

Pediatric Regional Anesthesia

WHY ? WHEN ? HOW ?

Marie-Pier Malenfant Rancourt MD FRCPC

Pediatric Anesthesiologist, Montreal Children's Hospital, MUHC

Assistant Professor, McGill University

Disclosure

No conflict of interest

Objectives

At the end of this session, participants will be able to

Discuss the **benefits, safety and efficacy** of regional anesthesia in
children
(why?)

Recognize the most **common surgical indications** of peripheral nerve
blocks in children
(when?)
)

Describe and apply the **techniques and general considerations** of the
most
frequently used peripheral nerve blocks in the pediatric population
(how?)

Why ?

Benefits

Safety

Efficacy

Why ?

Poorly controlled pain has multiple known adverse consequences

We need to improve the management of post-operative pain in children

Regional anesthesia can be used in over 80% of pediatric procedures

Why ? – Benefits

Regional anesthesia is a very effective alternative to systemic analgesics

Its use reduces general anesthetic requirements, which leads to :

avoidance of invasive airway instrumentation

decreased need for muscle relaxants

smoother emergence

faster awakening times

rapid discharge from PACU

earlier return of appetite

reduction of the impact anesthetics might have on immature developing brain

Why ? – Benefits

Successful blocks also help achieve ideal conditions in the recovery room :

more cooperative children
less PONV
faster discharge times
reduced workload for nurses
reduction in unplanned admissions and overall costs

Its use also has physiological benefits, such as :

decreased surgical stress response
immune benefits
hemodynamic stability

Why ? – Is it safe ?

Pediatric Anesthesia
Pediatric Anesthesia 2010 20: 1061-1069 doi:10.1111/j.1460-9592.2010.03448.x

Epidemiology and morbidity of regional anesthesia in children: a follow-up one-year prospective survey of the French-Language Society of Paediatric Anaesthesiologists (ADARPEF)

**Pediatric Regional Anesthesia Network (PRAN):
A Multi-Institutional Study of the Use and Incidence
of Complications of Pediatric Regional Anesthesia**

David M. Polaner, MD, FAAP^{††} Andreas H. Taenzer, MD, MS, FAAP^{†§} Benjamin J. Walker, MD,^{||}
Adrian Bosenberg, MB, ChB, FFA,^{||} Elliot J. Krane, MD,^{¶#} Santhanam Suresh, MD,^{**††}
Christine Wolf, MBS,^{††} and Lynn D. Martin, MD, MBA, FAAP FCCM^{||§§}

Incidence of overall morbidity is approximately

1 : 1000

Complications occur “at the end of the needle”, when the anesthesiologist is present and are usually managed without long term sequelae

Peripheral blocks seem safer than central techniques

Ecoffey C et al. *Pediatr Anesth* 2010;20:10

Polaner D et al. *Anesth Analg* 2012;115:1

Bosenberg A. B. *Pediatr Anesth* 2012; 22 : 10-18

Why ? – Efficacy

British Journal of Anaesthesia **113** (3): 375–90 (2014)
Advance Access publication 6 June 2014 · doi:10.1093/bja/aeu156

BJA

Regional anaesthesia to improve pain outcomes in paediatric surgical patients: a qualitative systematic review of randomized controlled trials

S. Suresh¹, K. Schaldenbrand¹, B. Wallis² and G. S. De Oliveira Jr^{2*}

Most important finding of this study was the **lack of sufficient clinical trials**

However, **very few studies demonstrated a lack of benefit**

No significant morbidity was attributed to regional techniques in the 5125 patients assessed in this study

Why ? – Efficacy

British Journal of Anaesthesia 113 (3): 375–90 (2014)
Advance Access publication 6 June 2014 · doi:10.1093/bja/aeu156

BJA

Regional anaesthesia to improve pain outcomes in paediatric surgical patients: a qualitative systematic review of randomized controlled trials

S. Suresh¹, K. Schaldenbrand¹, B. Wallis² and G. S. De Oliveira Jr^{2*}

Only a few surgical procedures had **more than one small RCT supporting the use** of regional anesthesia to reduce post-operative pain scores:

Ophthalmologic procedures

Cleft lip/palate repair

Inguinal hernia repair

Urologic procedures

When ?

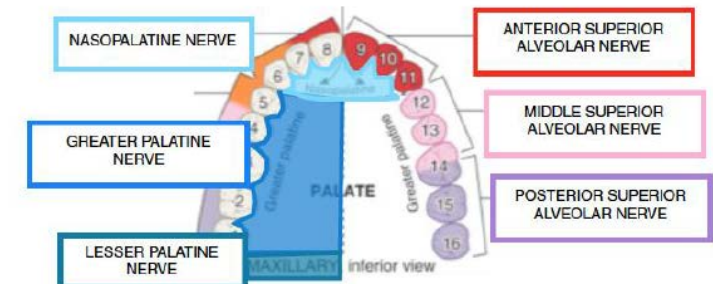
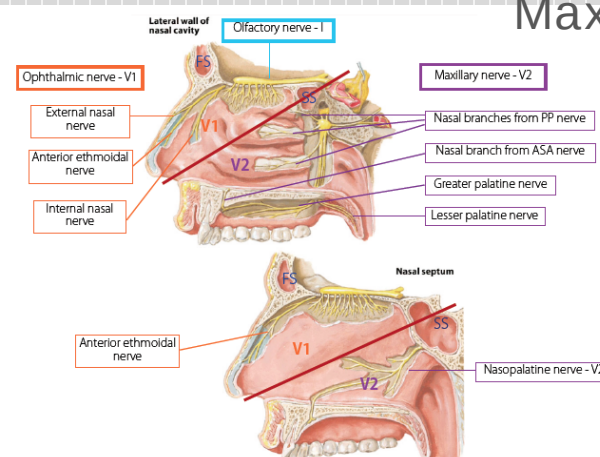
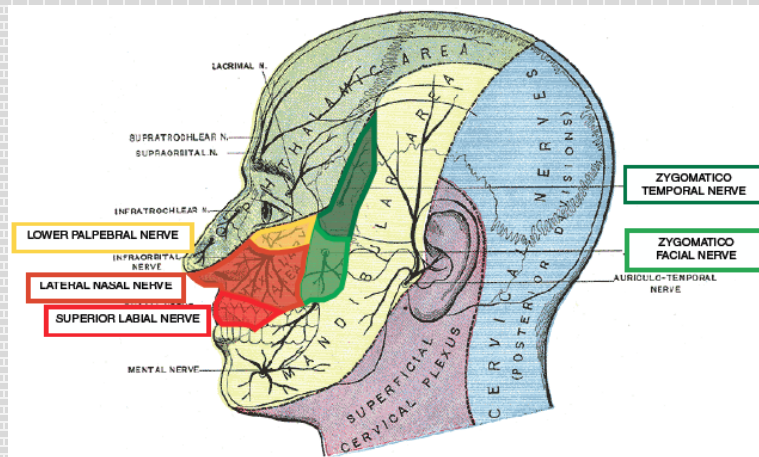
Common indications

Awake or Asleep ?

When ? – Indications – Face blocks

Suprazygomatic maxillary nerve block

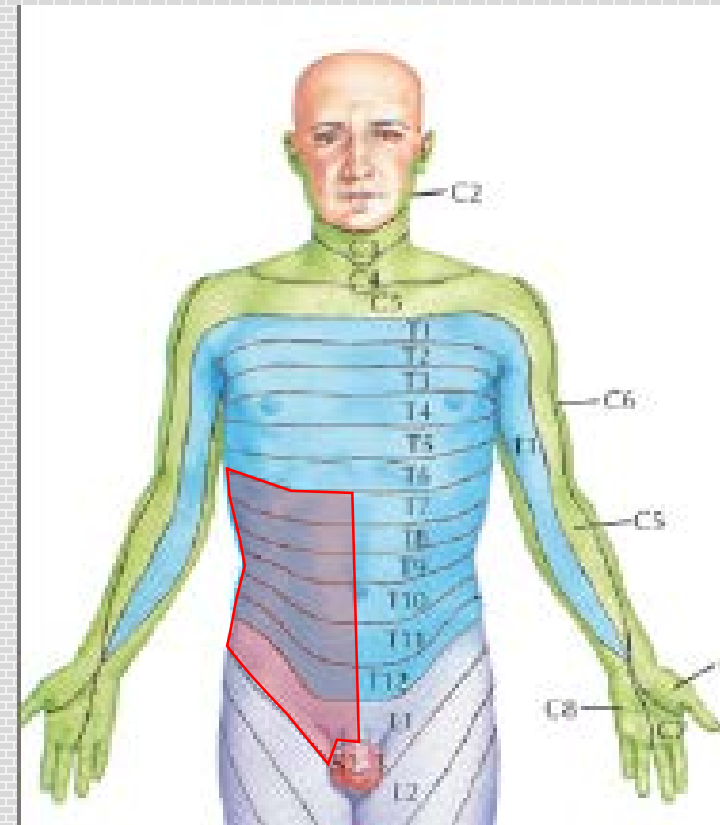
- Surgery of sinuses or nasal cavity
- Septoplasty
- Endoscopic sinus surgery
- Trans sphenoidal hypophysectomy
- Cleft lip/palate repair
- Surgery of Maxillary bone/teeth
- Le Fort I osteotomy
- Maxillary alveolar graft



When ? – Indications – Truncal blocks

TAP block

- Abdominal incisions
 - Laparoscopy
 - Laparotomy (if epidural C-I)
 - Pyloromyotomy
 - Inguinal surgery (ilio-inguinal block preferred)
- Iliac crest harvest



When ? – Indications – Truncal blocks

Ilio-inguinal block

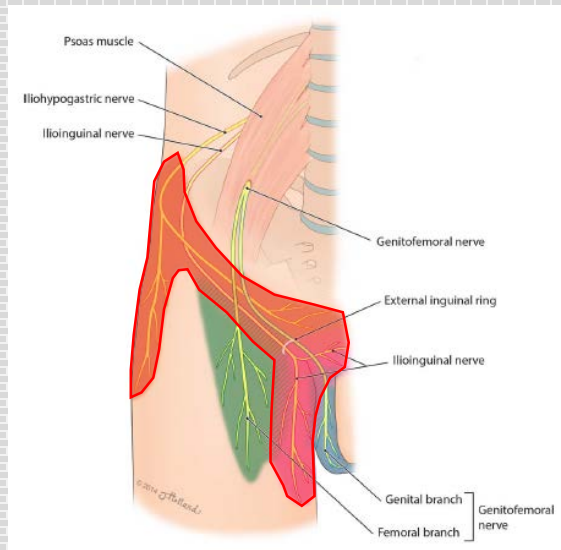
Inguinal incisions

Inguinal hernia repair

Orchidopexy

Hydrocelectomy

Varicocelectomy



Rectus sheath block

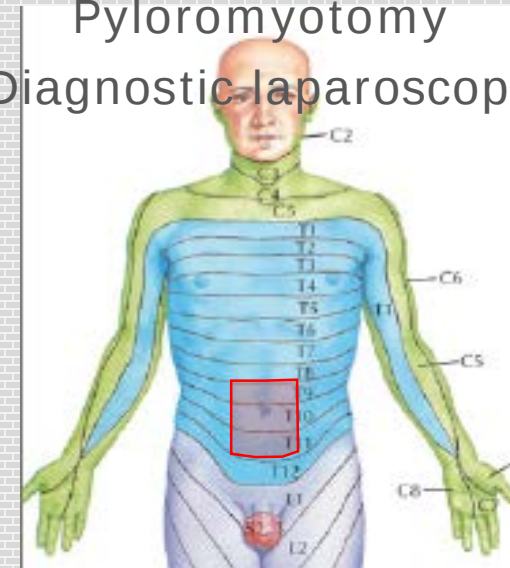
Midline abdominal incisions

Epigastric hernia repair

Umbilical hernia repair

Pyloromyotomy

Diagnostic laparoscopy



When ? – Indications – Truncal blocks

Pudendal nerve block

- External genitalia surgery

Circumcision

Hypospadias repair

Labioplasty

Hymenectomy

Perineal surgery

incisions

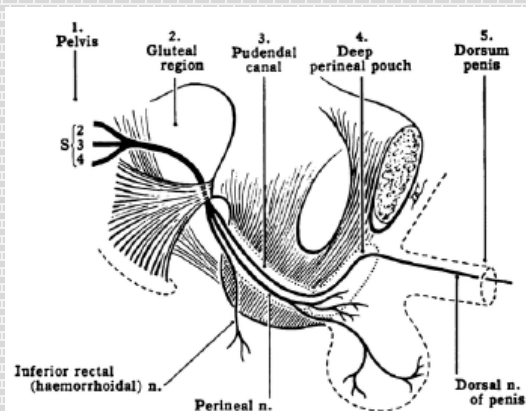
Orchidopexy

Orchiectomy

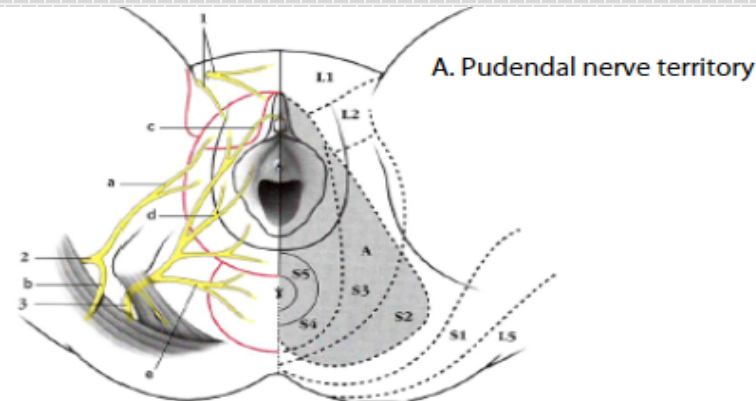
- Anal or peri-anal surgery

Colic pull-through

Hemorrhoidectomy



1. I-I + G-F nerves
2. Posterior cut femoral of thigh
 - a. Perineal branch
 - b. Cluneal inferior
3. Pudendal nerve
 - c. Dorsal branch
 - d. Perineal branch
 - e. Rectal inferior



Ventral view



Right lateral view



- ☐ Innervated by the perineal nerve
- ☐ Innervated by the DNP and perineal nerve
- ☐ Innervated by the DNP

When ? - Awake or Asleep ?

Transient and permanent nerve injury has occurred in awake patients who
did not feel any pain as the block was conducted

Merely a third of needle-to-nerve contact are noticed by adult patients;
Could patients be poor monitors of nerve injury?

Proper use of high resolution US provides a means to avoid needle-to-nerve contact

When ? - Awake or Asleep ?

LAST may be detected more quickly in awake patients, but only because of the very early symptoms

Hemodynamic signs are detectable in anesthetized patients;
cardiopulmonary resuscitation can be instituted more rapidly

When ? - Awake or Asleep ?

Performing a block on an awake and afraid child is **difficult** ;
Placing a block on a crying and moving infant can be **dangerous and impossible**

In children, **anatomical structures are close** to each other;
the **patient must be immobile** to ensure the safety of regional techniques

When ? – Awake or Asleep ?

Asleep Versus Awake: Does It Matter?

Pediatric Regional Block Complications by Patient State: A Report From the Pediatric Regional Anesthesia Network

Andreas H. Taenzer, MD, MS, Benjamin J. Walker, MD,† Adrian T. Bosenberg, MBChB, FFA(SA),‡
Lynn Martin, MD,‡ Santhanam Suresh, MD,§ David M. Polaner, MD, FAAP,||
Christie Wolf, MBS,# and Elliot J. Krane, MD***

TABLE 1. Summary of all Blocks and Corresponding Patient State

	GA No NMB	GA With NMB	GA Total	Sedated	Awake	Missing	Total
Single-shot blocks							
Neuraxial	15,867	3261	19,128	186	282	0	19,596
Upper extremity	2571	205	2776	350	111	45	3282
Lower extremity	8210	892	9102	563	116	0	9781
Head and neck	1324	511	1835	62	54	0	1951
Other	7102	2349	9451	132	50	0	9633
Catheter blocks							
Neuraxial	3748	3033	6781	608	228	0	7617
Upper extremity	105	11	116	33	5	0	154
Lower extremity	1302	99	1401	126	23	0	1550
Total	40,229	10,361	50,590	2060	869	45	53,564

When ? – Awake or Asleep ?

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Overall rate of adverse events **11.9 : 1000**

Post-op neurological complications **1.3 : 1000**

Local anesthetic toxicity **0.09 : 1000**

When ? - Awake or Asleep ?

Asleep Versus Awake: Does It Matter?

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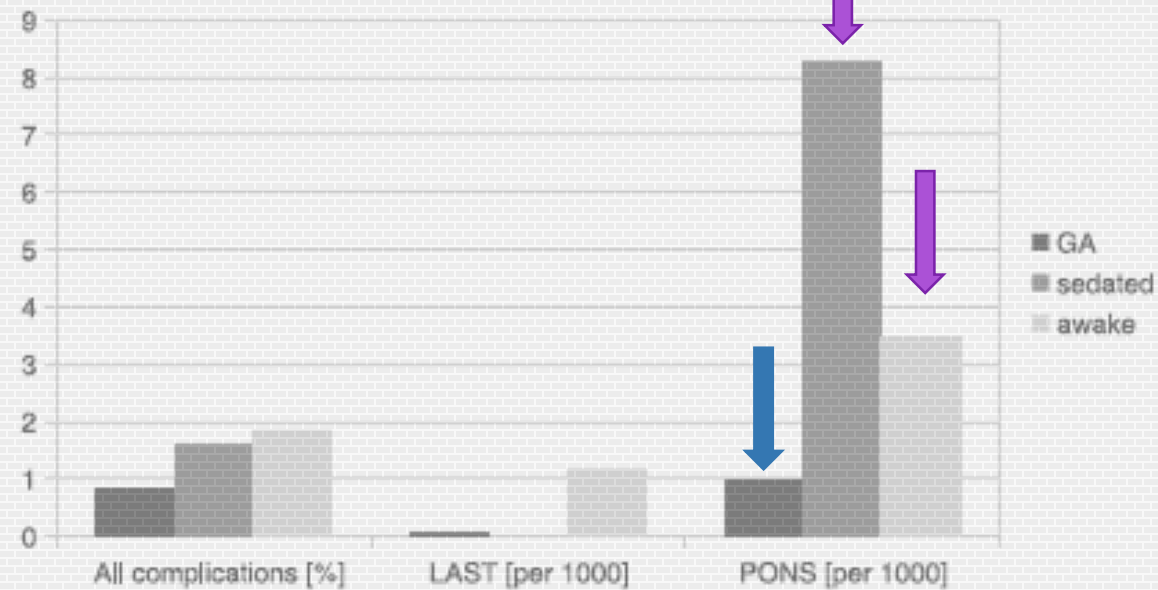


FIGURE 1. Rates of complications based on patient state at time of block placement.

How ?

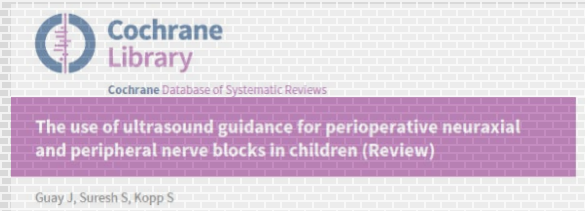
Ultrasound guidance

Neuraxial or peripheral blocks ?

Clinical pearls

Technique – Pudendal nerve block

How ? – Ultrasound guidance



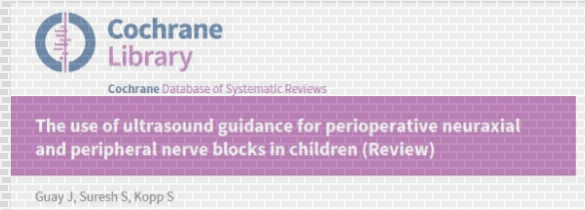
The use of ultrasound guidance:

increased the success rate by decreasing the occurrence of failed block

increased the duration of the block by 62 min

For those outcomes, the younger the child was, the more beneficial was the use of US

How ? – Ultrasound guidance



The use of ultrasound guidance:

was associated to lower pain scores one hour after surgery

was associated to fewer needle passes

reduced the time required to perform neuraxial blocks

How ? – Ultrasound guidance

Evidence for the Use of Ultrasound Imaging in
Pediatric Regional Anesthesia
A Systematic Review

Darren K.M. Lam, BSc, Gareth N. Corry, PhD, and Ban C.H. Tsui, MD

*Are peripheral and neuraxial blocks with
ultrasound guidance more effective and safe in
children?*

KASIA RUBIN MD, DENISE SULLIVAN MD AND
SENTHILKUMAR SADHASIVAM MD MPH

US guidance led to **shorter block performance time** and **higher success rates** vs neurostimulation techniques (*Ib, B ; Ib, A*)

US guidance also **improved the block quality** by:

reducing analgesic consumption vs infiltration (*Ib, A*), landmarks (*Ib, B*) and GA alone (*Ib, A*)

increased the duration of the block vs infiltration, landmarks and neurostim (*Ib, A*)

was associated to lower pain scores infiltration and landmarks (*Ib, A*)

US guidance also led to **shorter onset times** and **lower LA volume requirements**

How ? – Neuraxial vs Peripheral

Whenever possible, **favor peripheral nerve blocks** over central blocks:

Complication rate is six times lower with PNB (ADARPEF 2010)

Landmarks are clear and constant

Lower LA volumes required – therefore reduced systemic absorption and toxicity

More targeted and controlled area of anesthesia

Longer duration of blockade

How ? – Clinical pearls – Max doses

BUPIVACAINE

Bolus injection

Neonates	1.5-2.0 mg/kg
Children	2.5 mg/kg (1 ml/kg bupi 0.25%)

Continuous infusion

Neonates	0.2 mg/kg/hr
Children	0.4 mg/kg/hr

ROPIVACAINE

Bolus injection

Neonates	1.5-2.0 mg/kg
Children	3 mg/kg (1.5 ml/kg ropi 0.2%)

Continuous infusion

Neonates	0.2 mg/kg/hr
Children	0.4 mg/kg/hr

How ? – Clinical pearls – Dosage

CLINICAL INVESTIGATION

Local anaesthetic dosage of peripheral nerve blocks in children: analysis of 40 121 blocks from the Pediatric Regional Anesthesia Network database

S. Suresh¹ and G. S. De Oliveira Jr.^{2,*}

LA doses varied up to 10-fold for the same nerve blocks

The incidence of systemic toxicity was low (0.005%), with no long-term sequelae

Ropivacaine was used for 59% of blocks

Guidelines need to be developed to reduce variability of LA dosage practices in children receiving single-shot nerve blocks

How ? – Clinical pearls – Dosage

The European Society of Regional Anaesthesia and Pain Therapy/American Society of Regional Anesthesia and Pain Medicine Recommendations on Local Anesthetics and Adjuvants Dosage in Pediatric Regional Anesthesia

Santhanam Suresh, MD, Claude Ecoffey, MD,† Adrian Bosenberg, MB, ChB, FFA(SA),‡
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NEURAXIAL BLOCKS		
Caudal block		
Bupivacaine	2.5 mg/kg	1 ml/kg bupi
Ropivacaine	2.0 mg/kg	0.25% 1 ml/kg ropi 0.2%
Lumbar or Thoracic epidural		
LOADING DOSE Bupi and Ropi	0.5 ml/kg (lumbar) 0.3 ml/kg (thoracic) Maximum 1.7 mg/kg	
INFUSION Bupi and Ropi	<3 months → 0.2 mg/kg/hr 3-12 months → 0.3 mg/kg/hr > 1 year → 0.4 mg/kg/hr	

How ? – Clinical pearls – Dosage

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SINGLE-SHOT PERIPHERAL NERVE BLOCKS

Upper and Lower extremity blocks

Bupi and Ropi	0.5-1.5 mg/kg	0.2-0.6 ml/kg bupi 0.25% 0.25-0.75 ml/kg ropi 0.2%
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Fascial plane blocks (RSB, TAP, Fascia Iliaca)

Bupi and Ropi	0.25-0.75 mg/kg	0.1-0.3 ml/kg bupi 0.25% 0.12-0.4 ml/kg ropi 0.2%
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CONTINUOUS PERIPHERAL NERVE INFUSIONS

How ? – Clinical pearls – Dosage

Maxillary nerve block Ropi 0.2% 0.15 ml/kg/side (max 5 ml) Always block bilaterally	TAP block Ropi 0.05-0.2% 0.2-0.5 ml/kg/side (max 20 ml) [...] depends on max dose for weight	Rectus Sheath block Ropi 0.2% 0.1 ml/kg/side (max 10 ml) Always block bilaterally
Ilio-inguinal nerve block Ropi 0.2% 0.1-0.2 ml/kg/side	Pudendal nerve block Ropi 0.2% 0.2 ml/kg/side (max 10 ml) Always block bilaterally No epinephrine	

Question ?

What are the possible indications for ultrasound-guided pudendal nerve block?

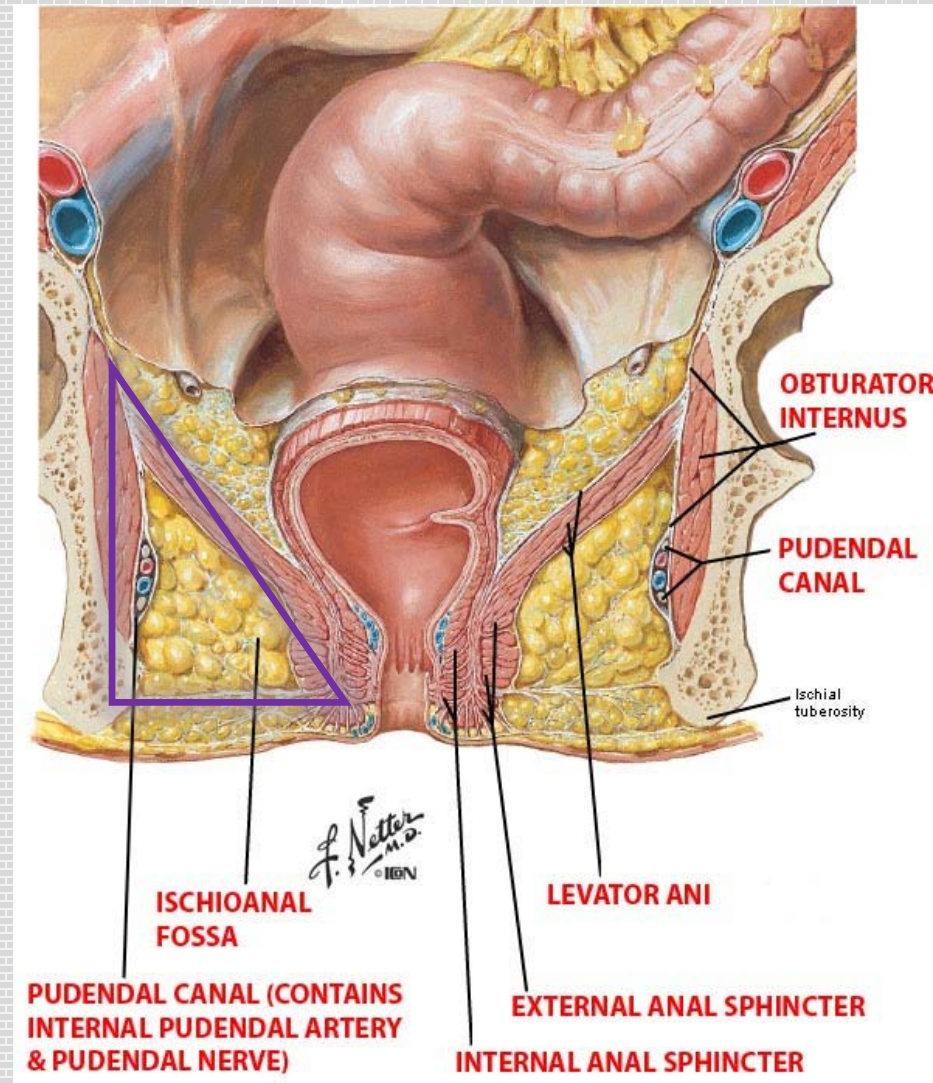
- A) Circumcision
- B) Orchidopexy
- C) Hemorrhoidectomy
- D) Labioplasty
- E) All of the above

Question ?

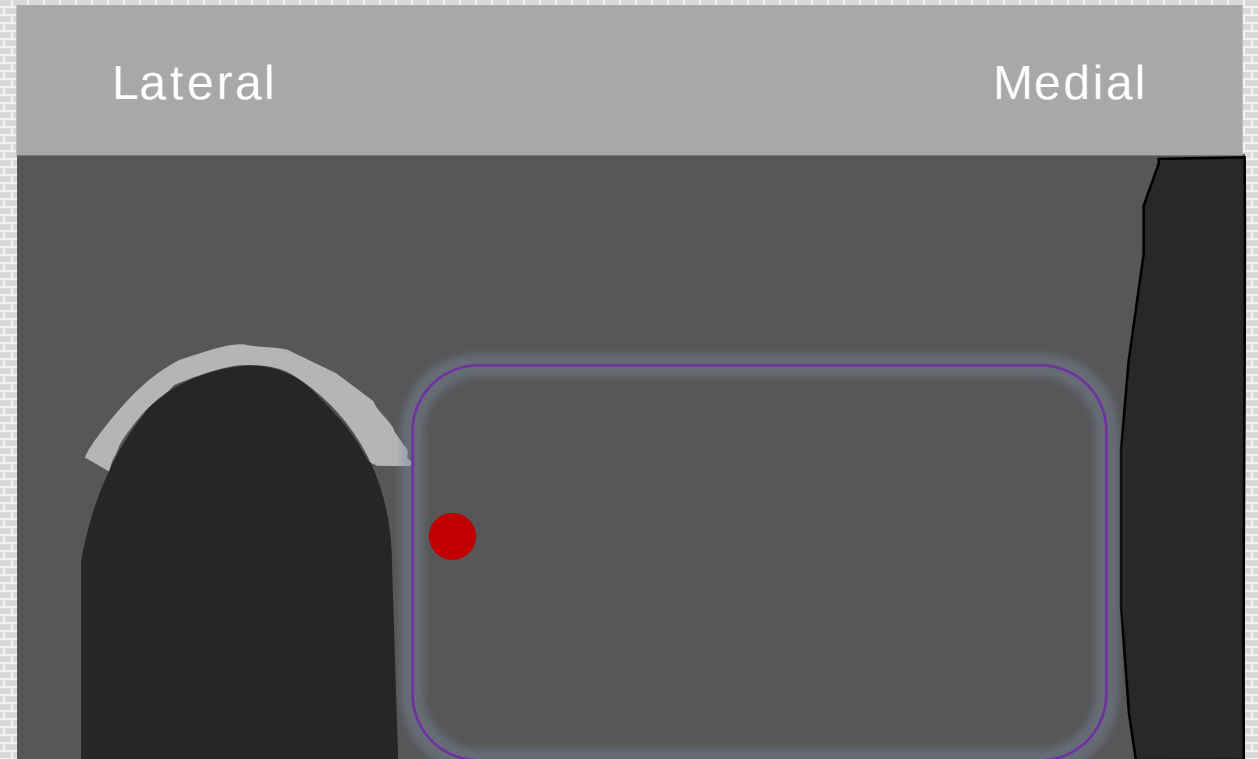
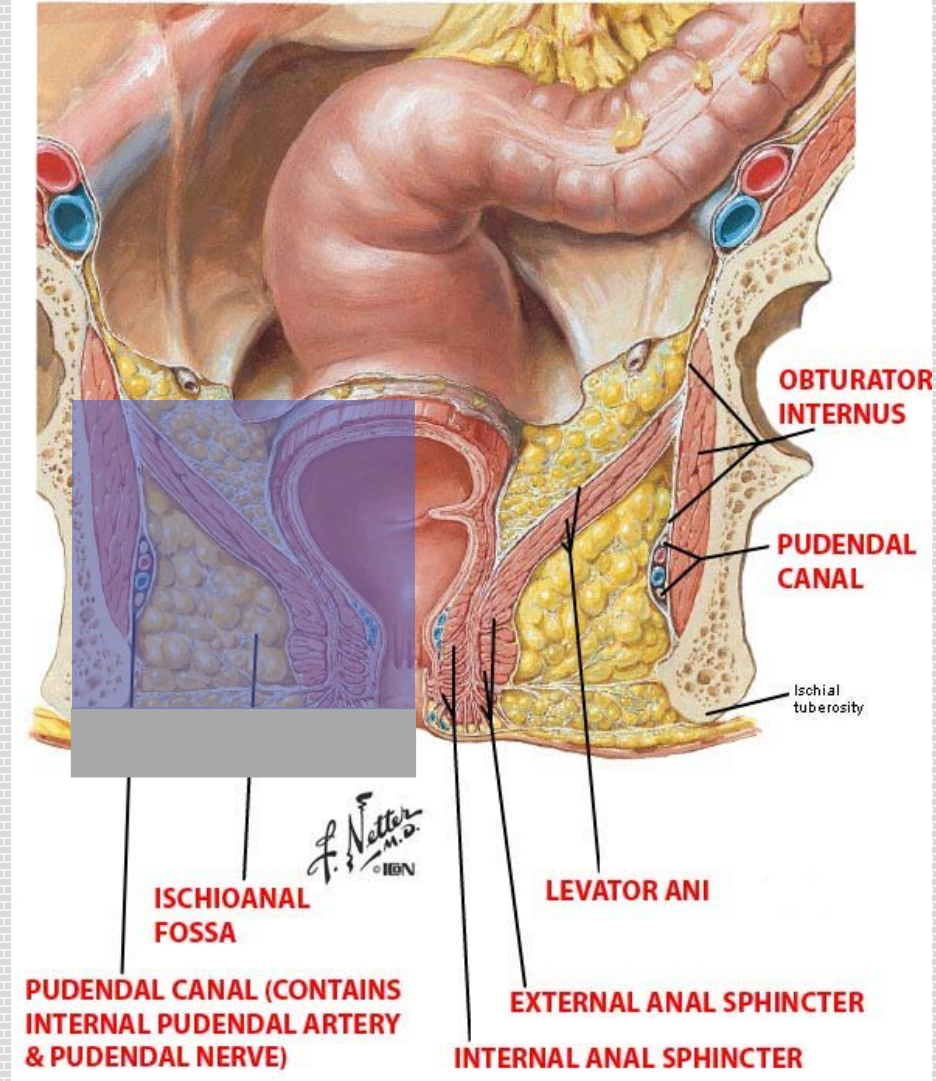
What are the possible indications for ultrasound-guided pudendal nerve block?

- A) Circumcision
- B) Orchidopexy
- C) Hemorrhoidectomy
- D) Labioplasty
- E) All of the above**

How ? – Technique – Pudendal block



How ? – Technique – Pudendal block



How ? – Technique – Pudendal block

Supine, frog position

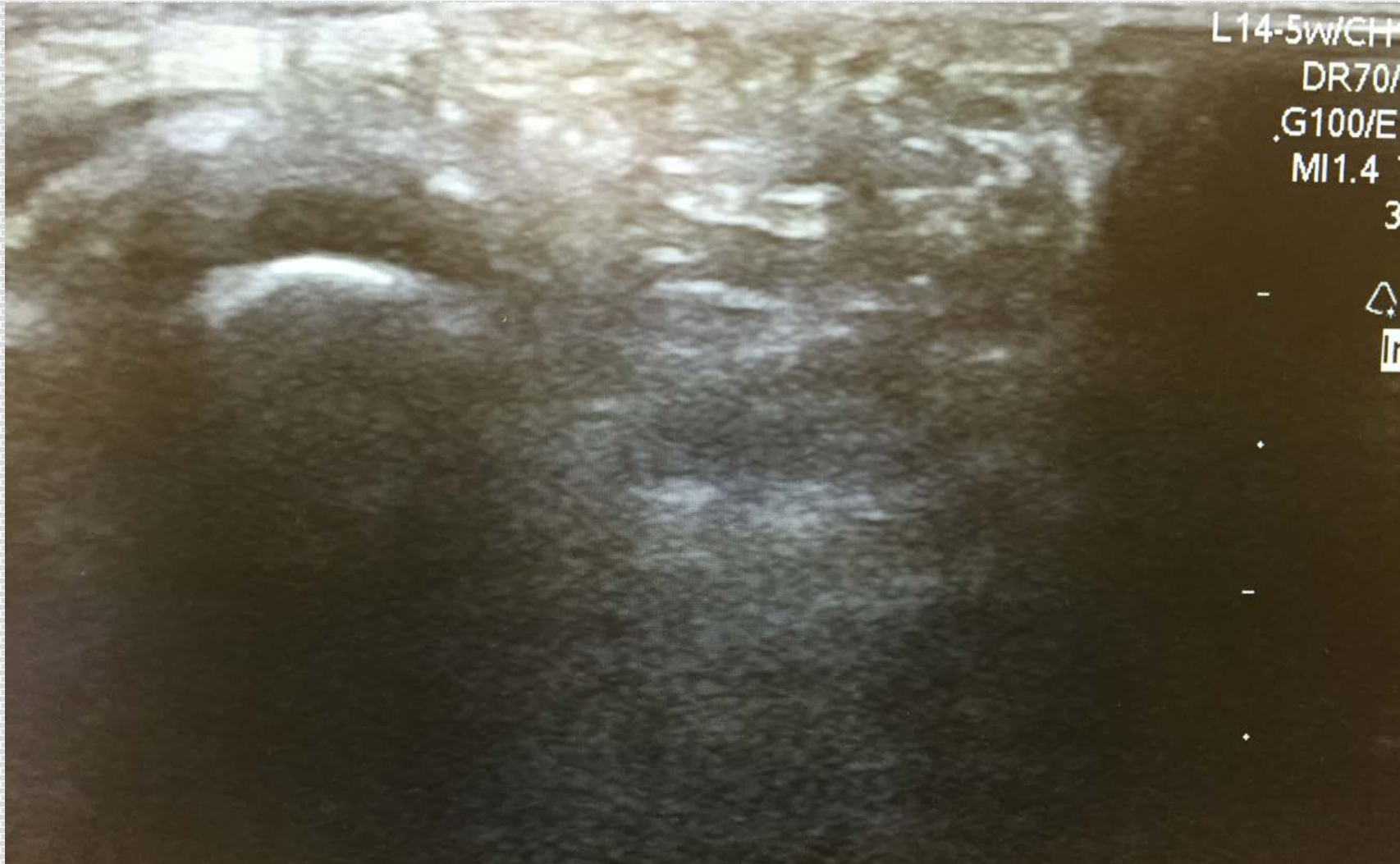


Palpate ischial tuberosity

Linear transducer positioned transverse on buttocks, over tuberosity

Identify ISCHIAL TUBEROSITY, RECTUM and pudendal artery (Doppler)

How ? – Technique – Pudendal block



How ? – Technique – Pudendal block



Insert 22G needle **OUT OF PLANE** in the middle of the probe's long edge

Advance needle with a slight posterior orientation

★ Position needle tip **in the fossa, between tuberosity and rectum** ★

How ? – Technique – Pudendal block



Conclusion

The management of post-operative pain in children needs to be improved

The use of regional anesthesia in children has **increased in the past years** and has proven to be **very safe**, even when performed **under general anesthesia**

Peripheral nerve blocks have been shown to improve pain outcomes for some procedures;

more studies are required to prove its efficacy in other surgical interventions

Conclusion

When possible, peripheral nerve blocks should be chosen over neuraxial blocks

Ultrasound guidance should always be used

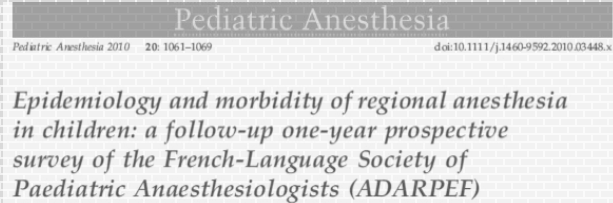
ESRA and ASRA recommendations for dosage of LA for various peripheral nerve blocks are now available and can be used as a guide

Questions ?

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- Taenzer AH et al. Asleep Versus Awake: Does It Matter? Pediatric Regional Block Complications by Patient State: A Report

Why ? – Is it safe ?



ADARPEF 2010

31,132 regional blocks

The incidence of complications was 0.12%

All complications occurred at the **time of needle placement** in the OR and none led to harm or sequelae 1 year later

Complications **significantly higher in central blocks (6x) vs peripheral blocks**

Complications **significantly higher in infants < 6 months (4x) vs in children > 6 months**

Why ? – Is it safe ?

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PRAN 2012

14,917 regional blocks on 13,725 patients

No deaths or complications with sequelae lasting > 3 months

Single-injection blocks had fewer adverse events than continuous blocks

Most common complication with continuous blocks was catheter-related
problems (33%)

Majority of complications detected at time of needle or catheter placement