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Neuraxial Anaesthesia for Children

PD Dr. med. Jacqueline Mauch

Agenda

- Awake neuraxial anaesthesia
  Combined use of neuraxial and general anaesthesia – new aspect
- Caudal block
  - Landmark technique – ultrasound
  - Safety
  - Test dose
- Epidural catheter
  - Complications
- Asleep vs awake
- Adjuncts
- Summary

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Awake neuraxial anaesthesia

- Only few indications in paediatric patients
  - preterm and ex-preterm infant for herniotomy
  - teenager for lower limb surgery

Comparison of awake spinal with awake caudal anesthesia in preterm and ex-preterm infants for herniotomy[1]

- historical population, SA n=339, CB n=236
- **Caudal block**
  - technically less difficult (fewer puncture attempts, lower failure rate)
  - higher success rates (fewer need for supplementation / conversion to AA)

Hoelzle M – Paediatr Anaesth 2010

Combined use of neuraxial and general anaesthesia

- Benefit of combining neuraxial anaesthesia with general anaesthesia
  1. limit intra-/postoperative need for opioids -> ventilatory function, PONV
  2. decrease the dose requirements of general anaesthetic agents (0.5 MAC)

- Exposure to certain anaesthetics and sedatives increase the incidence of neuronal apoptosis in animal models

- GABA-agonists, NMDA-antagonists

- Effect on neurocognitive dysfunction / outcome is dose and duration dependent

- Impact of such effects in humans remains controversial

Goal: reducing the overall exposure to potentially neurotoxic agents

Goeller JK – Paediatr Anaesth 2014

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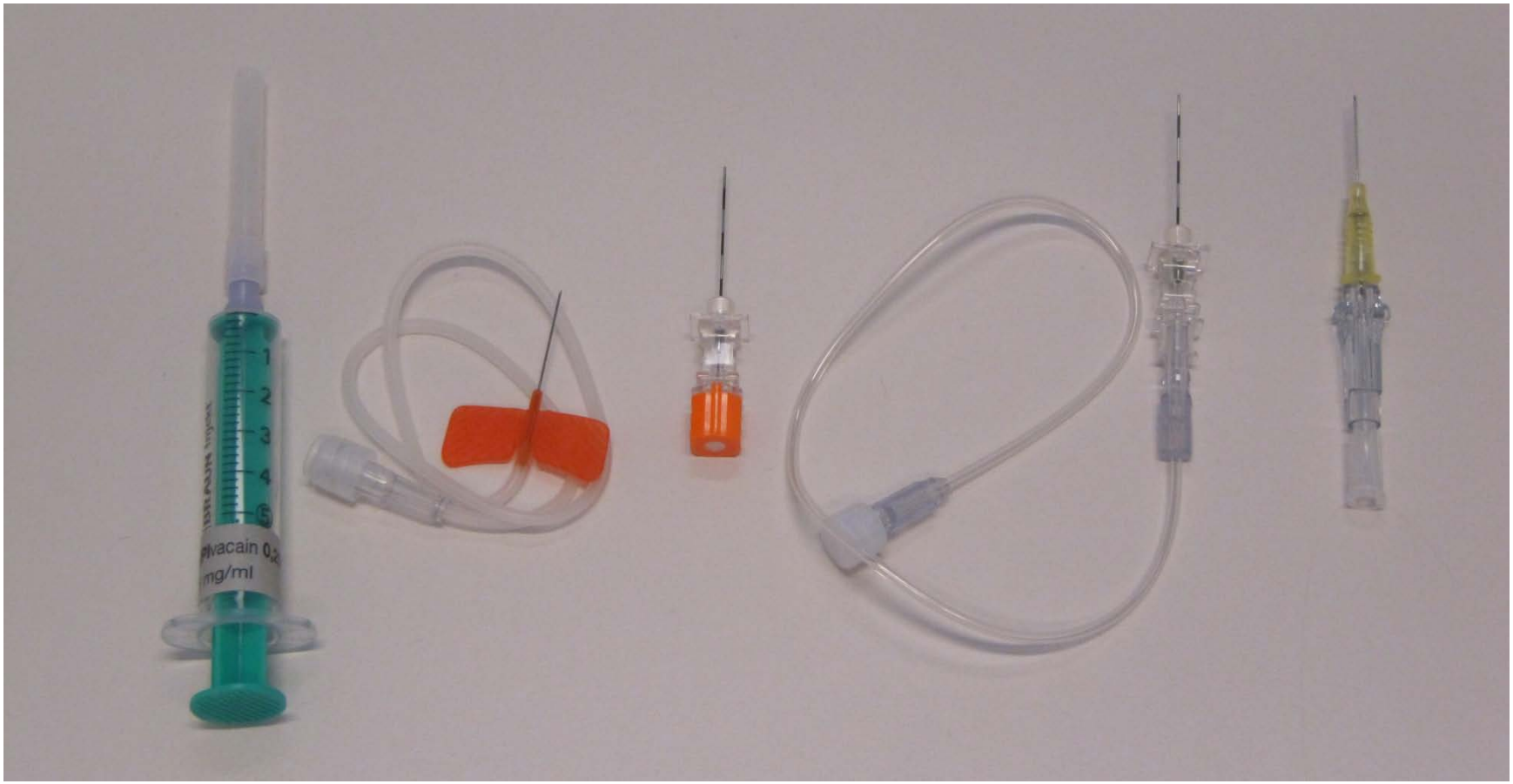
Caudal block

- Most common regional anaesthesia technique performed in children
  - Bupivacaine (0.125-0.25%) or ropivacaine (0.1-0.375%)
  - 1-1.5 ml/kg

Caudal block



Ultrasound in caudal blocks

ORIGINAL ARTICLE

Should we abandon landmark-based technique for caudal anesthesia in neonates and infants?

- 26 healthy infants, 13 weeks of age (mean)
- Relating anatomical landmarks to ultrasound findings

- Sacral cornu not palpable in 15%
- Posterior superior iliac spines and sacral cornua forms an isosceles triangle sacral hiatus more cephalad
- Shorter distance between PSIS and SC in female infants

Mirjalili SA – Paediatr Anaesth 2015

Safety of caudal block

Are Caudal Blocks for Pain Control Safe in Children? An Analysis of 18,650 Caudal Blocks from the Pediatric Regional Anesthesia Network (PRAN) Database

- n=18'650
- Complications?
  Local anaesthetic dosing selection?

- Performed with ultrasound
  - 3.3% before 2010
  - 1.9% subsequent years

Table 1. Demographic and Block Characteristics

	Subjects (n = 18,650)
Age (mo)	14 (7–29)
Gender	
Male	16,236
Female	2414
Weight (kg)	10.3 (8–14)
ASA class	
I	11,198
II	5744
III	1596
IV	111
V	1
Calendar year of block performance	
2007	1398
2008	1737
2009	2181
2010	2949
2011	4645
2012	5740
Anesthetic technique used with the block	
None (awake)	92
Sedation	108
General anesthesia without muscle paralysis	15,430
General anesthesia with muscle paralysis	3020
Ultrasound	
Yes	443
No	16,342
Not determined	1865
Local anesthetic type	
Bupivacaine	12,075
Ropivacaine	6358
Unknown/other	217

Suresh S – Anaesth Analg 2015

Safety of caudal block

- Overall incidence of complications 1.9%
  Patients with complications were younger
  No beneficial role of ultrasound
- No long-term sequelae
- Dosing: Large variation
  Ropivacaine > bupivacaine
- Efficacy?

Table 2. Incidence of Specific Complications in Caudal Block

	Incidence (95% confidence interval)
Block failure	1% (0.8 to 1.1)
Blood aspiration	0.6% (0.5 to 0.8)
Positive test dose	0.1% (0.1 to 0.2)
Dural puncture	0.08% (0.005 to 0.01)
Cardiac arrest	0.005% (– to 0.002)
Seizure	0.005% (– to 0.002)
Sacral pain	0.005% (– to 0.002)
Muscle spasm	0.005% (– to 0.002)

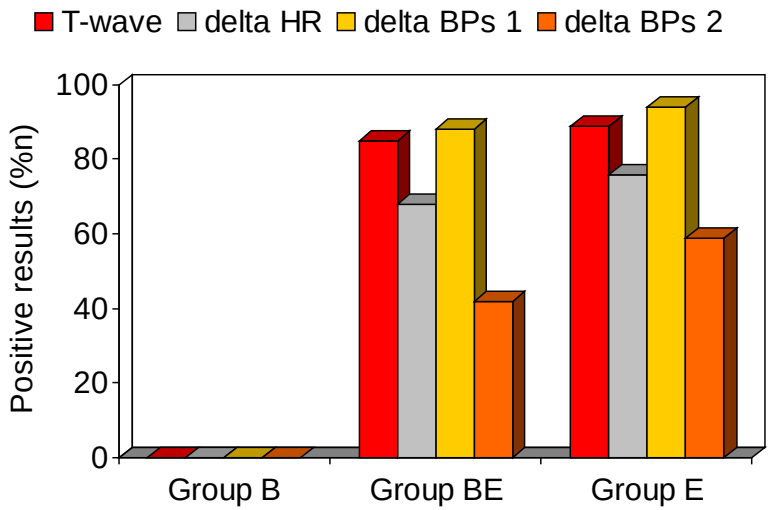
Table 3. Detailed Patient Information on Serious but Infrequent Complications

	Age (mo)	Gender	Weight (kg)	Local anesthetic drug	Dose (mg/kg)	Patient state	Test dose	Comments
Cardiac arrest	36	Male	17.3	Ropivacaine	1.08	General anesthesia	No	Delayed hospital discharge 1–2 d
Seizure	1	Male	4	Lidocaine	1.5	General anesthesia	Unknown	Seizure occurred in postanesthesia care unit
Sacral pain	24	Female	11.5	Ropivacaine	2.2	General anesthesia	Yes	Sacral pain lasting 1 wk
Muscle spasms	2	Male	4.3	Ropivacaine	1.5	Awake	No	Spasms in bilateral lower extremities lasting for 1 wk

Suresh S – Anaesth Analg 2015

Test dose for caudal blocks

- Sensitive and reliable technique to detect intravascular injection of LA
  0.2 ml/kg, epinephrine 5 µg/ml



Positive intravascular test dose **criteria** in children:

T-wave:	**≥ 25%**
HR:	**≥ 10 bpm**
BP syst.:	**≥ 15 mmHg**

Tobias JD. Anesth Analg 2001

Mauch JY – Br J Anaesth 2012

Test dose for caudal blocks

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
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)

The inclusion of T-wave and HR
allows detection of an epinephrine-containing test dose
with a reliability of 100%.

Mauch J – Br J Anaesth 2012

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Epidural catheter - complications

- n=190
  1x catheter site infection, 1x seizures, 1x respiratory depression

- n=2’824
  morbidity 3.9 per 1’000
  dural penetration, intravascular injection, overdose, transient paraesthesia

- n=1’605
  morbidity 10 per 1’000
  dural tap, total spinal, cardiac toxicity, transient nerve injuries, local inflammation

Wood CE – Can J Anaesth 1994
Gaufré E – Anaesth Analg 1996
Ecoffey C – Paediatr Anaesth 2010

Epidural catheter - complications

- n=10’633
  morbidity 5.3 per 1’000
  neurological deficit (cauda equina syndrome) due to infusion pump error

Grade 1 (n = 5)		*Grade 2 (n = 8)*		*Grade 3 (n = 43)*	
Infection – epidural abscess	2	Drug error – respiratory arrest	1	Drug error	10
Infection – meningism	1	Drug error – seizure	1	Local infection	25
Postdural puncture headache	1	Local anesthetic toxicity	1	Postdural puncture headache	5
Drug error, resulting in cauda equina syndrome	1	Peripheral nerve injury	5	Peripheral nerve injury	1
				Inadvertent spinal anesthetic	2

- n=3’152
  morbidity 7.6 per 1’000
  neonates > infants > children
  most common complications: **skin infection, drug error**

Llewellyn N – Paediatr Anaesth 2007
Wong GK – Can J Anaesth 2013

Epidurals - complications

- Adverse events single-injection

	Total procedures	Total adverse events (%)
Neuraxial		
Caudal	6011	172 (3)
Lumbar	103	5 (5)
Thoracic	13	2 (15)
Subarachnoid	83	5 (6)
Total neuraxial	6210	183 (3)

Adverse events catheters

	Total procedures	Total adverse events (%)
Caudal		
Sacral	274	36 (13)
Lumbar	261	38 (15)
Thoracic	195	26 (13)
Epidural		
Lumbar	1518	243 (16)
Thoracic	695	177 (25)
All neuraxial catheters	2946	520 (18)

- **Increased risk: thoracic epidural injection and catheter techniques**

Polaner DM – Anaesth Analg 2012

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Asleep Versus Awake: Does It Matter?

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

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

- Postoperative neurological symptoms
  0.93 per 1'000 under GA
  6.82 per 1'000 in sedated / awake patients

- Local anaesthetic systemic toxicity
  0.08 per 1'000 under GA
  0.34 per 1'000 in sedated / awake patients

Taenzer AH – Reg Anesth Pain Med 2014

Adjuncts – epidural application

- Morphine
  Most powerful adjunct
  Up to 24 h of good-quality analgesia
  Useful when epidural catheter tip is not optimally positioned
  33-50 µg/kg
  Cave: delayed respiratory depression, nausea, pruritus, urinary retention

- Clonidine
  Prolongation of analgesia of 50%
  1-2 µg/kg

- S-Ketamine
  Lack of proper scientific data – neurotoxicity?
  Not recommended.

All adjunct have to be preservative-free!

Summary

- Combining regional and general anaesthesia
  - ➢ Reducing overall exposure to potentially neurotoxic agents and opioids

- Caudal block
  Most common regional anaesthesia technique performed in children
  Excellent safety record

- Epidurals
  For experienced hands only
  Increased rate of adverse events for catheter techniques
  Higher complication rates with thoracic punctures

- Epinephrine containing test dose strongly recommended
  Cave drug error in administration of local anaesthetic
  Clonidin: adjunct with best risk-benefit relation
  Morphin: long lasting analgesia, cave side effects, for special indications only