Komplikationen Regionalanästhesie

KATZ 23 hybrid

Zurich, 25th March 2023

Thomas Engelhardt
Montreal Children's Hospital
Shriner's Hospital for Children - Canada

Conflict of interest

- None

Regional Anesthesia and Pain Medicine 23(1): 104–107, 1998

Paraplegia Following Intracord Injection During Attempted Epidural Anesthesia Under General Anesthesia

Philip R. Bromage, M.B.B.S., F.F.A.R.C.S., F.R.C.P(C)*
and Jonathan L. Benumof, M.D.†

British Journal of Anaesthesia **92** (3): 427–9 (2004)
DOI: 10.1093/bja/aeh065 Advanced Access publication January 22, 2004

BJA

CASE REPORTS

Fatal streptococcal necrotizing fasciitis as a complication of axillary brachial plexus block

S. Nseir*, P. Pronnier, S. Soubrier, T. Onimus, F. Saulnier, D. Mathieu and A. Durocher

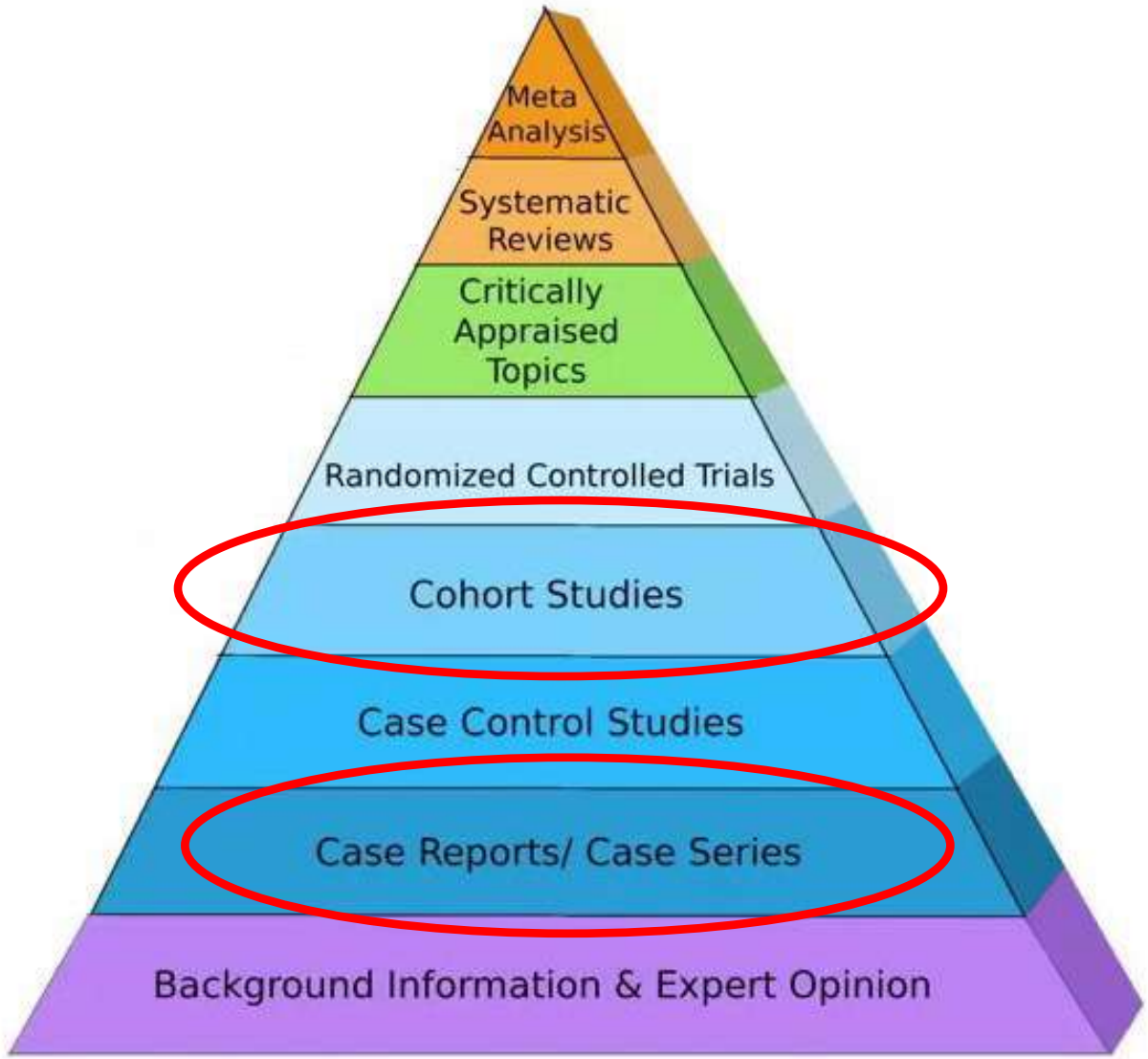
Complications

1. Nerve damage

2. Infections

3. Local anesthesia systemic toxicity

Levels of Evidence



Short Title	Title	Est.	Webpage
	Acute postoperative pain on the first postoperative day		
PAIN OUT	Improvement in Postoperative Pain Outcome	2009	pain-out.med.uni-jena.de
QUIPS	Quality Improvement in Postoperative Pain Management	2005	quips-projekt.de
	Regional anesthesia and acute postoperative pain		
net-ra	German Network for Safety in Regional Anesthesia and Acute Pain Medicine	2007	net-ra.eu
	Regional anesthesia		
PRAN	Pediatric Regional Anesthesia Network	2007	pedsanesthesia.org
IRORA	International Registry of Regional Anesthesia	2006	regionalanaesthesia.wordpress.com
	Administrative databases		
Medicare	Medicare and Medicaid healthcare claims database	1999	medicare.gov resdac.org
Premier	Premier healthcare database	1997	premierinc.com
MarketScan	IBM MarketScan research database (previously: Truven Health MarketScan Database)	1989	ibm.com/products/marketscan-research-databases
	Anesthesiology and Perioperative Medicine		
NACOR	National Anesthesia Clinical Outcomes Registry	2008	aqihq.org
MPOG	Multicenter Perioperative Outcomes Group	2008	mpog.org
NSQIP	American College of Surgeons National Surgical Quality Improvement Program	1991	facs.org

Epidemiology and Morbidity of Regional Anesthesia in Children: A One-Year Prospective Survey of the French-Language Society of Pediatric Anesthesiologists

Anesth Analg 1996;83:904–12

Elisabeth Giaufré, MD* Bernard Dalens, MD†, and Anne Gombert, MD‡

*Service de Chirurgie Pédiatrique, Fondation-Hôpital Saint-Joseph, Marseille, France, †Pavillon Gosselin, Hôtel-Dieu, Clermont-Ferrand, France, and ‡Département d'Informatique Médicale, Hôpital de la Conception, Marseille, France

Epidemiology of regional anesthesia in children: Lessons learned from the European Multi-Institutional Study APRICOT

Pediatric Anesthesia. 2019;29:1128–1135.

Christophe Dadure[1,2] | Francis Veyckemans[3] | Sophie Bringuier[4] | Walid Habre[5]

The National Pediatric Epidural Audit

Pediatric Anesthesia 2007 **17**: 520–533

N. LLEWELLYN, RN, RSCN, BA* AND A. MORIARTY FRCA†

*Acute Pain Service and †Department of Anaesthesia, Birmingham Children's Hospital NHS Trust, Birmingham, UK

Brachial plexus block with ultrasound guidance for upper-limb trauma surgery in children: a retrospective cohort study of 565 cases

Markus Zadrazil[1], Philipp Opfermann[1], Peter Marhofer[1,*], Anna I. Westerlund[2] and Thomas Haider[3]

British Journal of Anaesthesia, 125 (1): 104–109 (2020)

Nerve Damage

Complications in Pediatric Regional Anesthesia

An Analysis of More than 100,000 Blocks from the Pediatric Regional Anesthesia Network

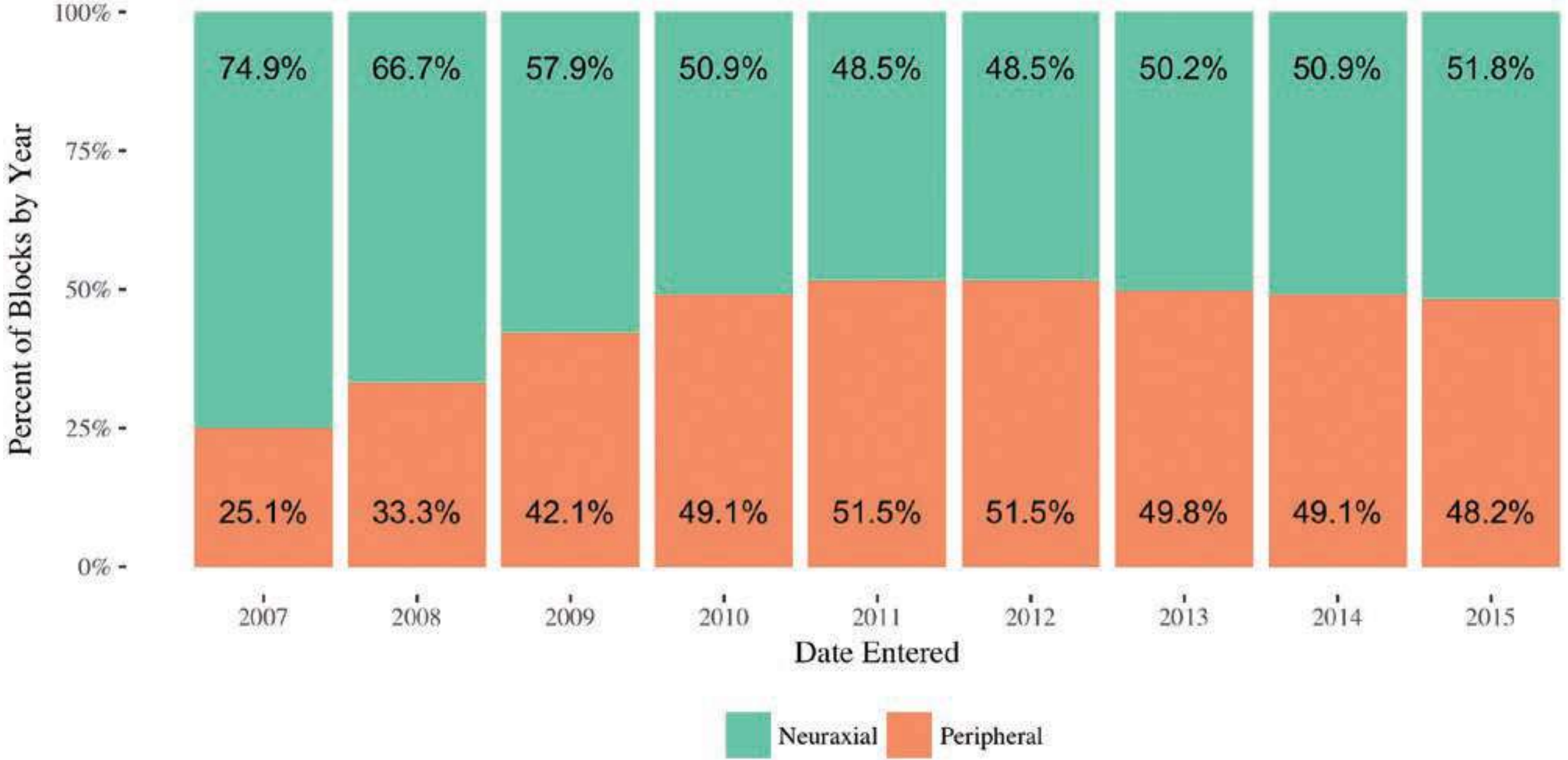
Benjamin J. Walker, M.D., Justin B. Long, M.D., Madhankumar Sathyamoorthy, M.B.B.S., M.S., M.B.A., Jennifer Birstler, M.S., Christine Wolf, M.B.S., Adrian T. Bosenberg, M.B., Ch.B., F.F.A. (S.A.), Sean H. Flack, M.B., Ch.B., F.C.A., Elliot J. Krane, M.D., F.A.A.P., Navil F. Sethna, M.D., Santhanam Suresh, M.D., F.A.A.P., Andreas H. Taenzer, M.S., M.D., David M. Polaner, M.D., F.A.A.P., on behalf of the Pediatric Regional Anesthesia Network Investigators*

Anesthesiology 2018; 129:721-32

104,393 blocks
91,701 patients

2007 to 2015

23 Hospitals



Anesthesiology 2018; 129:721-32

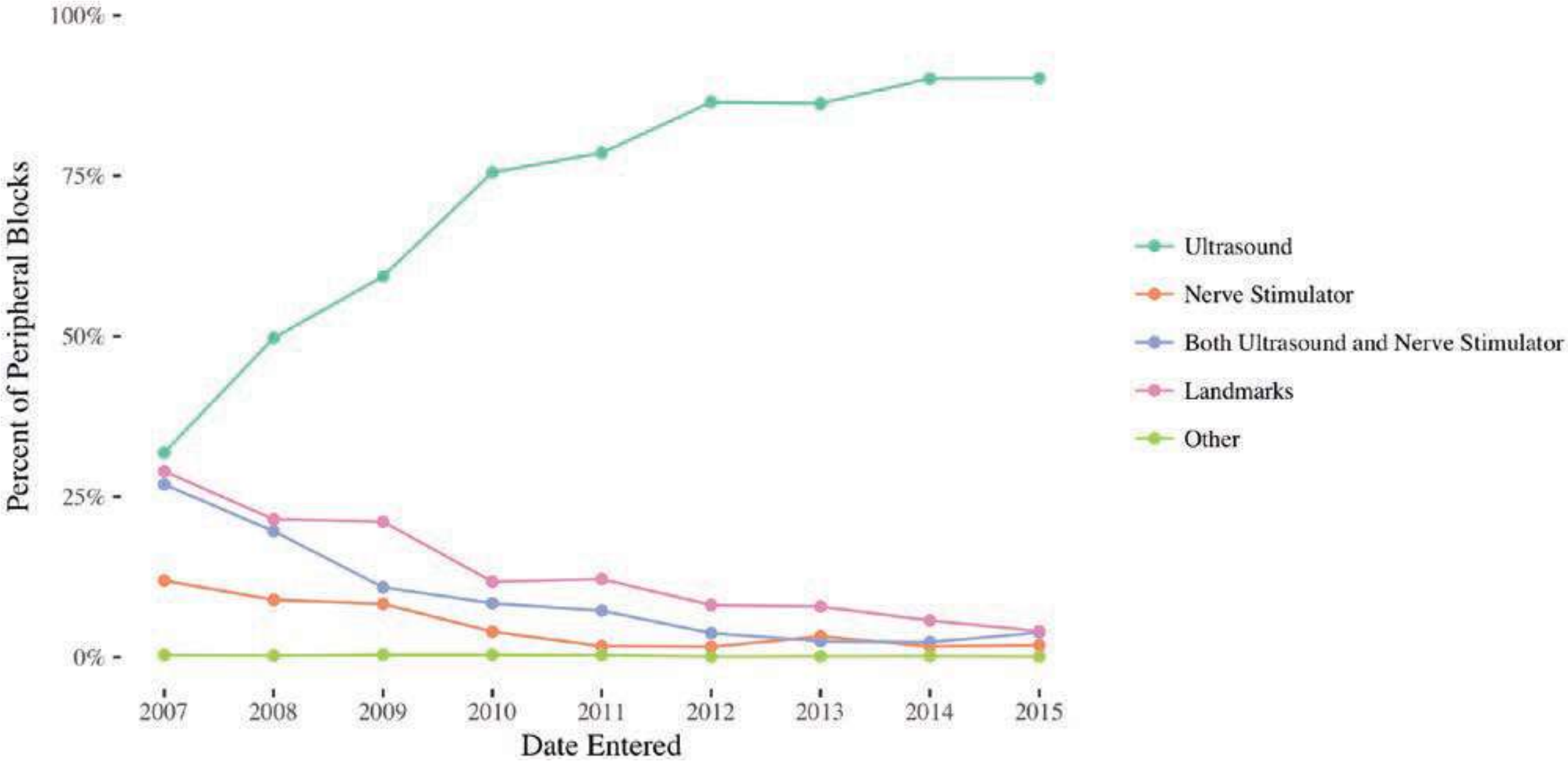
Single-injection Blocks by Age Group

	Neonate	1–5 months	6–11 months	1–2 yr	3–9 yr	≥ 10 yr	Total
Total	705	7,385	12,595	16,738	20,974	27,931	86,328
Neuraxial							
Caudal	520	5,630	10,918	12,989	7,515	544	38,116
Lumbar epidural	2	20	29	49	203	373	676
Sacral intervertebral	0	5	4	4	3	0	16
Subarachnoid	19	201	18	41	185	1,570	2,034
Thoracic epidural	3	12	8	16	37	86	162

Continuous Catheters by Age Group

	Neonate	1–5 months	6–11 months	1–2 yr	3–9 yr	≥ 10 yr	Total
Total	353	1,080	910	2,013	4,768	8,941	18,065
Neuraxial							
Caudal – lumbar	41	135	154	226	334	223	1,113
Caudal – sacral	40	142	175	298	209	39	903
Caudal – thoracic	116	281	123	186	172	272	1,150
Lumbar epidural	43	150	172	527	2,081	2,740	5,713
Sacral intervertebral	3	5	1	4	1	0	14
Thoracic epidural	105	321	206	617	1,100	1,878	4,227

Anesthesiology 2018; 129:721-32



Anesthesiology 2018; 129:721-32

Age Group	Cases	Blocks	Incidence	95% CI
Neonate	0	1,058	0:10,000	0–43.7
1–5 months	0	8,465	0:10,000	0–5.5
6–11 months	0	13,505	0:10,000	0–3.4
1–2 yr	0	18,751	0:10,000	0.02–4
3–9 yr	3	25,742	1.2:10,000	0.2–3.6
≥10 yr	27	36,872	7.3:10,000*	5–10.7

30 blocks; 25 patients

2.4:10,000

(95% CI 1.6-3.6:10,000)

!

- > 10 years
- All transient
- No difference peripheral/ central
- Ultrasound not safer

Anesthesiology 2018; 129:721-32

Peripheral nerve catheters in children: an analysis of safety and practice patterns from the pediatric regional anesthesia network (PRAN)

British Journal of Anaesthesia, 2015, 457–62

Complication	Incidence (95%CI)
Catheter malfunction (e.g. dislodgement, occlusion)	7.3% (6.2–8.5)
Abandoned or block failure	1.3% (0.8–1.7)
Catheter related infection	0.9% (0.5 to 1.4)
Vascular (e.g. blood aspiration, haematoma)	0.9% (0.5–1.3)
Excessive motor block	0.6% (0.3–1)
Difficult catheter removal	0.1% (0.04–0.3)
Other (e.g. foot swelling, muscle spasms, dizziness, burning sensation, adverse drug reaction, nausea and vomiting, contact dermatitis)	1% (0.6–1.5)

12% (minor) problems overall

Conclusions: Our data support the safety of placing PNCs in children, with adverse event rates similar to adult studies. Catheter problems are common, yet minor, in severity.

Infections

- Epidural Abscess
- Meningitis
- Skin and soft tissue infection or deep abscess formation

Cutaneous Catheter Infections by Site

Catheter Location	Infections	Catheters	Duration	Incidence	95% CI
Caudal	18	3,166	2 (0–3)	57:10,000	34–90
Lumbar epidural	21	5,713	2 (1–3)	38:10,000	24–58
Thoracic epidural	40	4,227	3 (2–4)	99:10,000	72–134
Upper extremity	1	338	2 (1–3)	30:10,000	1–164
Lower extremity	11	3,838	3 (2–3)	29:10,000	14–51
Paravertebral	1	550	3 (2–5)	18:10,000	0–101
Other	0	233	3 (2–4)	0:10,000	0–195
Total	92	18,065	2 (1–3)	53:10,000	43–64

Catheter duration is reported in days as median (interquartile range) for all catheters in each category.

92 infections in 18,065 catheters

53:10,000

(95% CI 43-64:10,000)

!

- 2x higher in neuraxial
- > 4 days, 6.7% increase per day
- No difference caudal/ lumbar/ thoracic
- Epidural abscess 1:100,000

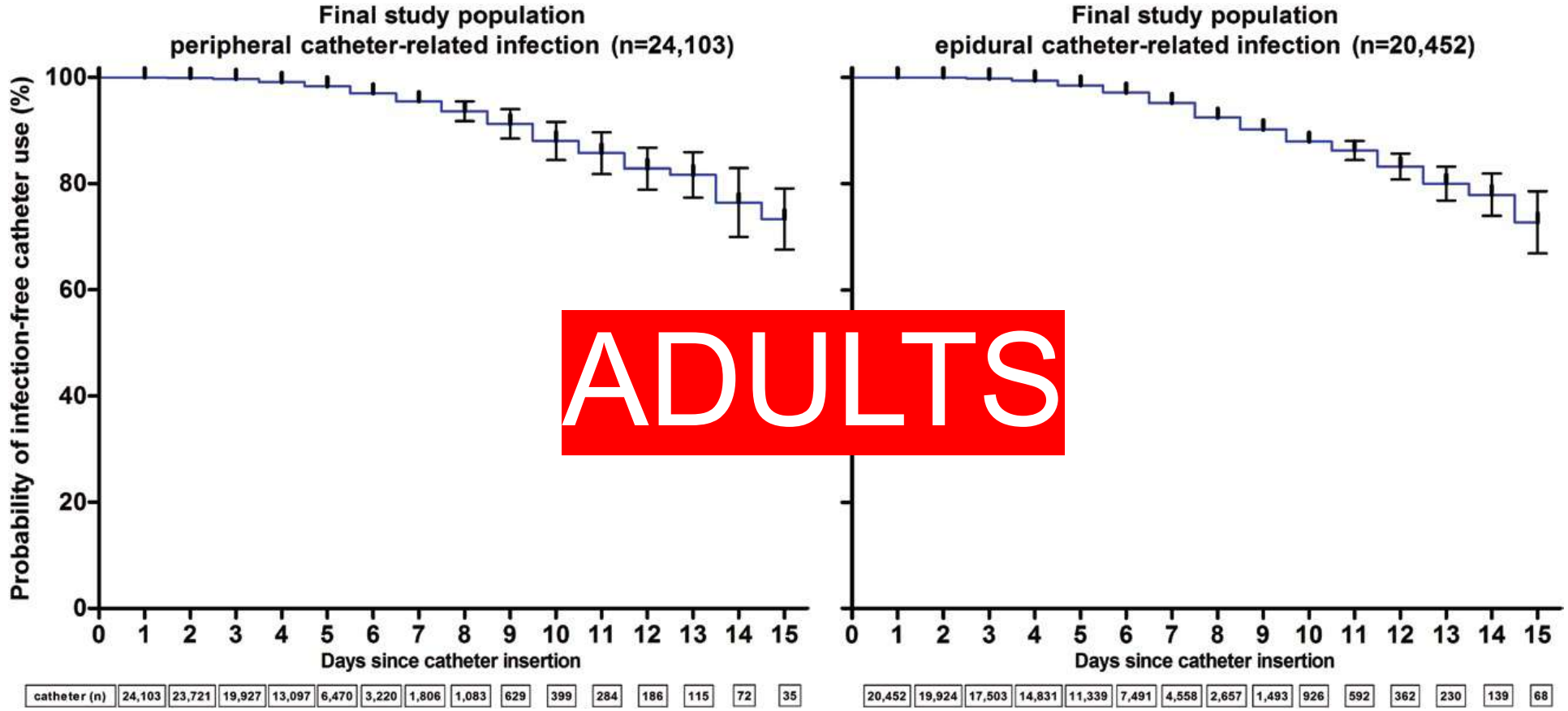
...results similar to other reports

Prolonged Catheter Use and Infection in Regional Anesthesia

Anesthesiology 2018; 128:764-73

A Retrospective Registry Analysis

Hagen Bomberg, M.D., Ina Bayer, M.D., Stefan Wagenpfeil, Ph.D., Paul Kessler, M.D., Hinnerk Wulf, M.D., Thomas Standl, M.D., André Gottschalk, M.D., Jens Döffert, M.D., Werner Hering, M.D., Jürgen Birnbaum, M.D., Claudia Spies, M.D., Bernd Kutter, M.D., Jörg Winckelmann, M.D., Simone Liebl-Biereige, M.D., Winfried Meissner, M.D., Oliver Vicent, M.D., Thea Koch, M.D., Daniel I. Sessler, M.D., Thomas Volk, M.D., Alexander Raddatz, M.D.



ADULTS

Practice Advisory for the Prevention, Diagnosis, and Management of Infectious Complications Associated with Neuraxial Techniques

Anesthesiology 2017; 126:585-601

*An Updated Report by the American Society of Anesthesiologists Task Force on Infectious Complications Associated with Neuraxial Techniques and the American Society of Regional Anesthesia and Pain Medicine**

- Strict hand hygiene (remove all jewelry)
- Use antiseptic (chlorexhidine in alcohol or poviodine 10%)
  - Use single use sticks
  - Let it dry! (3 minutes)
- Aseptic technique
- Wear a mask covering mouth and nose
- Use probe cover + clean probe after use

Practice Advisory for the Prevention, Diagnosis, and Management of Infectious Complications Associated with Neuraxial Techniques

Anesthesiology 2017; 126:585-601

*An Updated Report by the American Society of Anesthesiologists Task Force on Infectious Complications Associated with Neuraxial Techniques and the American Society of Regional Anesthesia and Pain Medicine**

- Single shot peripheral
  Aseptic technique, sterile gloves
- Single shot neuraxial
  Aseptic technique, sterile gloves, sterile field
- Peripheral or neuraxial catheter
  Aseptic technique, gown, gloves, sterile field

CAS GUIDELINES REQUIREMENTS

CANADIAN ANESTHESIOLOGISTS' SOCIETY

Regional Time Out:

- Correct block
- Correct patient
- Correct surgery

TIME OUT
When patient is in OR
Anesthesia/Block (after induction before surgery): ☐ Patient identity ☐ Patient weight: _____Kg ☐ Patient's allergy Allergy to chlorhexidine ☐ Yes or ☐ No Allergy to local anesthetics ☐ Yes or ☐ No ☐ Procedure planned (Surgical consent) Confirm side ☐ & site ☐ Block (s) to be performed: _____ ☐ Right ☐ Left ☐ Bil ☐ N/A _____ ☐ Right ☐ Left ☐ Bil ☐ N/A _____ ☐ Right ☐ Left ☐ Bil ☐ N/A Max local anesthetic dose _____mL _____% Anticoagulation /Bleeding disorders ☐ Yes or ☐ No Planned anticoagulation for post-op ☐ Yes or ☐ No In case LAST, intralipid dose (1.5 mL/Kg) _____mL

Disconnected catheter

CANADIAN ANESTHESIOLOGISTS' SOCIETY

- If witnessed:

  RN should immediately cover both ends with a sterile occlusive dressing

  Clean the catheter with chlorhexidine in alcohol and cut using sterile scissors then reattach with a new clip

- If unwitnessed:

  Remove

- If unwitnessed, but seen recently connected:

  Case by case decision (speak to your staff)

Outpatient elastomeric pumps

Peri-and post-operative management of patients undergoing ACL reconstruction

Goals:
-Minimize opioid use and side effects while controlling pain
Pre-op: Explanation of baby bottle, oral acetaminophen

Intra-operative
- Avoid long acting opioid
- Consider TCI propofol and remifentanil infusion (especially if history PONV)
- At induction: ketamine 0.2-0.3 mg/kg, dexamethasone 0.1-0.15 mg/kg (Max 8 mg)
- End of surgery: Ketorolac 0.5 mg/kg (max 30), ondansetron 0.1 mg/kg (max 4)

Blocs:
- Single shot IPACK – consider adding dexmedetomidine to the block to prolong the effect 1 mcg/mL (into the ropivacaine 0.2% syringe), use 15-20 mL ropivacaine 0.2%

- Adductor Continuous nerve block, placed high, initially load block with 20-30 mL ropivacaine 0.2%
    - Ropivacaine 0.2% 8 mL/hr (600 mL pump) for all patients

PACU:
- Teaching by RN with information sheet and show family how to connect baby bottle, especially if need to connect a 2nd bottle after 30 hours.

Post-operative home pain management:
- As per surgeon's prescription – Nursing reminds patients to take NSAIDs and Acetaminphen ATC X 72 hours, opioids PRN
- Elastomeric pumps X 60 hours

Follow up:
- Daily phone call by APS nurse during the week and Anesthesia fellow or RN on weekends.


ROPIVACAINE
0.2 %

Establishing a pediatric elastomeric pump program for ambulatory knee surgeries in adolescents

Christelle Poulin-Harnois, MD, FRCPC[1,2]; Rosa Alicia Paradelo CNS, MSc.N. [2]

Montreal Children's Hospital (McGill University Health Center)[1] and Shriner's Hospital Canada[2]

INTRODUCTION and OBJECTIVES

- Minimizing postoperative opioids use is desirable in ambulatory surgery in the context of the opioid epidemic .[1,]
- Continuous infusion of local anesthesia in a peripheral nerve catheter has been showed to be safe and effective.[2]
- We initiated a quality improvement project for adolescents undergoing anterior cruciate ligament (ACL) reconstruction using an adductor canal catheter with elastomeric pumps combined with a single I-PACK* block[3] .
- We describe the setup and initial results of this program in a Canadian context.

* Infiltration between Popliteal Artery and Capsule of the Knee

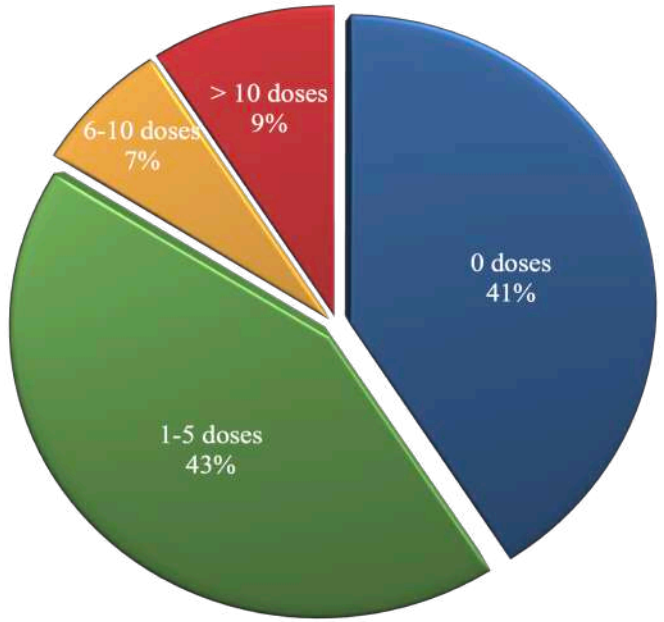
METHODS

- Ethics approval was waived by the local REB.
- This multidisciplinary program was developed in 2021 and started January 2022 with:
  - Selected procedure: ACL reconstruction
  - Elastomeric pumps infusing ropivacaine 0.2% at 10 mL/hr were used for 60 hrs (2 pumps containing 300 mL each)
  - staff education: Rounds and protocol teaching
  - written and animated patient education material (see QR code for video)
  - extra pharmacy and nursing tasks
  - mechanism for follow-up
- All adolescents (> 12 years old and > 50kg) undergoing ACL reconstruction were included
- We retrospectively analyzed opioid consumption and complications for the first 8 months after its introduction. (January 1st 2022 – August 30th 2022)

RESULTS

- 44 patients had an adductor catheters placed, aged 12-21 years old
- Elastomeric pumps infusing ropivacaine 0.2% at 10 mL/hr for 60 hrs (2 pumps containing 300 mL each)
- Opioid use:
  - 18 patients (41%) used none
  - 19 patients (43%) used 1-5 doses
  - 3 patients (7%) used 6-10 doses
  - 4 patients (9%) used > 10 doses
- 6/7 who used >5 doses have a previous history of chronic pain, anxiety or drug use disorder.
  - Despite opioid use, chronic pain patients found their post-operative pain management much improved compared to prior surgeries
- Leaking reported on POD 2 in 1 patient
- No LAST, no infection.

OPIOID DOSES USED



CONCLUSIONS

- Implementation of an elastomeric pump program in a pediatric center is feasible and safe but requires multidisciplinary collaboration, there were no complications.
- Limitations of this QI project include the inablity to compare opioid use before and after implementation of this program. Overall opioid use was minimal for most teenagers.
- We were able to identify patients with risk factors for more complex post-operative pain management (such as history of chronic pain, anxiety or substance abuse).
- Challenge remains in finding optimal method to simplify follow-up: pain scores, medication use, side effects/complications (phone app, etc).

REFERENCES

1. https://www.hhs.gov/opioids/sites/default/files/2021-02/opioids-infographic.pdf
2. Gurnaney H, et al. Ambulatory Continuous Peripheral Nerve Blocks in Children and Adolescents: A Longitudinal 8-Year Single Center Study. *Anesth Analg* (2014) 118: 621-7.
3. Nguyen K T, et al. Infiltration between popliteal artery and capsule of the knee block to augment continuous femoral nerve catheter for adolescent anterior cruciate ligament reconstruction: a case series. *A&A Practice*(2020): 14: 37-9.

Contact: christelle.poulin-harnois@mcgill.ca

Local Anesthesia Systemic Toxicity (LAST)

71 male, primary LTHR

CVS, RS – NAD

Multiple (21) procedures for RTKR (infection)

Most SAB, all straightforward

SAB, no sedation, request for iPOD

Around 1 hour into procedure, just about closing..

Not feeling well

PLAY VIDEO

Local Anesthetic Systemic Toxicity by Age Group

Age Group	Cases	Total Patients	Incidence	95% CI
Neonate	0	998	0:10,000	0–46.3
1–5 months	4	7,935	5.0:10,000	1.5–13.5
6–11 months	1	12,943	0.8:10,000	0–4.8
1–2 yr	0	17,829	0:10,000	0–2.6
3–9 yr	1	22,702	0.4:10,000	0–2.8
≥ 10 yr	1	29,294	0.3:10,000	0–2.1
Total	7	91,701	0.76:10,000	0.3–1.6

7 reports

0.76:10,000

(95% CI 0.3-1.6:10,000)

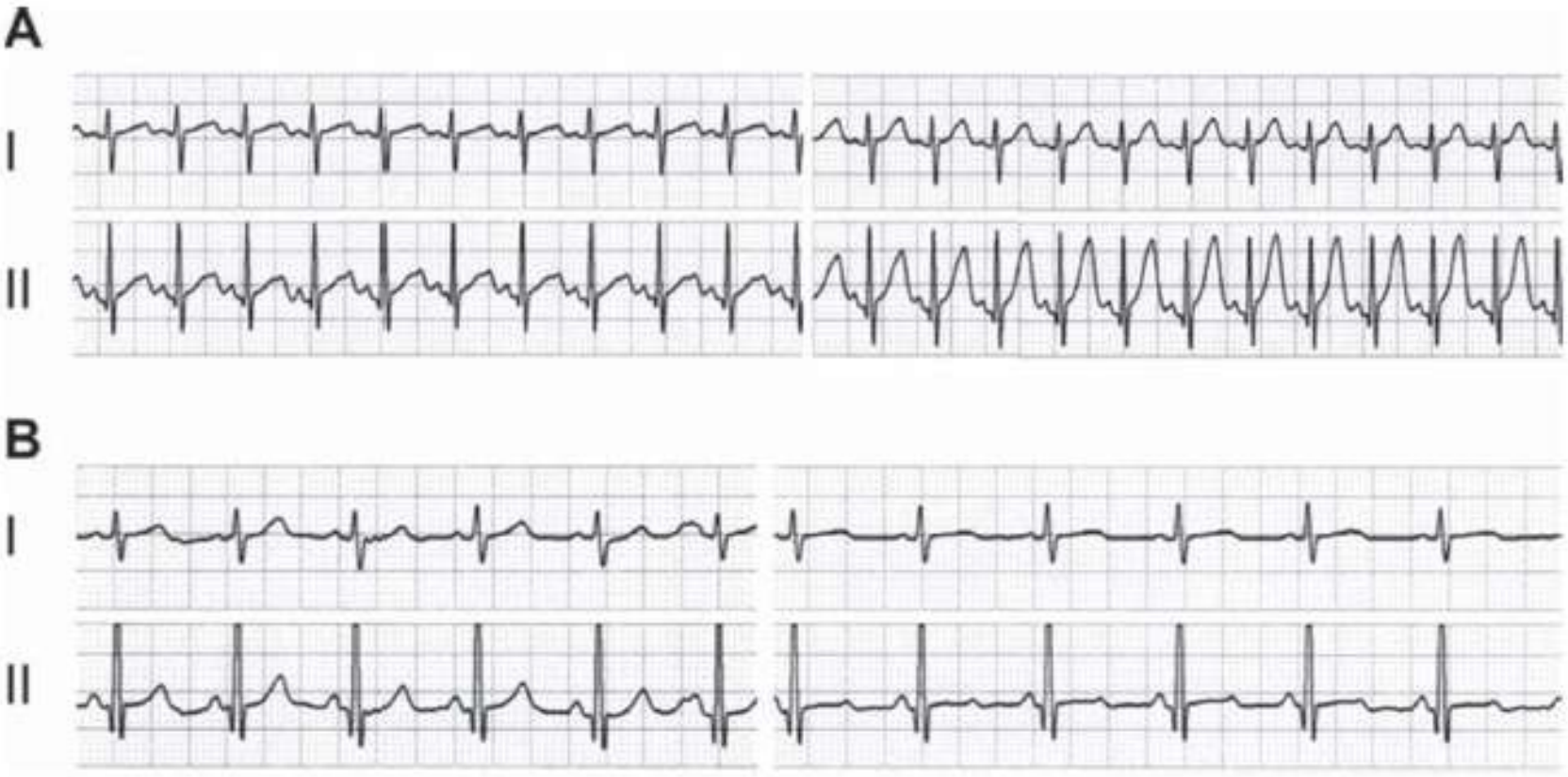
- Bolus dosing
- Test dose not effective
- Higher risk <6 months

Anesthesiology 2018; 129:721-32

Electrocardiographic and haemodynamic alterations caused by three different test solutions of local anaesthetics to detect accidental intravascular injection in children

J. Y. Mauch[1*], N. Spielmann[1], S. Hartnack[2] and M. Weiss[1]

British Journal of Anaesthesia **108** (2): 283–9 (2012)



The combination of T-wave elevation and increase in HR allows detection of an intravenous epinephrine-containing test dose in 100%

Electrocardiographic and haemodynamic alterations caused by three different test solutions of local anaesthetics to detect accidental intravascular injection in children

J. Y. Mauch[1*], N. Spielmann[1], S. Hartnack[2] and M. Weiss[1]

British Journal of Anaesthesia **108** (2): 283–9 (2012)

- **Increase in heart rate** and **T-elevation in the ECG**, as well as **increase in blood pressure** after intravenous injection of a common bupivacaine test dose are caused **by epinephrine**.
- A test dose bupivacaine alone can not be detected by ECG nor blood pressure
- Possible age-dependency

Prevention

- No single technique can prevent LAST
- Administer lowest effective dose (I;C)
- Use slow injection rate (I;C)
- Aspirate needle/catheter before/during injection (I;C)
- Use of an intravascular marker (II;B)
- Ultrasound guidance (II;C)

Rescue strategies

- Ventilation, Oxygenation, effective CPR, Lipid Rescue™

AAGBI Safety Guideline

Management of Severe Local Anaesthetic Toxicity

1 Recognition

Signs of severe toxicity:
- Sudden alteration in mental status, severe agitation or loss of consciousness, with or without tonic-clonic convulsions
- Cardiovascular collapse: sinus bradycardia, conduction blocks, asystole and ventricular tachyarrhythmias may all occur
- Local anaesthetic (LA) toxicity may occur some time after an initial injection

2 Immediate management
- Stop injecting the LA
- Call for help
- Maintain the airway and, if necessary, secure it with a tracheal tube
- Give 100% oxygen and ensure adequate lung ventilation (hyperventilation may help by increasing plasma pH in the presence of metabolic acidosis)
- Confirm or establish intravenous access
- Control seizures: give a benzodiazepine, thiopental or propofol in small incremental doses
- Assess cardiovascular status throughout
- Consider drawing blood for analysis, but do not delay definitive treatment to do this

3 Treatment

IN CIRCULATORY ARREST
- Start cardiopulmonary resuscitation (CPR) using standard protocols
- Manage arrhythmias using the same protocols, recognising that arrhythmias may be very refractory to treatment
- Consider the use of cardiopulmonary bypass if available

GIVE INTRAVENOUS LIPID EMULSION
(following the regimen overleaf)
- Continue CPR throughout treatment with lipid emulsion
- Recovery from LA-induced cardiac arrest may take >1 h
- Propofol is not a suitable substitute for lipid emulsion
- Lidocaine should not be used as an anti-arrhythmic therapy

WITHOUT CIRCULATORY ARREST
Use conventional therapies to treat:
- hypotension,
- bradycardia,
- tachyarrhythmia

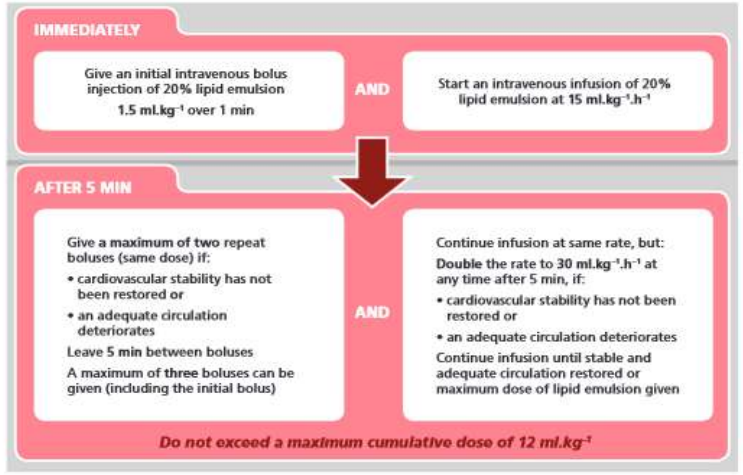
CONSIDER INTRAVENOUS LIPID EMULSION
(following the regimen overleaf)
- Propofol is not a suitable substitute for lipid emulsion
- Lidocaine should not be used as an anti-arrhythmic therapy

4 Follow-up
- Arrange safe transfer to a clinical area with appropriate equipment and suitable staff until sustained recovery is achieved
- Exclude pancreatitis by regular clinical review, including daily amylase or lipase assays for two days
- Report cases as follows:
  in the United Kingdom to the National Patient Safety Agency (via www.npsa.nhs.uk)
  in the Republic of Ireland to the Irish Medicines Board (via www.imb.ie)

If Lipid has been given, please also report its use to the international registry at www.lipidregistry.org. Details may also be posted at www.lipidrescue.org

Your nearest bag of Lipid Emulsion is kept

This guideline is not a standard of medical care. The ultimate judgement with regard to a particular clinical procedure or treatment plan must be made by the clinician in the light of the clinical data presented and the diagnostic and treatment options available.



IMMEDIATELY

Give an initial intravenous bolus injection of 20% lipid emulsion 1.5 ml.kg^{-1} over 1 min

AND

Start an intravenous infusion of 20% lipid emulsion at 15 ml.kg^{-1}.h^{-1}

AFTER 5 MIN

Give a maximum of two repeat boluses (same dose) if:
- cardiovascular stability has not been restored or
- an adequate circulation deteriorates

Leave 5 min between boluses

A maximum of three boluses can be given (including the initial bolus)

AND

Continue infusion at same rate, but:
Double the rate to 30 ml.kg^{-1}.h^{-1} at any time after 5 min, if:
- cardiovascular stability has not been restored or
- an adequate circulation deteriorates

Continue infusion until stable and adequate circulation restored or maximum dose of lipid emulsion given

Do not exceed a maximum cumulative dose of 12 ml.kg^{-1}

An approximate dose regimen for a 70-kg patient would be as follows:

IMMEDIATELY

Give an initial intravenous bolus injection of 20% lipid emulsion 100 ml over 1 min

AND

Start an intravenous infusion of 20% lipid emulsion at 1000 ml.h^{-1}

AFTER 5 MIN

Give a maximum of two repeat boluses of 100 ml

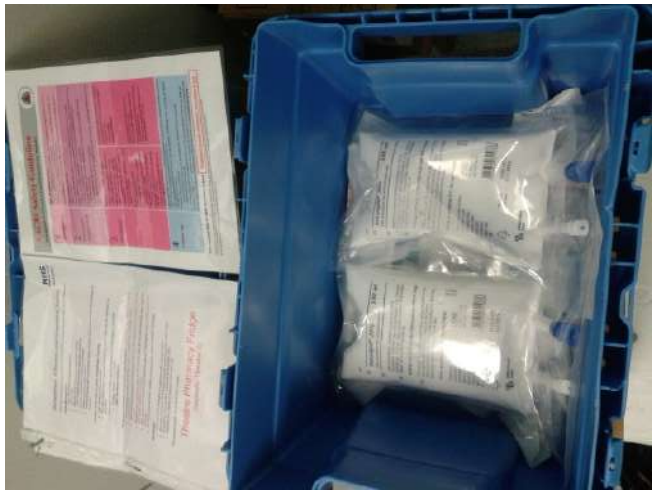
AND

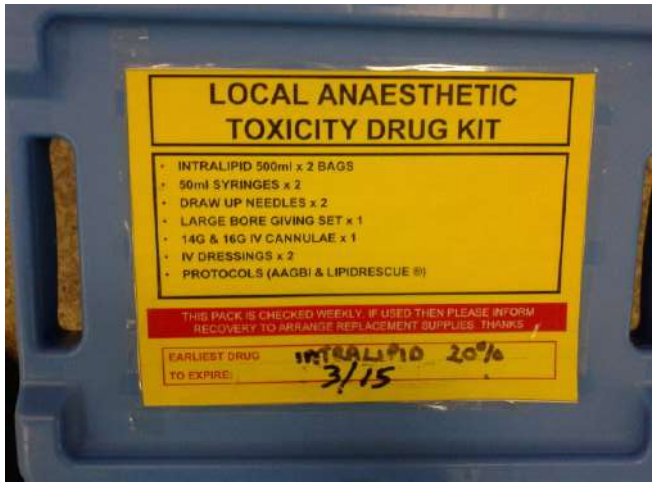
Continue infusion at same rate but double rate to 2000 ml.h^{-1} if indicated at any time

Do not exceed a maximum cumulative dose of 840 ml

This AAGBI Safety Guideline was produced by a Working Party that comprised:
Grant Cave, Will Harrop-Griffiths (Chair), Martyn Harvey, Tim Meek, John Picard, Tim Short and Guy Weinberg.

This Safety Guideline is endorsed by the Australian and New Zealand College of Anaesthetists (ANZCA).





Nerve blocks in trauma patients

Compartment syndrome

Most common: Lower leg and forearm

Limited ability of tissue to expand following trauma

Neurological deficits

Muscle necrosis

Loss of extremity viability

Compartment syndrome

Diagnosis

- Based on patients clinical signs and symptoms
- Pain out of proportion to injury most reliable indicator
- Compartment pressure measurements are the only objective and accurate tests to diagnose and record
- Fasciotomy if compartmental pressures exceed 30 mm Hg

TIME IS TISSUE

The National Pediatric Epidural Audit

Pediatric Anesthesia 2007 **17**: 520–533

N. LLEWELLYN, RN, RSCN, BA* AND A. MORIARTY FRCA†

**Acute Pain Service and †Department of Anaesthesia, Birmingham Children's Hospital NHS Trust, Birmingham, UK*

(vi) Forty incidents were also reported that were felt to be associated with the use of EIA; 33 of these incidents were the development of pressures sores. Four incidents of compartment syndrome were reported, in each of these cases the presence of EIA did not mask the condition.

10,633 epidurals

2001 to 2005

BUT

Assessment of Malpractice Claims Associated With Acute Compartment Syndrome.

John Mason DePasse, MD, Rachel Sargent, BS, Amanda J. Fantry, MD, Steven L. Bokshan, MD, Mark A. Palumbo, MD, and Alan H. Daniels, MD

J AAOS 2017, DOI:10.5435/JAAOS-D-16-00460

CONCLUSION: Defendants were more likely to lose a lawsuit concerning the management of acute compartment syndrome if the patient was a woman or child or if acute compartment syndrome developed as a complication of a surgical procedure.

Because effective regional anaesthesia may mask pain in compartment syndrome, regional blocks should be performed in consultation with the surgical team and shorter-acting, lower concentration, single shot, local anaesthetics without adjuncts should be used.

Thank you

Christelle Poulin-Harnois, Montreal
Jacqueline Mauch, Aarau
Jochen Elfgen, Zurich

luzerner kantonsspital
LUZERN SURSEE WOLHUSEN

KATZ 23 hybrid

Häufige Regionalanästhesien bei Kindern

Martin Hölzle

Kompetenz, die lächelt.

Häufigkeit der Regionalanästhesie

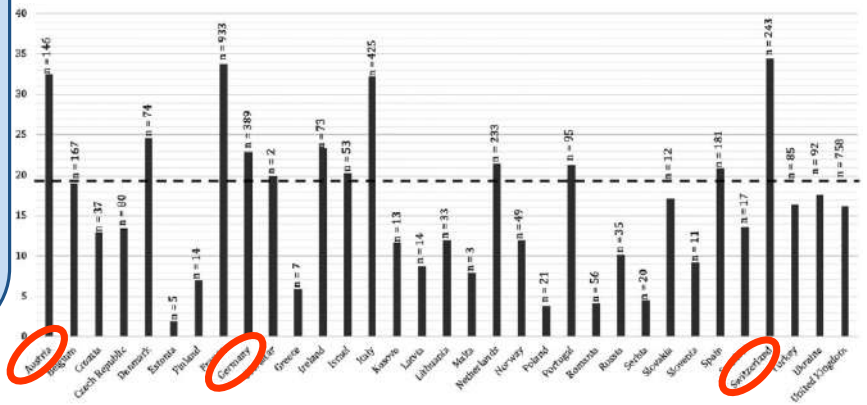
- Prospektive observationelle Studie
  - 33 europäische Länder
  - 261 Zentren
  - Während 2 Wochen Fälle analysiert
    - Critical Events
  - 30’874 Patienten, 31’127 Anästhesien

Dadure C. et al. Epidemiology of regional anesthesia in children: Lessons learned from the european multi-institutional study APRICOT. Pediatr Anaesth 2019; 29:1128-1135

Epidemiologie der Kinderregionalanästhesie

- Prospektive observationelle Studie
  - 30’874 Patienten, 31’127 Anästhesien
    - davon 22’224 Operationen

- 4’377 Regionalanästhesien (19.7%)
  - Zentrale Blockaden 42.6%
    - davon in 76.9% Caudalanästhesie
    - Stammesblockaden 41.8%



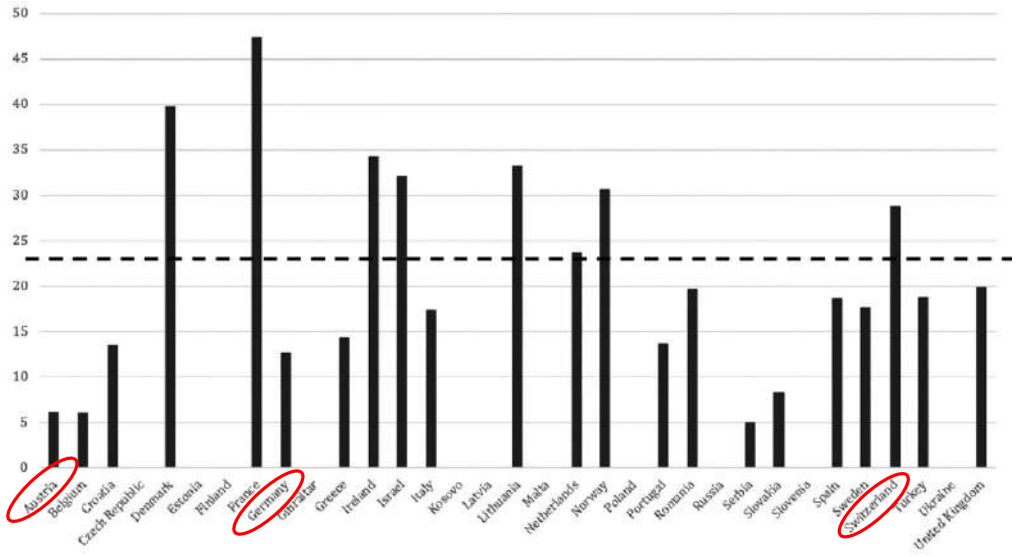
- Komplikation: 1x falsche Seite blockiert

Dadure C. et al. Epidemiology of regional anesthesia in children: Lessons learned from the european multi-institutional study APRICOT. Pediatr Anaesth 2019; 29:1128-1135

Epidemiologie der Kinderregionalanästhesie

- Prospektive observationelle Studie
  - 30’874 Patienten, 31’127 Anästhesien
    - davon 22’224 Operationen

- Ultraschall
  - 23.8% aller Blockaden
  - Obere Extremität 65.7%
  - Untere Extremität 69.9%
  - Il/ih-Block 48%
  - TAP 95.9%



Dadure C. et al. Epidemiology of regional anesthesia in children: Lessons learned from the european multi-institutional study APRICOT. Pediatr Anaesth 2019; 29:1128-1135

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LUZERN SURSEE WOLHUSEN

Regionalanästhesie mit Ultraschall in Luzern

- Fast alle peripheren Blockaden
  - Ausnahmen: Penisblock, N. supraorbitalis, N. infraorbitalis, N. mentalis
- Caudal
  - in Ausnahmefällen (unklarer Tastbefund)
  - Ausbreitung LA bei unsicherem Loss

Übersicht

- Caudalblock
- axilläre Plexusblockade
- Penisblock

Caudalblock

- Indikationen:
  - Operationen untere Körperhälfte bis/mit Nabel

Mauch J et al. Kaudalanästhesie bei Kindern. Schmerz 2012; 26:443-454

Caudalblock

- Indikationen:
  - Operationen untere Körperhälfte bis/mit Nabel

- Kontraindikation:
  - lokaler Infekt
  - Sepsis / Meningitis
  - Gerinnungsstörungen
  - anatomische Malformationen (MMC…)
  - Allergie auf Lokalanästhetika
  - Ablehnung durch die Eltern

Mauch J et al. Kaudalanästhesie bei Kindern. Schmerz 2012; 26:443-454

Caudalblock - Sicherheit

- PRAN Daten:
  - 18’650 CB (2007-2012)
  - Gesamtkomplikation 1.9%

Anästhesie:

wach	92
Sedation	108
AA –R	15’430
AA +R	3’020

Komplikationen:

Blockversager	1%
Blutasp	
positive Testdosis	0.1%
Duraperforation	0.08%

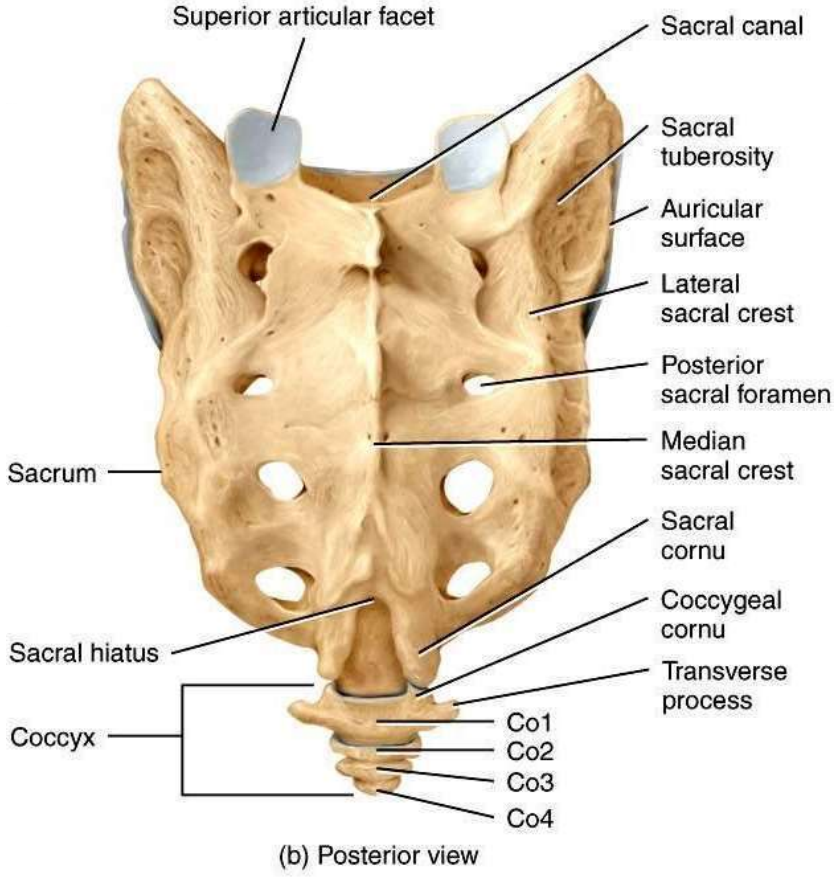
1x Herzstillstand, 1x Krampfanfall postop, 1x Schmerzen sacral (1Wo), 1x Muskelspasmen (1Wo)

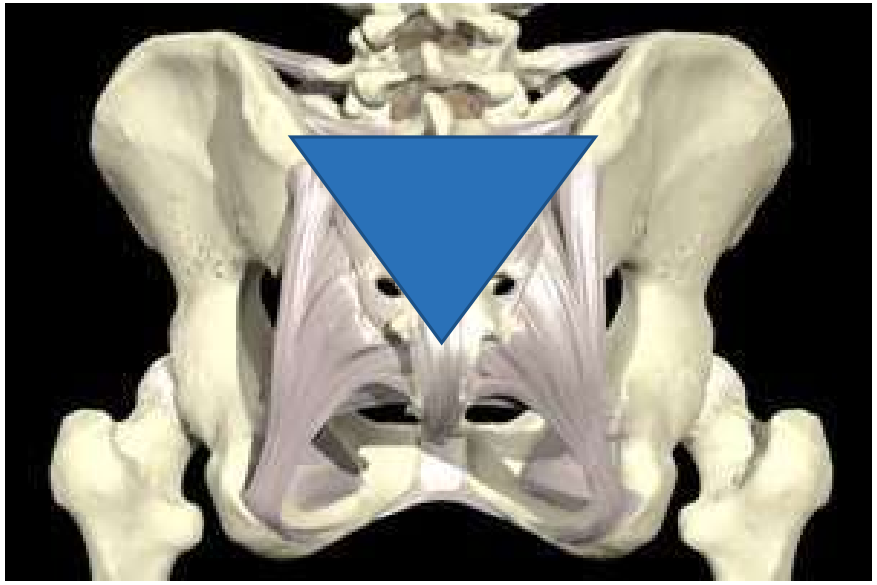
} **<0.005%**

Keine bleibenden Probleme!

Suresh S. et al. Are caudal blocks for pain control safe in children? An analysis of 18’650 caudal blocks from the PRAN database. Anesth Analg 2015; 120:151-6

Caudalblock



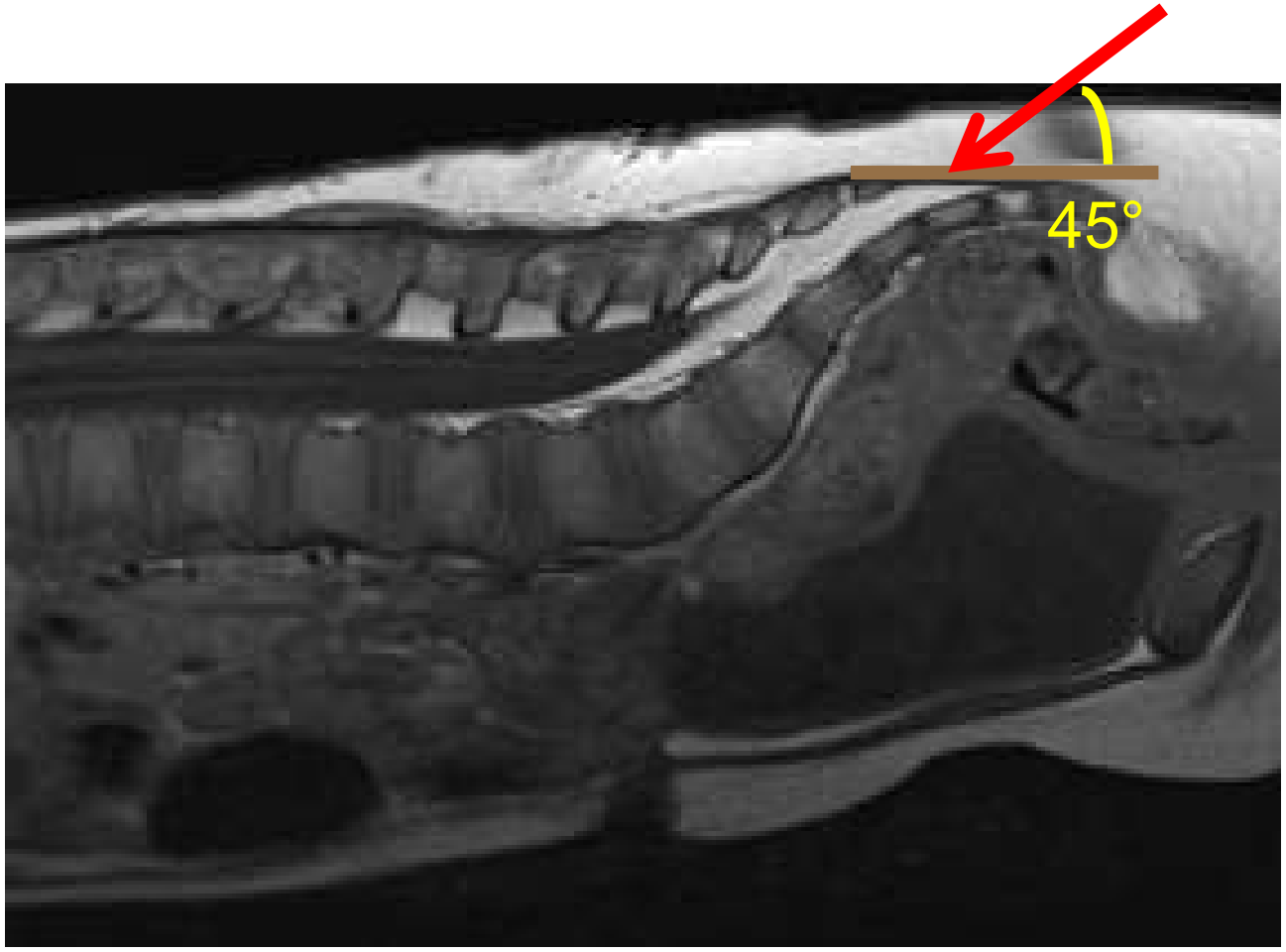


Bilder aus: http://www.darts-store.com/sacrum-and-coccyx/great-sacrum-and-coccyx-69-for-l3-spine-with-sacrum-and-coccyx/ ; https://sspphysio.com.au/coccyx-pain.html

Caudalblock

Punktionsort:

Caudalblock



Caudalblock

- Injektion
  - Aspirationstest
  - Testdosis

Caudalblock - Testdosis

- 105 Kinder, 1 Mt bis16 J, randomisiert
- Testdosis direkt iv, 3 Gruppen
  - (B) Bupivacain 0.125%
  - (BE) Bupivacain 0.125% + Adrenalin 1:200'000
  - (E) Adrenalin 1:200'000
- Kriterien für positive Testdosis:
  - T-Wellen Anstieg >25%
  - Herzfrequenz +/- 10/min
  - systol. Blutdruck ↑ >15mmHg

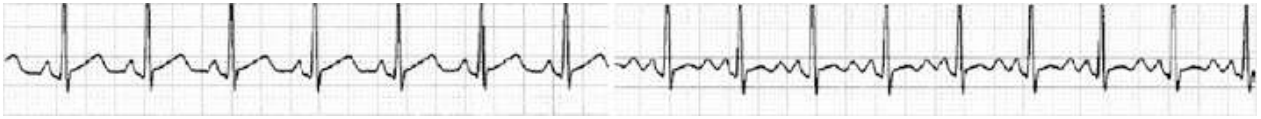
Mauch JY et al. Electrocardiographic and haemodynamic alterations caused by three different test solutions of local anaesthetics to detect accidental intravascular injection in children. BJA 2012; 108:283-289

Caudalblock - Testdosis

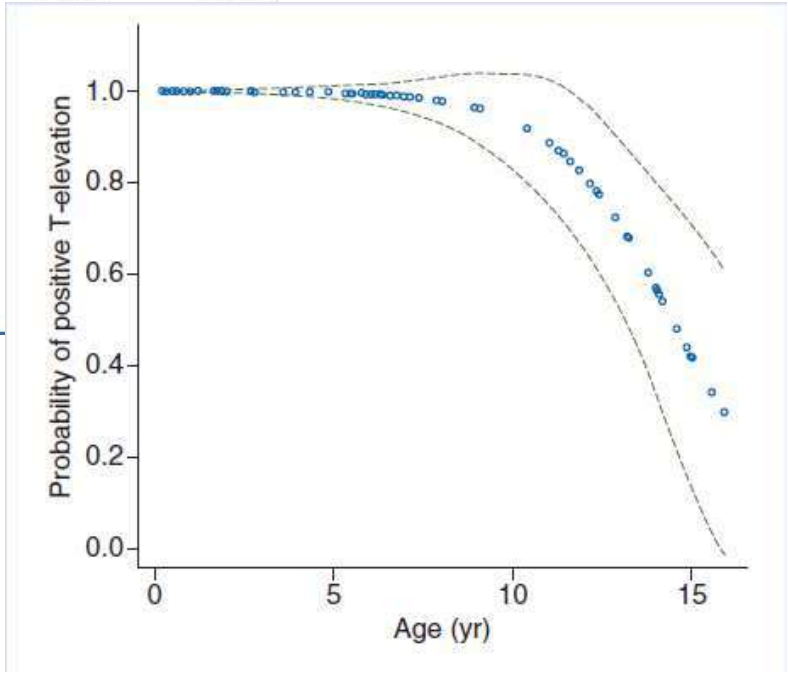
Study group	Patients	T-wave ECG I	T-wave ECG II	HR increase	HR decrease	AP 1	AP 2
B	All (*n*=35)	0 (0)	0 (0)	0 (0)	2 (6)	0 (0)	0 (0)
	0–1 yr (*n*=5)	0 (0)					
	1–6 yr (*n*=10)	0 (0)					
	6–12 yr (*n*=10)	0 (0)					
	12–16 yr (*n*=10)	0 (0)	0 (0)	0 (0)	1 (10)	0 (0)	0 (0)
BE	All (*n*=34)	25 (76)	28 (85)	23 (68)	26 (76)		
	0–1 yr (*n*=5)	5 (100)	5 (100)	5 (100)	1 (20)		
	1–6 yr (*n*=10)	10 (100)	10 (100)	6 (60)	8 (80)		
	6–12 yr (*n*=10)	9* (100)	9* (100)	5 (50)	9 (90)		
	12–16 yr (*n*=9)	1 (11)	4 (44)	7 (78)	8 (89)		
E	All (*n*=35)	26 (74)	31 (89)	26 (76)	24 (69)		
	0–1 yr (*n*=5)	5 (100)	5 (100)	4 (80)	0 (0)		
	1–6 yr (*n*=10)	9 (90)	10 (100)	9 (90)	7 (70)		
	6–12 yr (*n*=10)	9 (90)	10 (100)	5* (55)	8 (80)		
	12–16 yr (*n*=10)	3 (30)	6 (60)	8 (80)	9 (90)		

EKG Ableitung II besser als I für T-Welle

Kind 5j



Kind 15j



Mauch JY et al. Electrocardiographic and haemodynamic alterations caused by three different test solutions of local anaesthetics to detect accidental intravascular injection in children. BJA 2012; 108:283-289

Caudalblock - Testdosis

Study drug	Patients	T-wave or HR increase	T-wave or HR increase or HR decrease	T-wave or AP 1	HR increase or AP 1	HR increase or HR decrease or AP 1
B	All (n=35)	0 (0)	2 (6)	0 (0)	0 (0)	2 (6)
	0–1 yr (n=5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	1–6 yr (n=10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	6–12 yr (n=10)	0 (0)	1 (10)	0 (0)	0 (0)	1 (10)
	12–16 yr (n=10)	0 (0)	1 (10)	0 (0)	0 (0)	1 (10)
BE	All (n=34)	33 (97)	34 (100)	33 (97)	31 (91)	33 (97)
	0–1 yr (n=5)	5 (100)	5 (100)	5 (100)	5 (100)	5 (100)
	1–6 yr (n=10)	10 (100)	10 (100)	10 (100)	10 (100)	10 (100)
	6–12 yr (n=10)	10 (100)	10 (100)	10 (100)	8 (80)	9 (90)
	12–16 yr (n=9)	8 (89)	9 (100)	8 (89)	8 (89)	9 (100)
E	All (n=35)	35 (100)	35 (100)	35 (100)	33 (97)	35 (100)
	0–1 yr (n=5)	5 (100)	5 (100)	5 (100)	5 (100)	5 (100)
	1–6 yr (n=10)	10 (100)	10 (100)	10 (100)	10 (100)	10 (100)
	6–12 yr (n=10)	10 (100)	10 (100)	10 (100)	9* (100)	10 (100)
	12–16 yr (n=10)	10 (100)	10 (100)	10 (100)	9 (90)	10 (100)

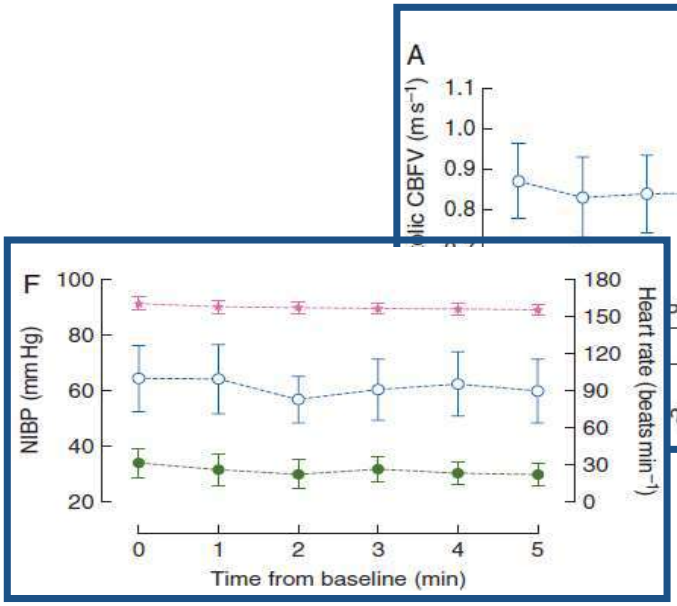
Mauch JY et al. Electrocardiographic and haemodynamic alterations caused by three different test solutions of local anaesthetics to detect accidental intravascular injection in children. BJA 2012; 108:283-289

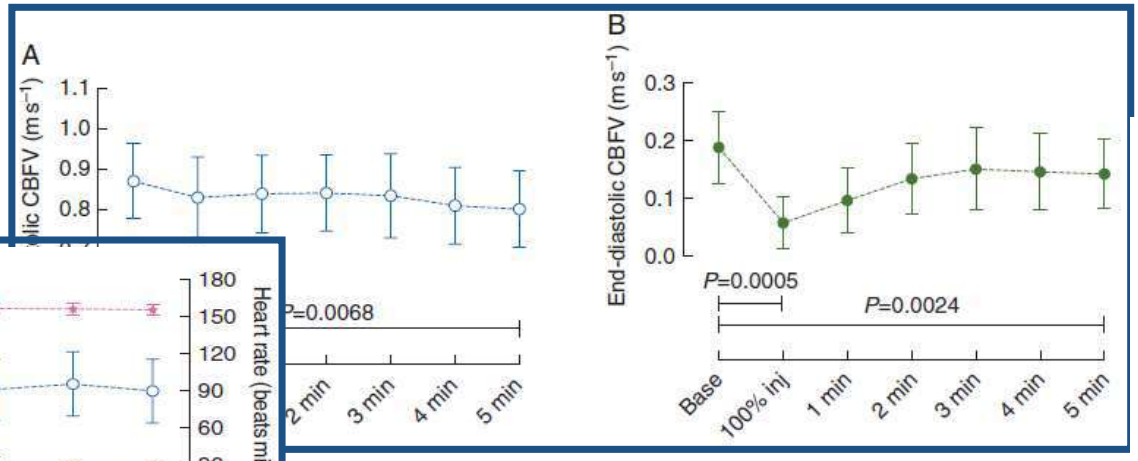
Caudalblock

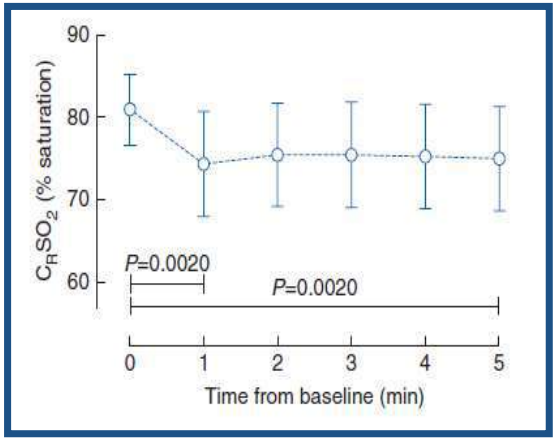
- Injektion
  - Aspirationstest
  - Testdosis
  - langsame Injektion

Caudalblock – Einfluss auf cerebralen Blutfluss

- 12 Patienten, 2-18 Wochen alt
- Caudalblock mit 1.5ml/kgKG
- Transcranieller Dopper und NIRS







Lundblad M. et al. Reduction of cerebral mean blood flow velocity and oxygenation after high-volume (1.5ml kg^{-1}) caudal block in infants. BJA 2014; 113:688-94

Caudalblock

Lokalanästhetika:

Kein Unterschied zwischen Bupivacain, Levobupivacain und Ropivacain betreffend Effekt und Nebenwirkung.

Falls motorische Blockade erwünscht:

Bupivacain > Ropivacain

Dobereiner EFA et al. Evidence-based clinical update: which local anesthetic drug for pediatric caudal block provides optimal efficacy with the fewest side effects. Can J Anaesth 2010; 57:1102-1110

Caudalblock

Adjuvantien:

Clonidin: Effektverlängerung,
Dosierung 1-2y/kgKG
NW: Sedierung, ↓BD

Morphin: Effektverlängerung, Analgesie
Dosierung 30-50y/kgKG
NW: Atemdepression, Nausea, Harnretention, Pruritus

Dobereiner EFA et al. Evidence-based clinical update: which local anesthetic drug for pediatric caudal block provides optimal efficacy with the fewest side effects. Can J Anaesth 2010; 57:1102-1110

Caudalblock - APAGBI

Luzern:

- Umfrage 2021, 370 Antworten (35% Rücklauf)
- 88% brauchen Venflon für Punktion
- 84.6% benutzen Landmark Technik
- 93.5% desinfizieren mit Chlorhexidin
- LA: 62.5% Levobupivacain (häufigste Konz: 0.25%)
- 69.2% brauchen Adjuvantien
  - Clonidin 2021: 98.4% vs 2008: 60.8%
  - Opioid 2021: 2.7% vs 2008: 26.1%

Nijjar R. et al. Caudal extradural anaesthesia – what's new?
https://www.apagbi.org.uk/sites/default/files/inline-files/P13_0.pdf

Caudalblock in Luzern

- Dosierung LA:
  - Genitale: 0.5ml/kg
  - Untere Extremität: 1ml/kg
  - Abdomen: 1.25ml/kg
- Kein Clonidin bei:
  - Kindern unter 6 Monaten
  - Kinder mit Risiko für Apnoe
  - Kinder mit Risiko für Atemwegsobstruktion (z.B. OSAS)

Caudalblock: wie viel LA?

Luzern:

- Ropivacain 0.2% 0.5-1.25 ml/kg + Testdosis (Lidocaine+A 0.2ml/kg)

- Neugeborene bis ca 5kg
  - Bis 1.5 ml/kg Ropivacain 0.2% mit Adrenalin

Caudalblock – Ultraschall?

US Sonde transversal

Caudalblock – Ultraschall?

US Sonde sagittal

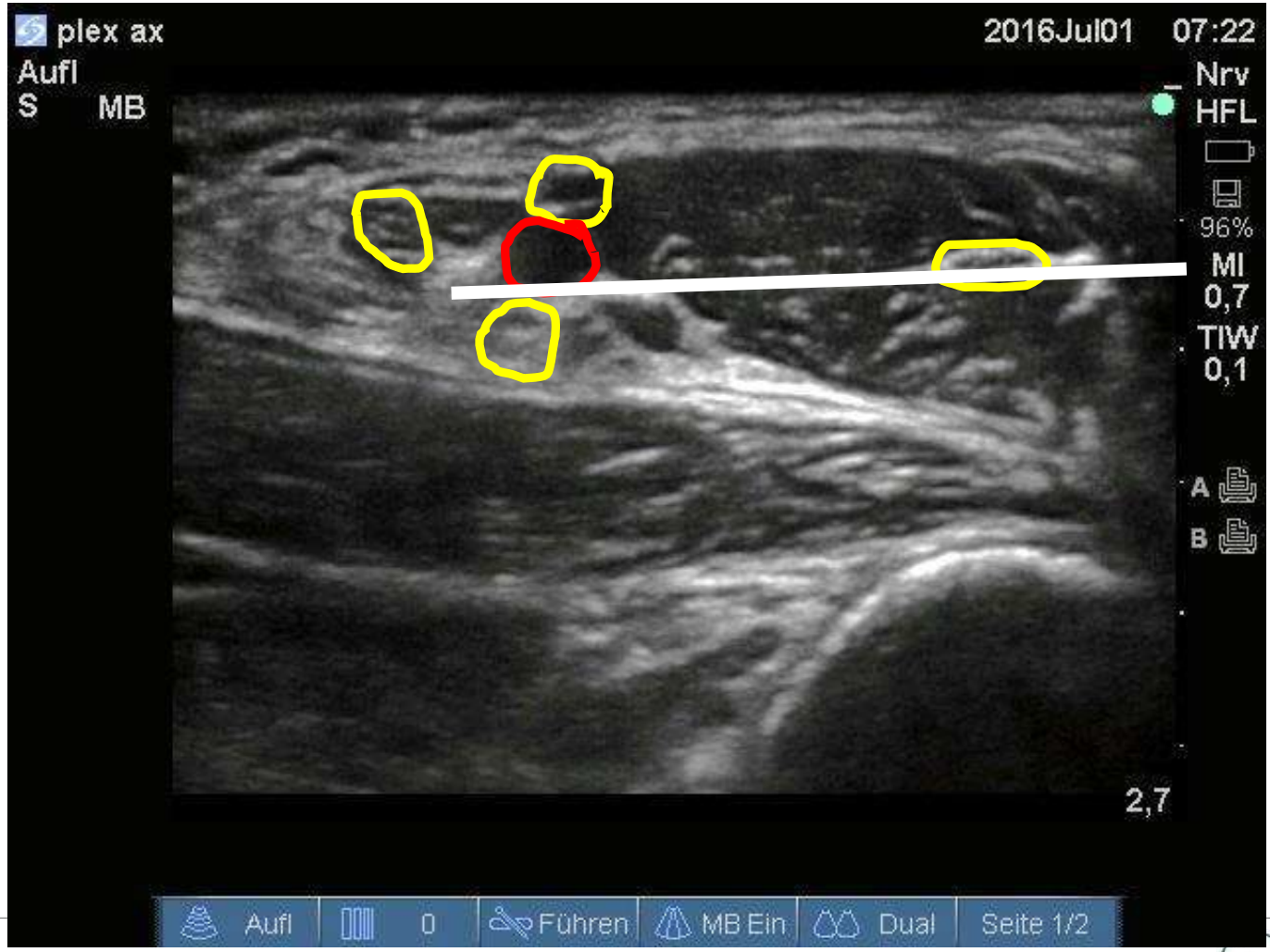
Übersicht

- Caudalblock
- axilläre Plexusblockade
- Penisblock

Plexus axillaris Block

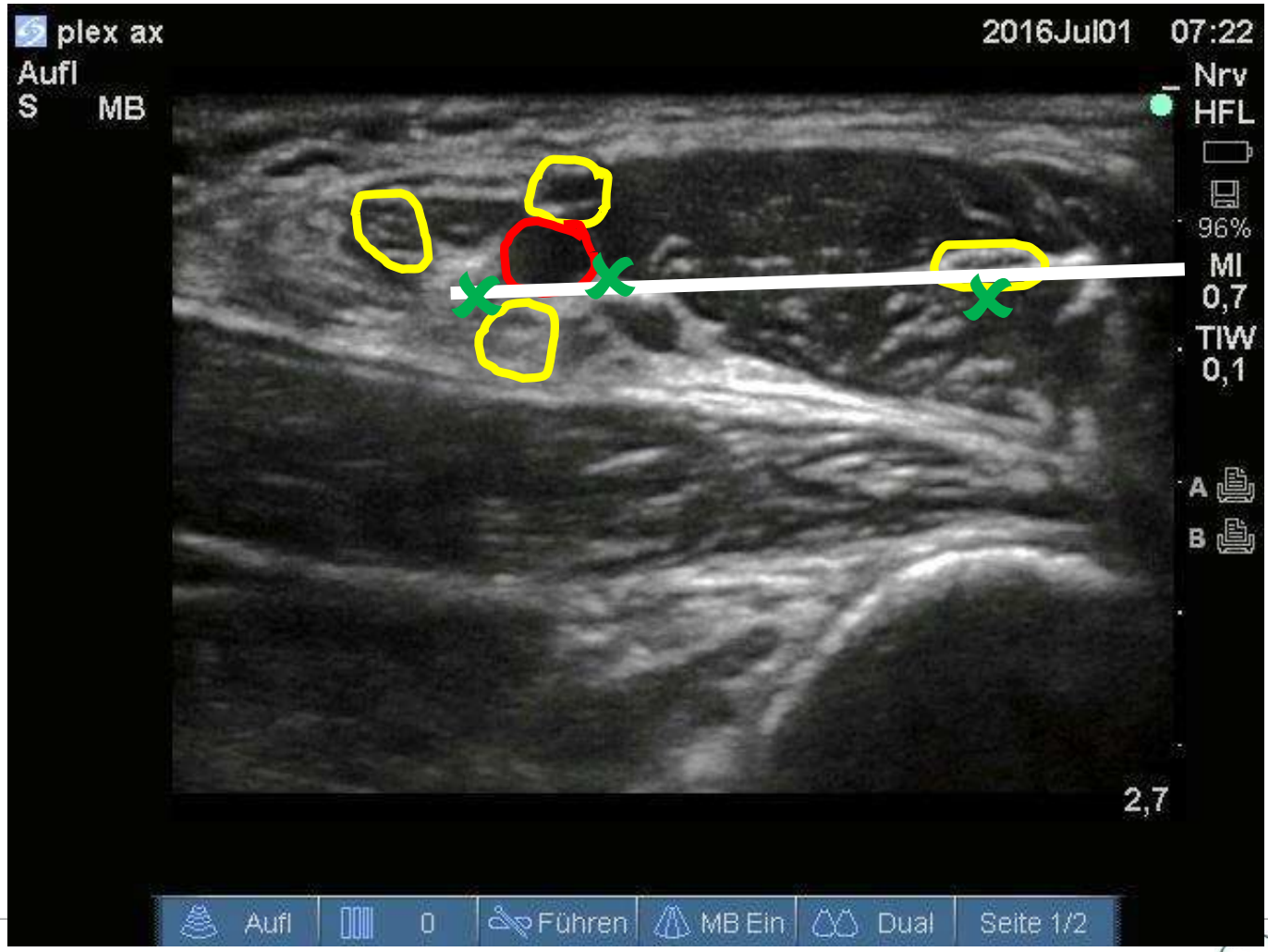
- Ultraschall gesteuert
- Inplane
- 1 Stich(-richtung)

Plexus axillaris Block



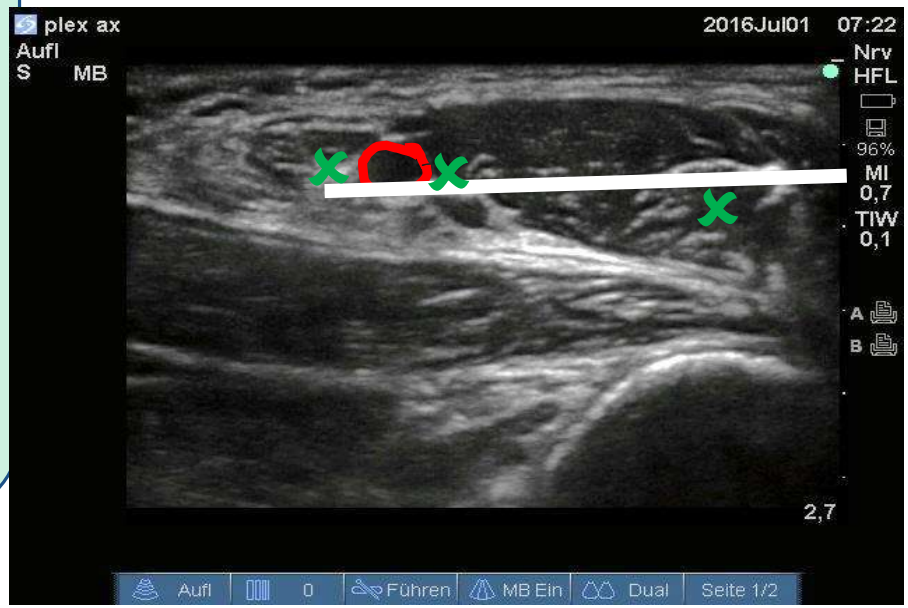
Plexus axillaris Block

Plexus axillaris Block



Plexus axillaris Block

- Für Musculocutaneus 1-3ml
- Depot «vor» Arterie: soll sich hoch zum Medianus verteilen 2-5ml
- Depot hinter der Arterie: Rest der Dosis
- Total: <½ ml/kgKG

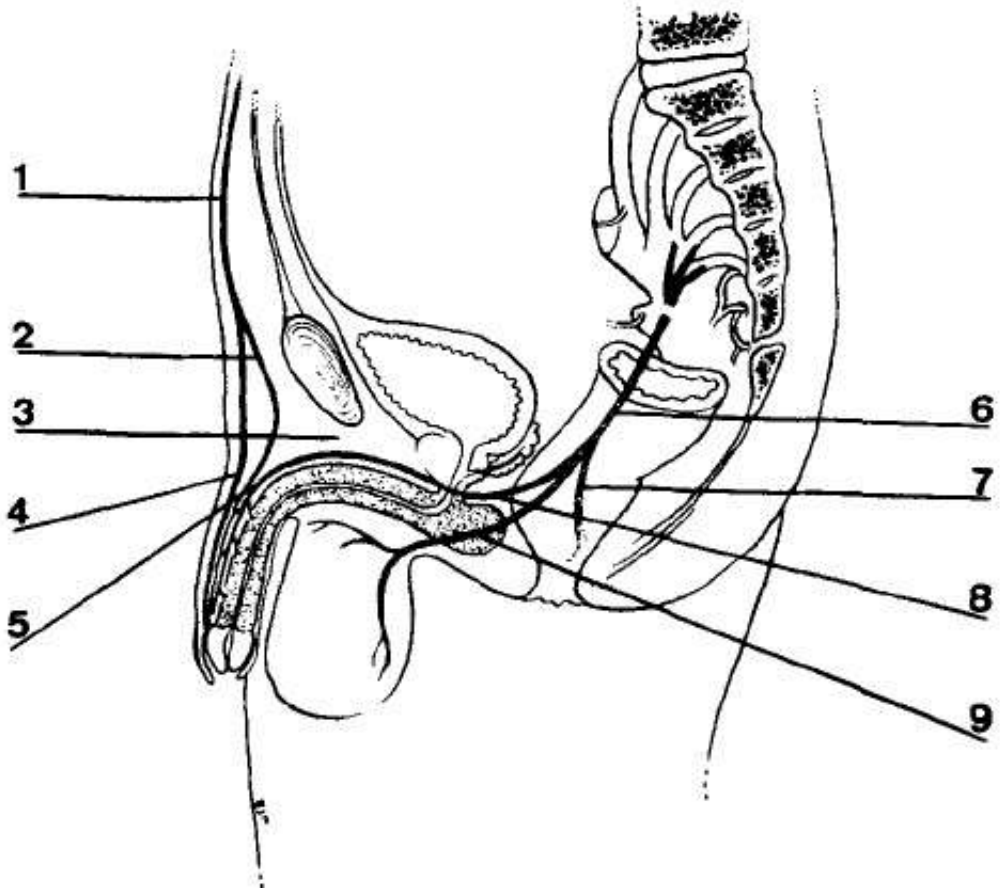


Übersicht

- Caudalblock
- axilläre Plexusblockade
- Penisblock

Penisblock

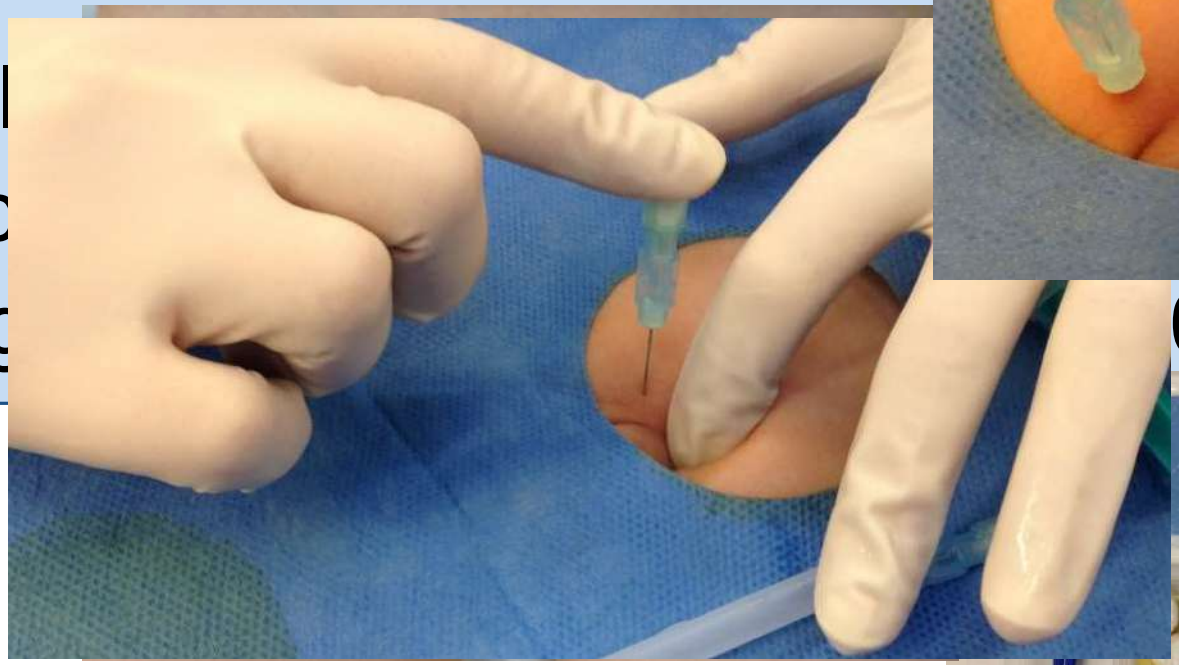
- Anatomie



Dalens B. et al. Penile block via the subpubic space in 100 children. Anesth Analg 1989; 69:41-5

Penisblock

- Fixation
- 25G Spinal
- Faszienklic
- 2x 0.1ml/kg



0.5%

Dalens B. et al. Penile block via the subpubic space in 100 children. Anesth Analg 1989; 69:41-5


Herzlichen Dank
für Ihre
Aufmerksamkeit!
10. Luzerner Repetitorium
Kinderanästhesie
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Regionalanästhesie bei Kindern

Frank Fideler
12.06.2023

Universitätsklinikum Tübingen

Brauchen Kinder eine Regionalanästhesie?

Schmerzwahrnehmung

Analgesie

- Hautrezeptoren und sensorische Nerven perioral: ab 7. Gestationswoche
- Kinder empfinden ab 24. Gestationswoche Schmerzen
- ZNS-Unreife betrifft bevorzugt deszendierende inhibitorische Signalwege (DIS): erst ab 32. Gestationswoche
- Schmerzen umso stärker, je jünger der Patient

Anand KJ, Hickey PR. Pain and its effects in the human neonate and fetus. N Engl J Med 1987; 317: 1321–9
Bouza HJ The impact of pain in the immature brain Matern Fetal Neonatal Med 2009; 22: 722–732
Davidson A, Flick RP Neurodevelopmental implications of the use of sedation and analgesia in neonates Clin Perinatol 2013; 40: 559-73
Sanders RD, Ma D, Brooks P et al Balancing paediatric anaesthesia: preclinical insights into analgesia, hypnosis, neuroprotection, and neurotoxicity Br J Anaesth 2008; 101: 597-609

Analgesie

Langzeiteffekte durch unbehandelten Schmerz:

- persistierende Hyperalgesie
- reduziertes Wachstum (Körper + Gehirn)
- beeinträchtigte motorische Entwicklung
- neuroendokrine und kognitive Veränderungen
- neuronaler Zelltod

Anand KJ, Hickey PR. Pain and its effects in the human neonate and fetus. N Engl J Med 1987; 317: 1321–9
Bouza HJ The impact of pain in the immature brain Matern Fetal Neonatal Med 2009; 22: 722–732
Davidson A, Flick RP Neurodevelopmental implications of the use of sedation and analgesia in neonates Clin Perinatol 2013; 40: 559-73

Analgesie

Behandelter Schmerz + chirurgischer Stress:

- signifikant weniger Reaktionen: -autonom + hormonal
  -metabolisch
  -immunolog.+ inflammatorisch
  -verhaltensneurologisch
- Regionalanästhesie:
  -Stresshormonspiegel und BZ niedriger als nach Opiaten
  -effektiver bei viszeralen Schmerzen im Vgl. zu Opiaten

Lönnqvist PA Regional anaesthesia and analgesia in the neonate Best Pract Res Clin Anaesthesiol 2010; 24: 309-21
Bosenberg A Benefits of regional anesthesia in children Pediatric Anesthesia 2012; 22: 10-18

Analgesie

⇨ Lokoregionale Verfahren sorgen für eine qualitativ hervorragende Analgesie

Sanders RD, Ma D, Brooks P et al Balancing paediatric anaesthesia: preclinical insights into analgesia, hypnosis, neuroprotection, and neurotoxicity Br J Anaesth 2008; 101: 597-609
Handlungsempfehlung zur perioperativen Schmerztherapie bei Kindern Anästh Intensivmed 2007; 48: S99-S103

7

Analgesie

Kombination von Allgemein- und Regionalanästhesie:

- Stressreaktionen ↓
- Anästhetika und Opiate ↓
  - ⇨ Gefahr der Atemdepression ↓
  - ⇨ Inzidenz von Übelkeit und Erbrechen ↓
- optimale und über Stunden anhaltende Analgesie
  - ⇨ ruhiges Erwachen ↑
  - ⇨ Zufriedenheit von Patient, Eltern + Personal ↑
  - ⇨ Intensivaufenthalt ↓
  - ⇨ chirurgisches Ergebnis ↑

Bosenberg A, Flick RP Regional Anesthesia in Neonates and Infants, Clinics in Perinatology 2013; 40: 525–538
Mauch J, Weiss M Kaudalanästhesie bei Kindern, Anästhesist 2012; 61: 512-20

8

Regionalanästhesie bei Kindern

Pro	Contra
○ sehr gute Analgesie ggf als alleiniges Verfahren möglich ○ weniger Opiate weniger PO(N)V ○ weniger Anästhetika periop. stabilere Hämodynamik ○ kürzere postop. Prozesszeiten Verweildauer im AWR / Intensivstation ⇨ Schonung ökonomischer Resourcen ○ schnellere + bessere Mobilisierung, besseres funktionelles Ergebnis ○ schnellere Darmerholung	○ verlängerte Einleitungszeiten ○ Risiko für Gefäß- und Nervenverletzungen? ○ Risiken der Lokalanästhetika? ○ Entstehung neuer bzw. Verschlechterung bestehender neurolog. Vorerkrankungen? ○ Maskierung eines Kompartmentsyndroms?

9

rückenmarksnahe Regionalanästhesie bei Neugeborenen / Säuglingen

10

Rückenmarknahe Regionalanästhesie bei Neugeborenen

Beobachtungsstudie der PRAN Datenbank

- 307 Neugeborene (2,68 – 3,5kg) mit neuroaxialem Katheter
  Keine
  - persistierenden neurolog. Probleme
  - tiefe Infektionen
  - Rückenmarkverletzungen oder Epiduralhämatome

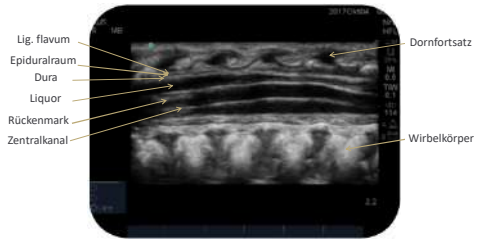
Cave: 85 von 272 (31%) Fälle: potentiell toxische LA-Dosis intra-/ postop

⇨ Neuroaxiale Katheter zur intraoperativen und postoperativen Analgesie scheinen bei Neugeborenen sicher

Long JB, Joselyn AS, Bhalla T et al The Use of Neuraxial Catheters for Postoperative Analgesia in Neonates: A Multicenter Safety Analysis from the Pediatric Regional Anesthesia Network. Anesth Analg 2016 Jun;122(6):1965-70

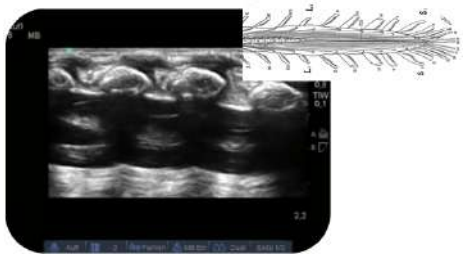
11

Ultraschall neuroaxial bei Neugeborenen / Säuglingen



12

Ultraschall neuroaxial bei Neugeborenen / Säuglingen



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Ultraschall neuroaxial bei Neugeborenen / Säuglingen

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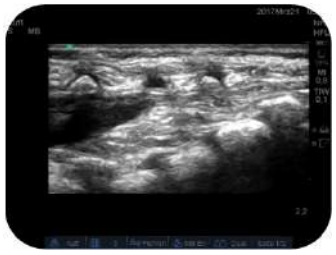
Ultraschall neuroaxial bei Neugeborenen / Säuglingen

Kaudalanästhesie



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Ultraschall neuroaxial bei Neugeborenen / Säuglingen

Kaudalanästhesie

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Ultraschall neuroaxial bei Neugeborenen / Säuglingen

Ausbreitung des Lokalanästhetikums

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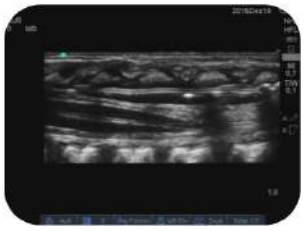
Ultraschall neuroaxial bei Neugeborenen / Säuglingen

Epiduralraum zur Katheteranlage



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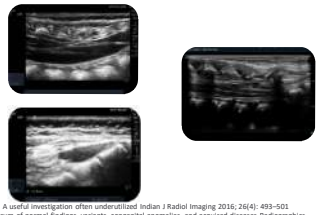
Ultraschall neuroaxial bei Neugeborenen / Säuglingen

Möglichkeit zur Detektion von Pathologien im Spinalkanal:

- Spina bifida occulta / aperta
  - (Myelo-) meningocele
- Tethered cord
- verdicktes Filum terminale
- Dermalsinus
  - (+Lipom, Dermoidcyste, Spina bifida occulta)
- Tumoren des Nervensystems
  - (Schwannom, MPNST)
- (Epi)dermoidtumoren
- kaudales Agenesiesyndrom
- Diastematomyelie
- neurenterische Zyste



Nair N, Sreenivas M, Gupta AK et al Neonatal and infantile spinal sonography: A useful investigation often underutilized Indian J Radiol Imaging 2016; 26(4): 493–501
Unsinn KM, Geley T, Freund MC et al US of the spinal cord in newborns: spectrum of normal findings, variants, congenital anomalies, and acquired diseases Radiographics 2000; 20(4): 923-38

Ultraschall neuroaxial bei Neugeborenen / Säuglingen

Kaudalanästhesie

⇨ bei 1,5% der Patienten hohe Gefahr für Durapunktion

Fideler F, Martus P, Grasshoff C Predictability of puncture depth for caudal anaesthesia in paediatric patients: a retrospective analysis. Br J Anaesth. 2021; 127(2): e50-e52

Kaudalanästhesie und Ultraschall

- prospektiv 109 Kaudalblockaden
- Erfolgsrate nur durch Palpation: 78,9%
- in 21,1% Nadellage falsch beurteilt (nach US-Überprüfung)

Adler AC, Belon CA, Guffey DM et al Real-Time Ultrasound Improves Accuracy of Caudal Block in Children. Anesth Analg. 2020; 130(4): 1002-1007

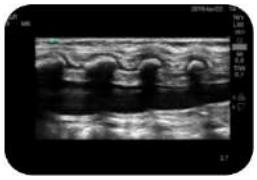
- US zeigt: 80% Erfolg für konventionell korrekte Nadelspitzenlage + epidurale LA Applikation
- Versagen assoziiert mit abnehmender Erfahrung + Vorliegen anatom. Varianten
- alle Fehllagen konnten mittels US korrigiert werden
- mittlere Zeit für Bestätigung im US 1 min

Boretsky KR, Camelo C, Waisel DB et al Confirmation of success rate of landmark-based caudal blockade in children using ultrasound: A prospective analysis. Paediatr Anaesth. 2020; 30(6): 671-675

lumbaler / thorakaler PDK mit real-time US

45 Kinder, 1-6J

	Ultraschall	Landmarken
Punktionszeit	143s	105,5s
Erfolgsrate bei 1. Versuch	87%	40,9%
	Insges. 100%	8x Versagen



Mital T, Kamal M et al Comparison of landmark and real-time ultrasound-guided epidural catheter placement in the pediatric population: a prospective randomized comparative trial. Anesth Pain Med (Seoul) 2021; 16(4): 368-376

Ultraschall nach Kaudalanästhesie

Cerebrale Perfusion

Optic nerve sheath diameter (ONSD)

Lee B, Koo BN, Choi YS et al Effect of caudal block using different volumes of local anaesthetic on optic nerve sheath diameter in children: a prospective, randomized trial Br J Anaesth 2017; 118 (5): 781–787

Tübinger Dosierungsschema neuroaxial

Ropivacain neuroaxial				
initialer Bolus	Kaudal: Ropivacain 0,2% 1 ml/kgKG Lumbal: Ropivacain 0,2% 0,6 ml/kgKG Thorakal: Ropivacain 0,2% 0,3 ml/kgKG			
		Kaudal	Lumbal / Thorakal	
Laufrate Katheter	< 3 Monate	Ropivacain 0,1% 0,2 mg/kg/h	Ropivacain 0,1% 0,2 mg/kg/h	+ Sufentanil wenn postop PICU
	≥ 3 Monate	Ropivacain 0,1% 0,3 mg/kg/h	Ropivacain 0,2% 0,3 mg/kg/h	+ Sufentanil 40 – 80 µg / 200 ml
Bolus über Katheter	2x / Schicht 50% der stdl. Laufrate			

eigene Auswertung neuroaxialer Katheter:

- 653 Kinder <13 Jahre, Median 2,2 Jahre
- OP-Dauer 290 (197 – 396) min
- Liegedauer Schmerzkatheter 105 (75 – 149) h

NRS <3: in ersten 24h bei 85,6%, über die Liegezeit der Schmerzkatheter in 88,9 % der Visiten

Brauchen Kinder eine Regionalanästhesie?

Diskussion pro / con

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Danke

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