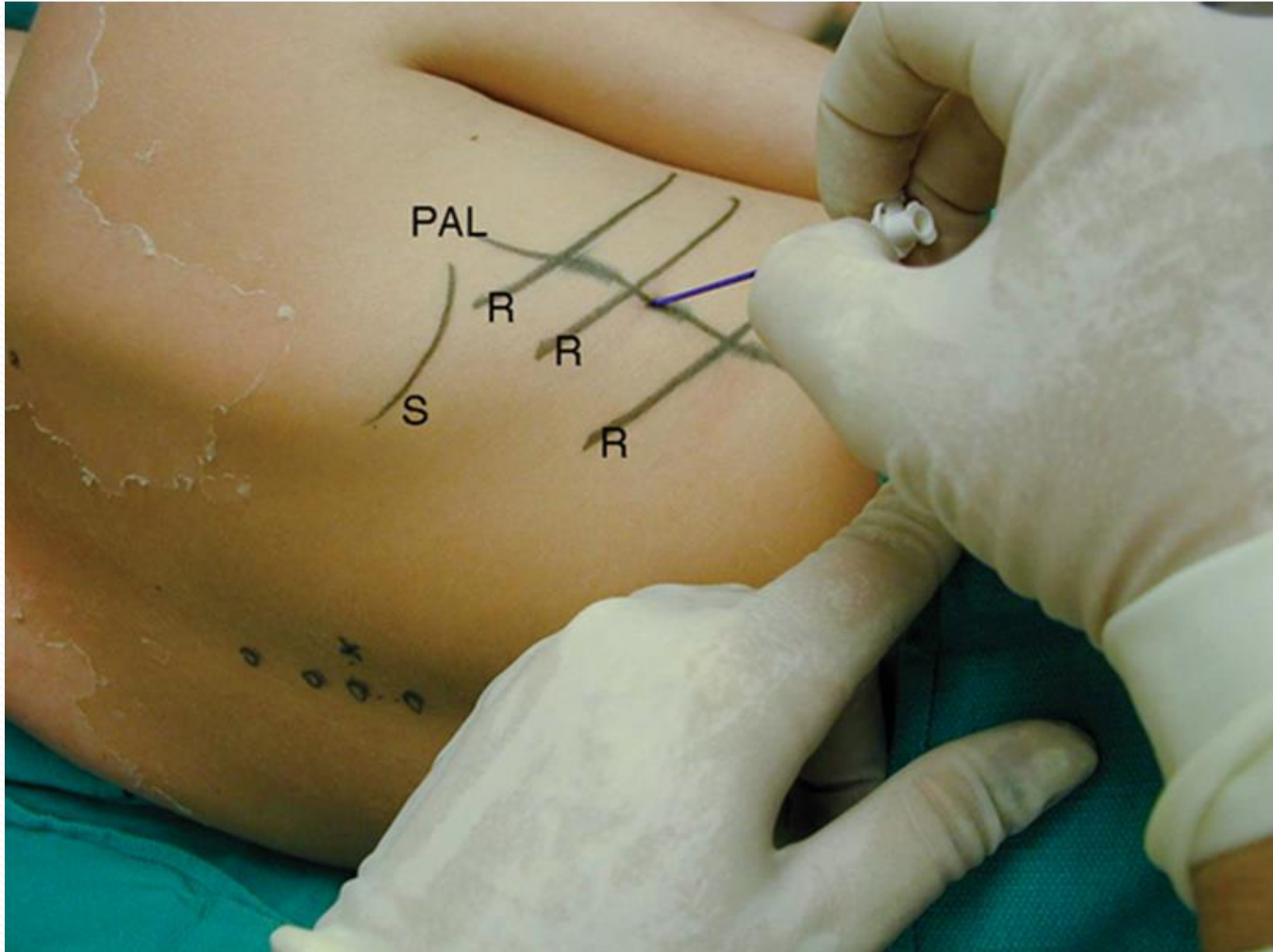
Anatomy of intercostal nerves.



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Performance of **intercostal block**. PAL, posterior axillary line; S, scapula; R, inferior border of rib. Needle is directed to contact inferior border of each rib to be blocked and then "walked off" posteriorly.



Periumbilical block (fascia of the rectus abdominis) (1)

Indication: umbilical hernia

Contraindication: omphalocele și a gastroskisis

Subcutaneous branches from X-th pair of intercostal nerves for the skin around umbilicus, contained in rectus abdominis fascia compartment.

Periumbilical block (fascia of the rectus abdominis) (2)

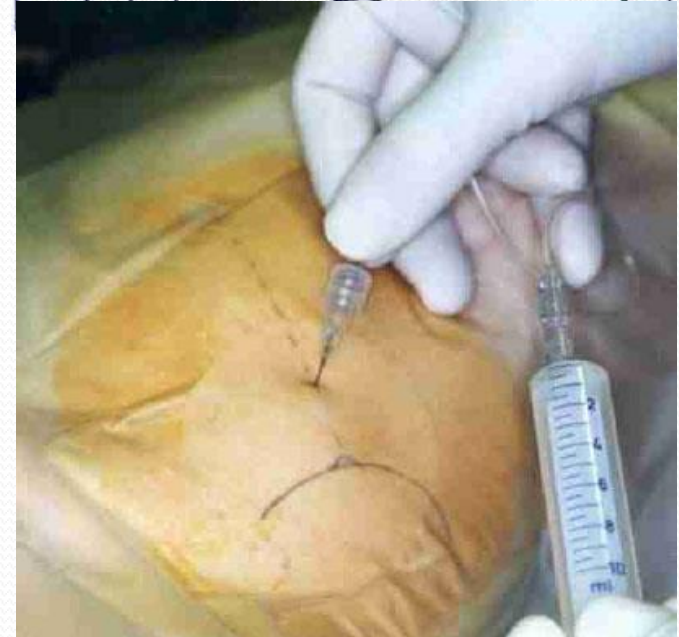
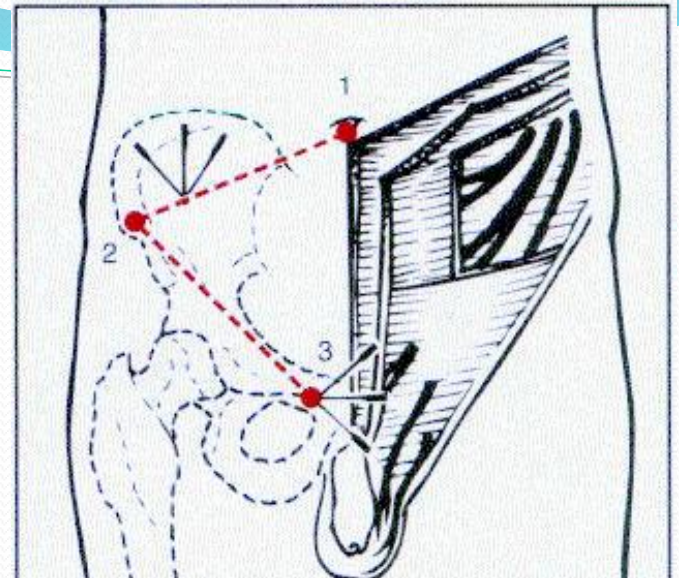
Technique

- Landmarks: umbilicus and lateral edge of both rectus abdominis muscles.
- Punction point: intersection of muscle edge with horizontal line tangent to inferior edge of umbilicus
- Short beveled needle angled 60 degrees against superior edge of umbilicus, until fascial perforation
- Bupivacaine 0.5 % (+/- adrenaline), ropivacaine 0.75-1 %, 0.2 ml/kg each part; +/- clonidine 1 µg/kg

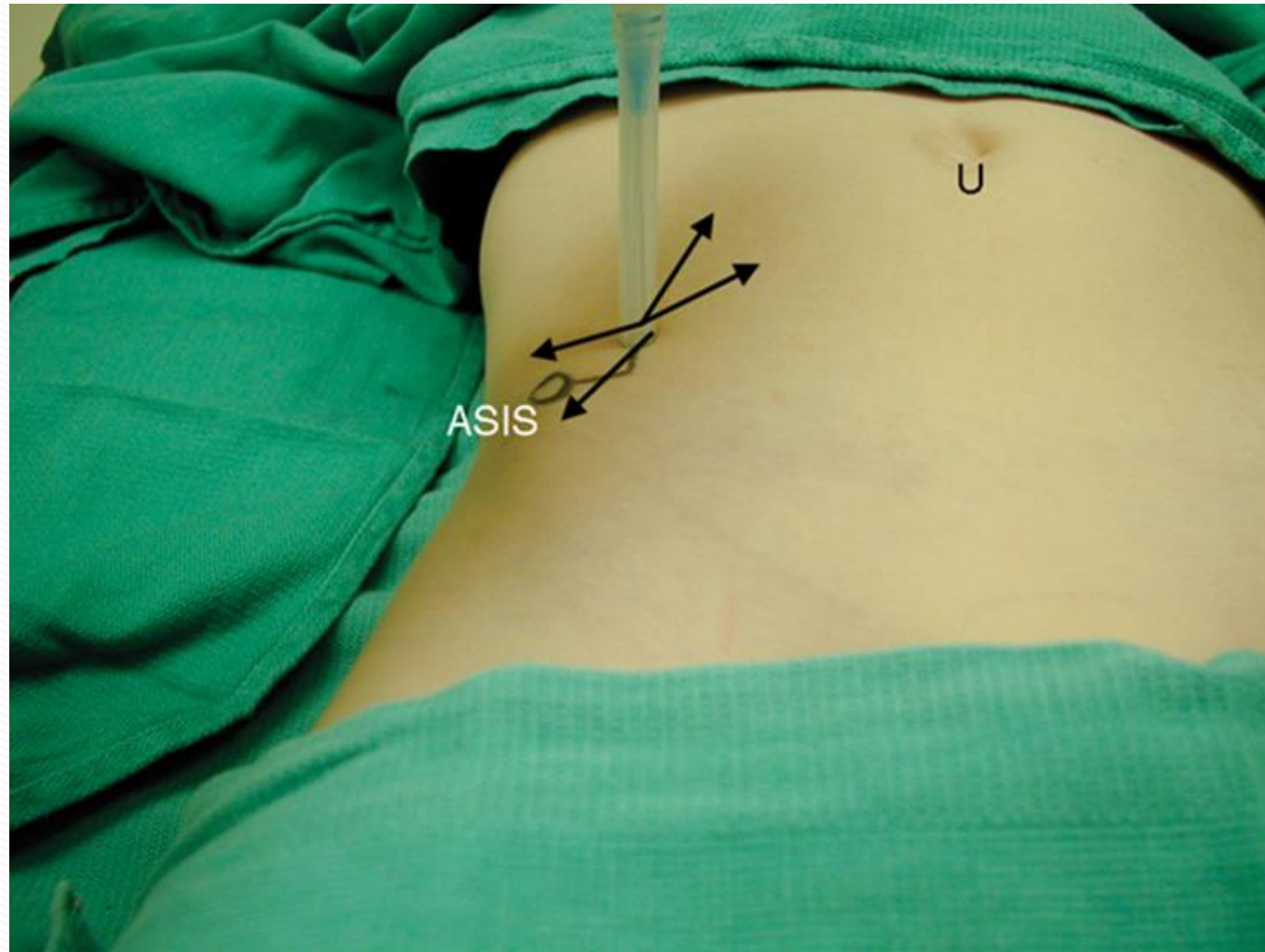


Ilioinguinal / iliohypogastric nerve block

- inguinal zone analgesia - by blocking the 2 nerves + genital branch of genitofemoral nerve.
- cases of intraabdominal penetration, or undesired extension (blocking femoral nerve)
- Other technique (simplified): fan injecting of the LA, close to inguinal channel



Ilioinguinal / iliohypogastric nerve block



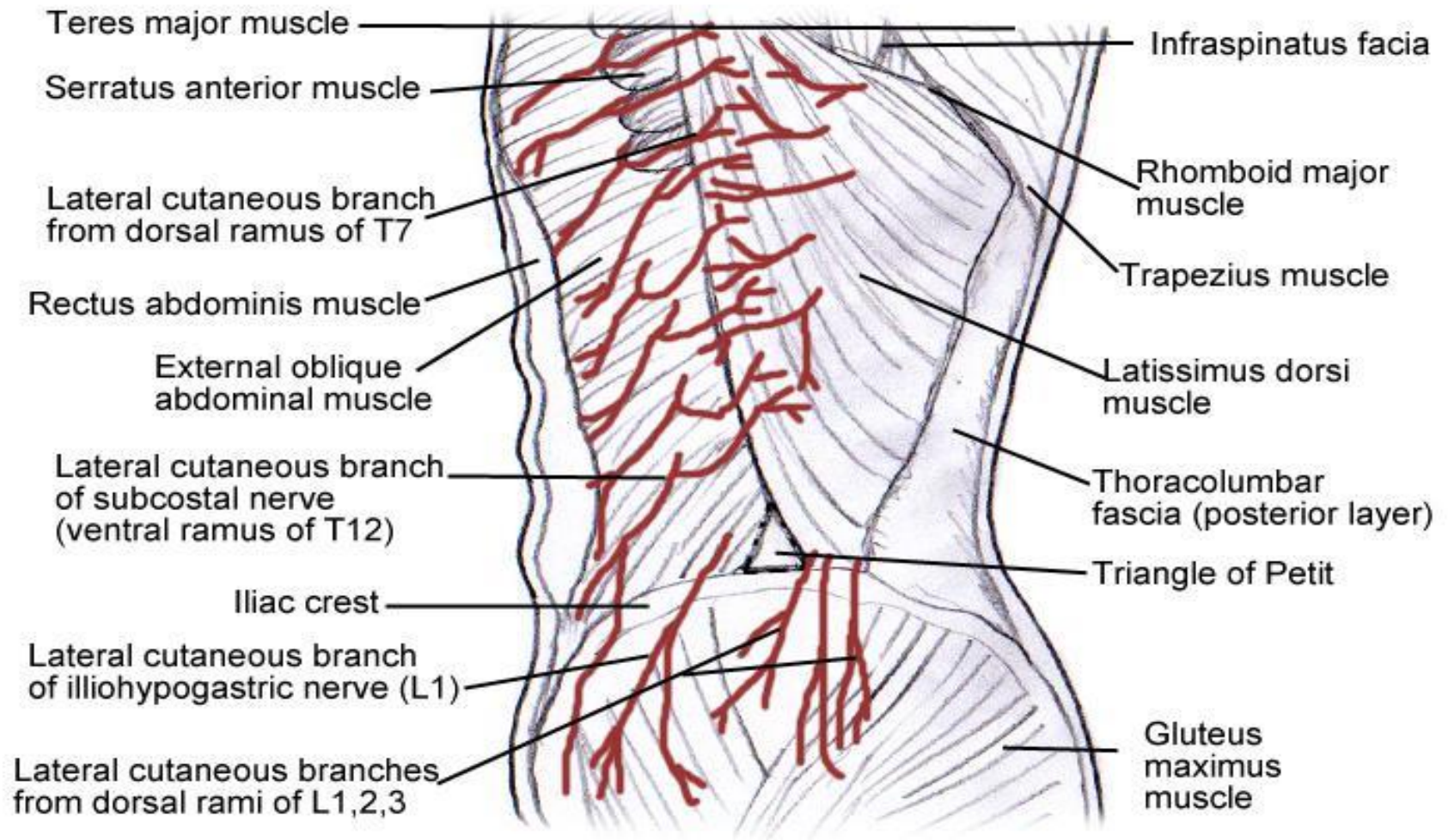
Transversus Abdominis Plane Block

Nerves supplying the anterior abdominal wall (T6 to L1).

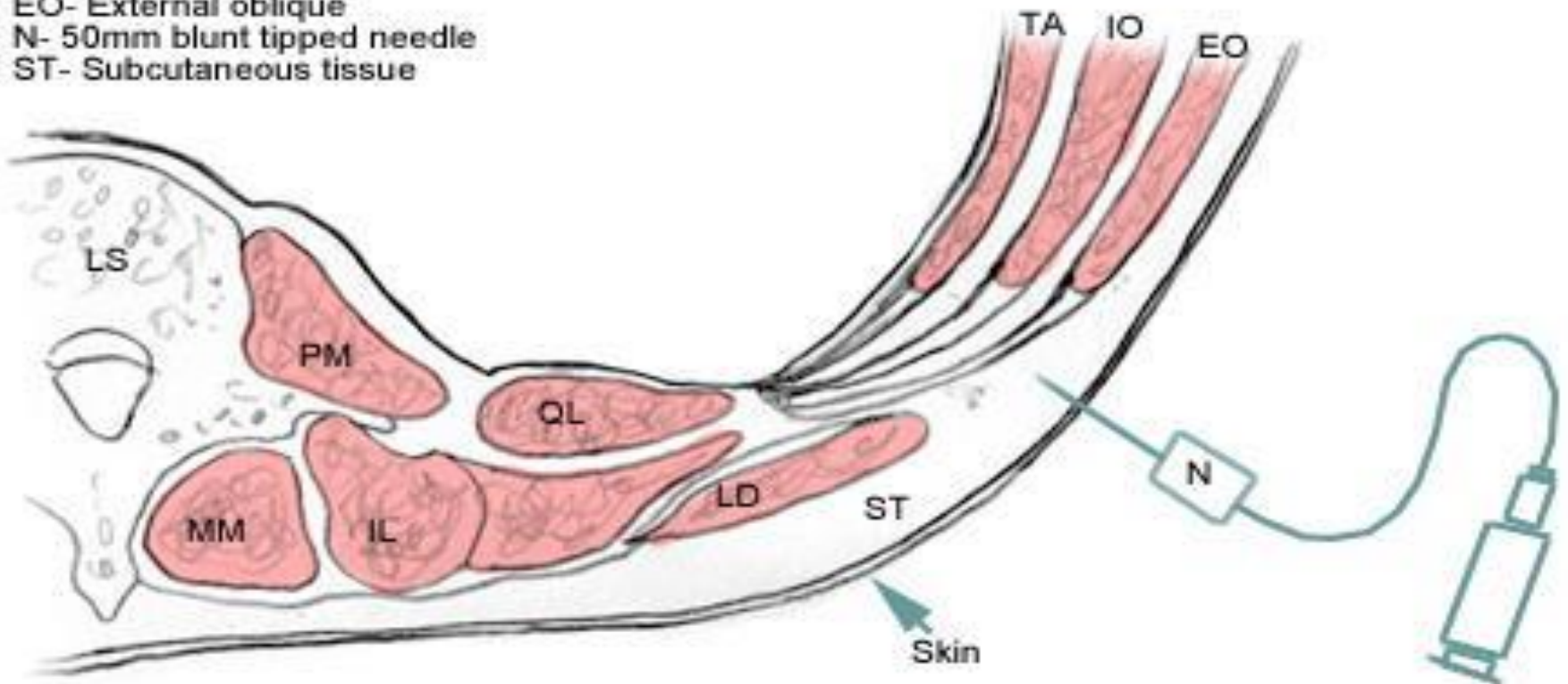
2001 (Rafi) blind landmark technique using the lumbar triangle of Petit

Local anesthetic injected between the internal oblique and transversus abdominis muscles just deep the fascial plane between

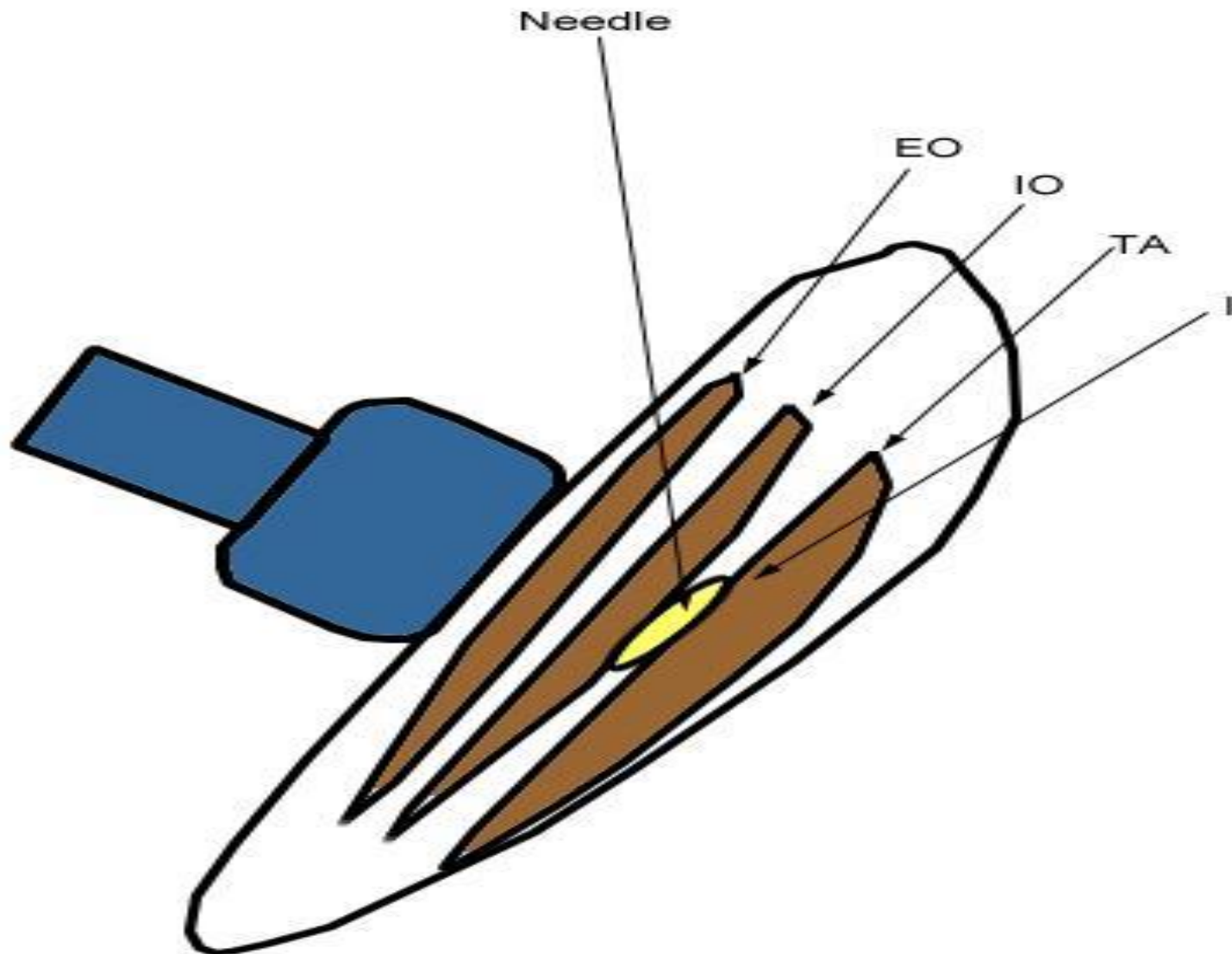
T A D



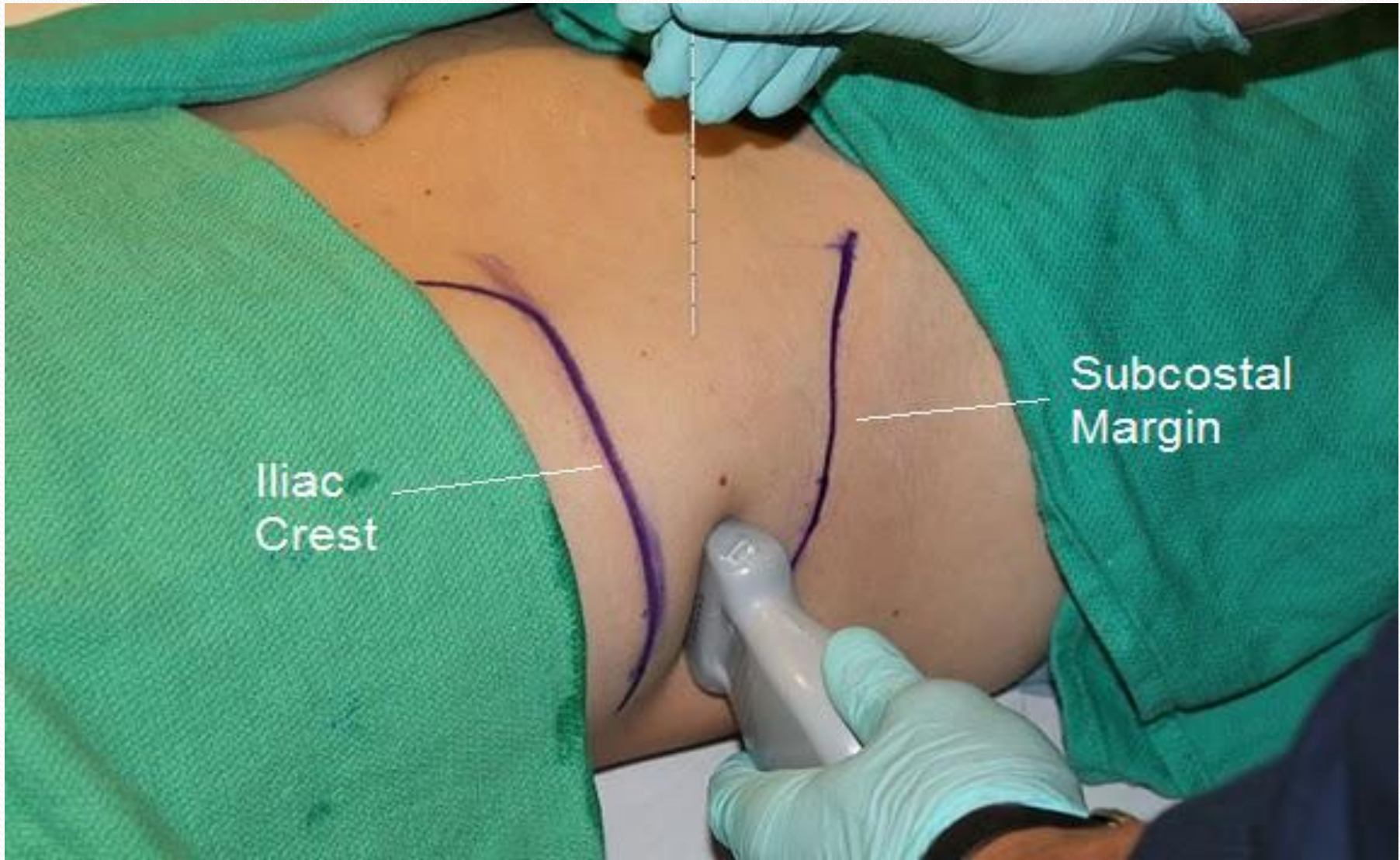
LS- Lumbar spine
LD- Latissimus dorsi
PM- Psoas major
QL- Quadratus lumborum
MM- Multifidus muscle
IL- Longissimus, iliocostalis
TA- Transversus abdominis
IO- Internal oblique
EO- External oblique
N- 50mm blunt tipped needle
ST- Subcutaneous tissue



TAP



TAP



Pudendal nerves (perineal) block

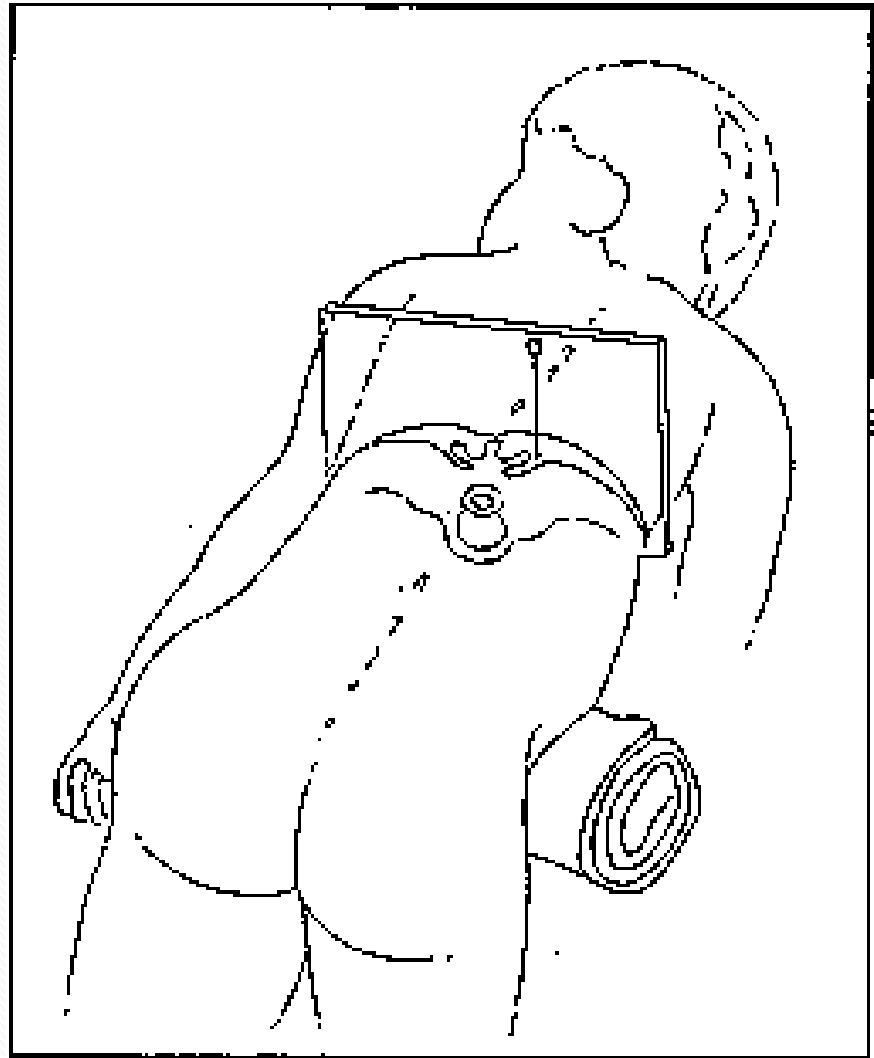
(peri)anal and labium minus pudendi surgery, complete ilioinguinal / iliohypogastric block for scrotum, complete penile block for superficial penis surgery.

punction: frontal skin projection of ischium tuberosity; short beveled needle 60-80 degrees from medial towards laterally, pointing the upper part of medial aspect of the tuberosity, until puncturing pelvine fascia; bupivacaine 0.5% 0.1-0.2 mg/kg, max 5 ml nonadrenalinated.

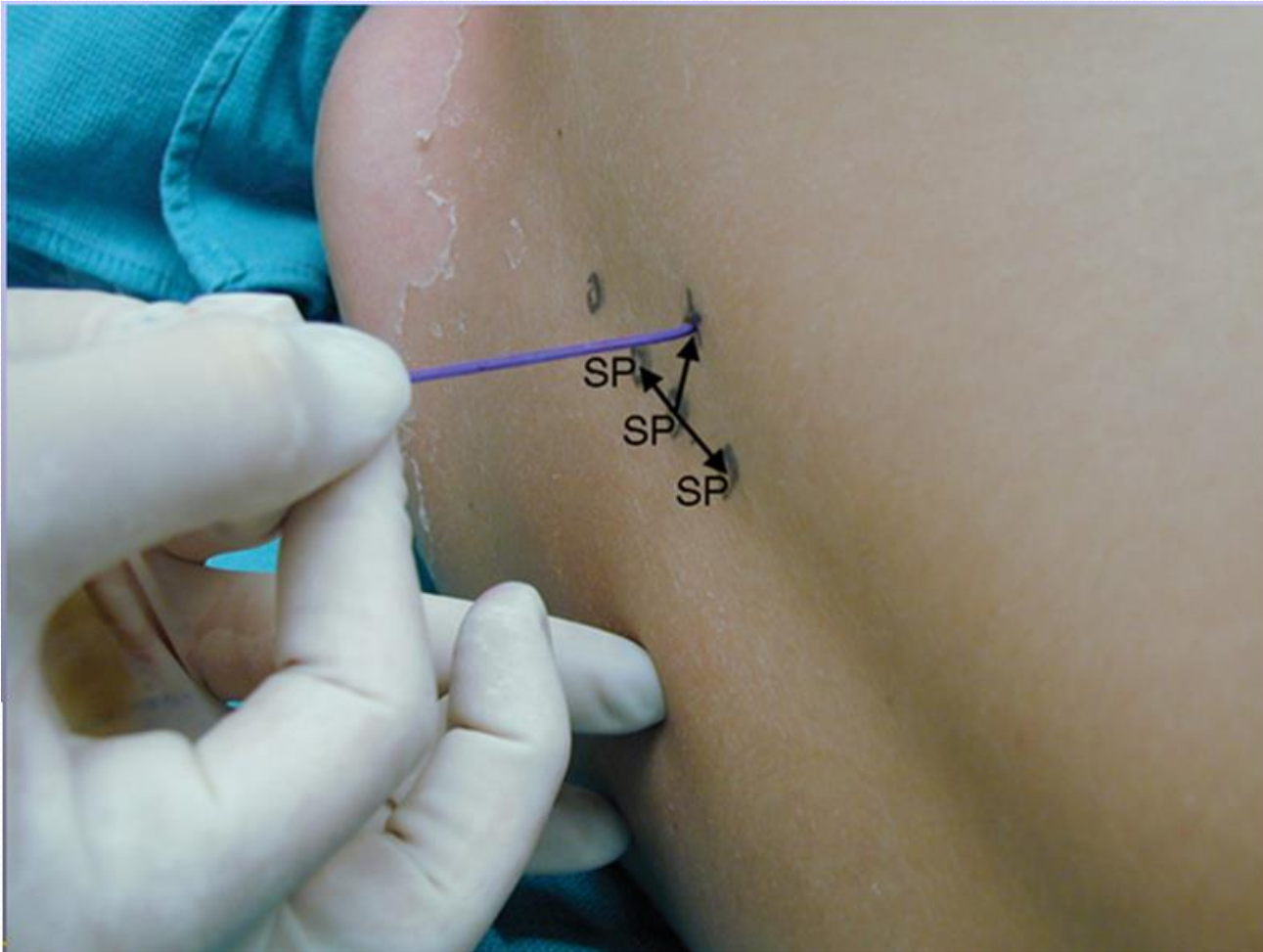


Paravertebral nerve block

- thoracic paravertebral space continues, LA passes freely until T12
- psoas muscle insertion stoppes difusion towards L1.
- new technique - same L1 punction 1-2 cm laterally from spinous process, 2 LA shots above and beneath transvers process L1.
- total dose 0.5 ml/kg bupivacaine or levobupivacaine 0.25 %
- lateral decubitus, operating zone upwards.



Paravertebral nerve block



Fascia iliaca compartment block

- Blocking lumbar plexus nerves : LA along the inner aspect of fascia iliaca.
- Pain control in femoral fracture
- Thigh surgery
- Canulla or catheter beneath fascia iliaca: reinjections or continuous infusion de LA
- Significant vascular absorption.

