Dorsal penile nerve block versus caudal block for circumcision in pediatric patients
A systematic review and meta-analysis

Dora Alexandra Carreira de Oliveira, Rafael Oliva Morgado Ferreira, Susimar Picado-Loaiza, Matheus Pedrotti, Eric Pasqualotto, Sara Amaral, Dorsal penile nerve block versus caudal block for circumcision in pediatric patients: A systematic review and meta-analysis, Trends in Anaesthesia and Critical Care, 2025, Volume 61.

A systematic review and meta-analysis comparing dorsal penile nerve block (DPNB) versus caudal block (CB), in addition to general anaesthesia, for paediatric patients undergoing circumcision. Primary outcomes considered were time to first analgesic requirement and pain scores at one, three and 24 hours post operatively.

Methods

The authors reported a comprehensive database search strategy and article review process, identifying 14 studies, 10 RCTs and four observational studies, with a total of 1425 patients. The mean age range of patients was 3-12.5 years, with studies taking place across Turkey, China, Israel, the United Kingdom and Australia.

Findings

There was no statistically significant difference in the primary outcomes of time to first analgesia, and pain scores at one, three and 24 hours post procedure between the DPNB and CB groups. Time to first walk and time to hospital discharge favoured the DPNB by a mean difference of 30.28 and 28.61 minutes respectively. In all other considered outcomes (incidence of post-operative nausea and vomiting and motor block, time to first micturition and PACU discharge) there was no significant difference between the two groups. There were no reported complications or adverse outcomes in either group.

Take home message/Commentary

While caudal analgesia is commonly used in children, there is concern regarding potential serious adverse outcomes such as hypotension when combined with general anaesthesia, high spinal from inadvertent dural puncture, sacral osteomyelitis and local nerve injury. DPNB has been proposed as an alternative, providing more localised regional anaesthesia, avoiding these potential risks, and using lower total doses of local anaesthetic. Of note, both techniques still carry the risk of systemic local anaesthetic toxicity, and failure of regional technique.

There were no reported serious adverse events with either of these techniques in all included studies, which is consistent with large European and American multicentre studies supporting the safety of regional techniques in paediatric patients under general anaesthesia.

Analgesic efficacy outcomes suggests neither technique is superior.

Statistically significant differences noted in the secondary outcomes for time to first walk and length of hospital stay favoured dorsal penile nerve block. Though statistically significant, the absolute mean difference was 30 minutes for each of these outcomes, in what was on average a four hour hospital stay. DPNB may lead to an earlier discharge from hospital, but the clinical workflow and economic benefit of a 30-minute reduction in length of stay will vary between institutions.

Although overall number of studies and patients included in the meta-analysis was large, only a few included studies reported on each of the predetermined outcomes. As such, the absolute number of patients for any given outcome is much smaller. Furthermore, the authors' assessment for bias identified "some concerns" with all included studies, and quality of evidence was determined to be low or very low quality for their primary outcomes.

Overall, this meta-analysis does not demonstrate analgesic superiority of one regional technique over the other. DPNB may offer the advantage of faster time to mobilise and shorter duration of hospital stay, however the beneficial significance of reducing hospital stay by 30 minutes will be institution specific.

Reviewed by Dr Erin Chevis

Electroencephalography and Anesthetic Depth in Children Under 2 Years of Age A Prospective Observational Study

Yoon SB, Park JB, Kang P, Jang YE, Kim EH, Lee JH, Lee HC, Kim JT, Kim HS, Ji SH. Electroencephalography and Anesthetic Depth in Children Under 2 Years of Age: A Prospective Observational Study. Paediatr Anaesth. 2025 Apr;35(4):294-301. doi: 10.1111/pan.15058. PMID: 39723638.

Overview

This single-centre prospective observational study aimed to compare EEG spectral parameters during periods of false positive elevations in processed EEG indices to elevations in these indices during emergence. They studied 50 ASA 1-2 children aged 4-23 months who were planned to have general anaesthesia with sevoflurane maintenance. All patients had simultaneous recordings from both paediatric BIS and SEDLINE sensors. The raw EEG data as well as the processed indices (BIS and PSi) were extracted and analysed.

Definitions:

Maintenance: 0.7-1.3 MAC with heart rate and MAP within 20% of baseline pre-operative values

Emergence: MAC 0.7 to 0.2

False positives: BIS values > 60 or PSi > 50 for greater than one minute during maintenance

Results:

During normal maintenance in the study, the average BIS was 56 and PSi was 45 (close in range to the defined values for elevated indices).

70% of children in the study had at least one false positive. The patients who did not have any false positives, on average had a shorter duration of anaesthesia (70 vs 125 min).

EMG, signal quality and artefacts remained consistent during false positives and normal maintenance on both sensors.

The study found that there was a difference in the spectral distribution of raw EEG during false positives compared to emergence. During emergence there was a significant decrease in normalised power of delta and theta waves, and higher power of beta waves. When the BIS or PSi was elevated during maintenance, there was an elevation in the spectral edge frequency compared to normal periods, but much higher power of delta waves than during emergence – suggesting a false positive. In other words, true emergence had a markedly different EEG power spectra compared to the false positives.

The elevation in the processed EEG indices was also statistically significantly higher during true emergence than during false positives (BIS 70 vs 65 and PSi 60 vs 53).

Take home messages:

- Elevations in processed EEG indices during maintenance phase are common in children aged 4-23 months.
- Due to the age of the patients, it's impossible to definitively determine if these "false positive" elevations are associated with periods of awareness.
- We can be reassured that when HR and NIBP are close to baseline and MAC is >0.7 that slight rises in processed EEG indices are likely due to a false positive rather than emergence or awareness because the raw EEG more closely represents the spectral parameters of an anaesthetised patient than the pattern during emergence.
- This may help with assessing depth of anaesthesia when there is an unexpectedly high EEG index compared to other clinical signs.
- Since the pattern of normalised delta and theta power was different between false positives and true arousal states in this study, incorporating this into the algorithm for BIS or SEDLINE for this age group may help improve the accuracy of anaesthetic depth assessment.
- A limitation of the study is that EEG indices are calculated on a delay, so capturing the raw EEG simultaneously to the raised index could be affected by a time lag.

- Although it is appropriate to look at this data in patients having volatile anaesthesia due to the ability to measure MAC, it would be useful to assess the same EEG parameters during TIVA anaesthesia where BIS or PSi is often used to titrate depth during maintenance.

Reviewed by Dr Grace Andrews

Regional Analgesia in Pediatric Cardiothoracic Surgery: A Bayesian Network Meta-analysis

Ren Y, Li L, Gao J, Hua L, Zheng T, Wang F, Zhang J. Regional Analgesia in Pediatric Cardiothoracic Surgery: A Bayesian Network Meta-Analysis. J Cardiothorac Vasc Anesth. 2025 Apr;39(4):1037-1048. doi: 10.1053/j.jvca.2024.12.043. Epub 2025 Jan 9. PMID: 39880711.

This meta-analysis compared the effect of 13 different epidural and regional anaesthetic techniques (ERATs) on opioid consumption and pain scores in paediatric patients following cardiothoracic surgeries.

Methods

A database search identified studies assessing the effect on ERATs on elective paediatric cardiothoracic patients. Primary endpoint was opioid consumption within 24 hours. Secondary outcomes were pain scores, time to first rescue analgesia, and incidence of PONV. P-value was set at <0.05.

Results

24 studies (n=1602) evaluating thoracic epidurals and 12 different regional anaesthetic techniques were included. Opioid consumption was evaluated in 13 studies (n=746). All ERATs significantly reduced 24-hour opioid requirements. Thoracic retro-laminar block (TRLB) significantly reduced opioid consumption in comparison to other techniques. All ERATs reduced opioid consumption beyond the predetermined minimum clinically important difference (MCID).

The effect of ERATs on pain scores varied over time. The thoracic retro-laminar block (TRLB) resulted in least pain immediately post-operatively. Paravertebral block (PVB) had least pain at 2 hours. At 4- and 6-hours post-surgery pain scores were lowest for combined transversus thoracic plane block (TTPB) with serratus anterior plane blocks (SAPB); and TTPB alone had greatest reduction in pain scores at 12 and 24 hours (non-significant).

Nine studies (n= 575) assessed time to first rescue analgesia. All ERATs analysed significantly prolonged the time to first rescue dose. Pectoral nerve block (PECS) was most likely to prolong

time to rescue analgesia. TRLB had the second greatest effect. Time frames were not reported. No ERAT had a significant effect on PONV.

Commentary

This paper adds to a limited body of work. There are no similar meta-analyses in paediatric cardiothoracic patients.

Sternotomy or thoracotomy incisions can result in difficult pain management and secondary morbidity. Findings confirm the benefit of all 13 ERATs in the management of paediatric patients following cardiothoracic surgery.

Opioid consumption and pain scores were interpreted in terms of MCID. This patient centred approach looks beyond absolute numbers to identify the smallest change that patients would find meaningful. All techniques in this study met the MCID threshold reiterating their benefit to the study population.

Multiple newer alternatives to 'gold standard' techniques of erector spinae block and thoracic epidural are highlighted. Of note, TRLB and TTPBs appear to compare most favourably. Both are relatively new, less invasive, fascial plane blocks. In the context of anticoagulation for cardiothoracic surgery these techniques may provide a non-inferior, lower risk alternative for post-operative analgesia. Further larger randomised control studies comparing TRLB and TTPB to gold standard techniques are required to confirm this.

Study strengths

A wide range of ERATs are included, including less commonly used techniques. Individual study populations were small, but use of Bayesian modelling enabled multiple comparisons between groups to identify clinically significant data.

Limitations

As acknowledged by the authors, direct comparisons between techniques are limited due to heterogeneity between studies. There are many variations between study protocols, techniques and outcomes measured, reducing generalisability of findings.

Reviewed by Dr Aisling Gormley

Racial Disparities in Pediatric Anesthesia: An Updated Review

Elizabeth Baetzel A, Holman A, Dobija N, Reynolds PI, Nafiu O. Racial Disparities in Pediatric Anesthesia: An Updated Review. Anesthesiol Clin. 2025 Mar;43(1):67-81. doi: 10.1016/j.anclin.2024.07.005. Epub 2024 Sep 2. PMID: 39890323.

This narrative review serves as an update of a previous paper published in 2020 by the same authors. It serves to highlight continued racial disparities in the provision of perioperative care in children.

The authors categorize factors contributing to inequality in health care provision into:

- Provider factors, highlighting the effect of explicit and implicit bias on the provision of health care and importance of education to help to reduce biases. The authors also discuss the importance of promoting diversity in the workforce.
- System factors focus on geographic location and the effect on access to surgery. Using standardised protocols may also assist in reducing disparities in perioperative care.
- Patient/Family factors include socioeconomic status, education level, language and cultural differences, lack of trust in the health care system and multigenerational social and health inequities.

The paper presents a table of recent publications (seven retrospective studies) relevant to paediatric anaesthesia, demonstrating disparities in postoperative mortality, complication rates, analgesic choice, pain scores and analgesic use.

The authors also describe proposed strategies to help to mitigate these racial discrepancies:

- Primarily promotion of diversity amongst paediatric anaesthesia providers and other health care workers.
- Improving diversity in clinical trials.
- Appropriate health care resource allocation.

Although these aforementioned themes carry through globally, it is worth acknowledging more specific concerns within the inequities in healthcare amongst the First Nations and Maori children. Waugh et al presented a review on discrepancies in paediatric anaesthetic care in Australia and New Zealand in 2024 with emphasis on the geographical challenges specific as well as cultural diversity within these two countries (1). This together with a high incidence of chronic disease, surgical pathologies as well as rheumatic heart disease pose significant challenges. Another notable paper on this topic is an editorial in Pediatric Anaesthesia discussing the imbalance of health care delivery and causative factors including poverty, geographical location, race and gender inequalities (2).

Reviewed by Dr Megan Wellbeloved

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Prolonged opioid use after surgery in children, adolescents, and young adults: A systematic review

Sun N, Chowdhury AR, Wu A, Englesakis M, Rosenbloom BN, Steinberg BE, Stinson JN, Aoyama K. Prolonged opioid use after surgery in children, adolescents, and young adults: a systematic review. Can J Anaesth. 2025 Apr;72(4):579-590. English. doi: 10.1007/s12630-025-02921-7. Epub 2025 Mar 24. PMID: 40126793.

Summary

Persistent use of opioids after surgery remains a significant concern in the paediatric population and has been the subject of debate, particularly in North America.

In Australia, between 2013 and 2017, dispensing of strong opioids in children increased in all age groups and in 2017, 1 in 74 Australian children (including 1 in 25 adolescents) were dispensed an opioid (1).

This systematic review conducted in North America sought to integrate rates of prolonged opioid use after surgery (POUS) and identify risk factors associated with POUS in children. It provides insights that may guide opioid stewardship after acute surgical care.

Seventeen studies (15 USA, 2 Canada) involving over 1.57 million patients included in this review were either prospective or retrospective observational studies with ≥50 paediatric/young adult patients (≤25 years), who underwent any surgery, measured opioid use ≥60 days post-op, and reported POUS rates. Risk of bias was assessed using an adapted SIGN checklist, and risk factors were analysed using a best-evidence synthesis. Findings included a median POUS rate of 4.5% (2.6-7.1%), highest POUS rates in cancer surgeries, and lowest POUS rates in ophthalmic surgeries. The median age was 15.4 years.

The review identified strong risk factors for POUS as older age (especially adolescents/young adults), female sex, history of chronic pain and pre-operative opioid use.

Commentary

This systematic review with a large sample size addresses an important question on a topical issue: prolonged opioid use after surgery in children. It focused exclusively on young

people/children, a demographic under-represented in opioid research, and evaluated a broad range of surgeries, enhancing its real-world relevance.

The study highlights several key predictors of POUS: adolescents/young adults, female sex, history of chronic pain and pre-operative opioid use. This equips us clinicians with actionable knowledge to identify higher risk individuals and tailor their peri-operative care to reduce/avoid long-term opioid exposure.

Encouragingly, the review also reports a decline in POUS over time, possibly reflecting evolving prescribing guidelines, increased provider awareness and the broader impact of national opioid stewardship efforts. Alternatively, this could reflect changing anaesthesia practices and peri-operative care such as increased use of peri-operative regional techniques. Further studies to evaluate this are required.

Despite these strengths, the study also had its limitations. Definitions of POUS varied significantly across included studies, making comparisons and pooled prevalence challenging.

Most included studies relied on prescription fill data or insurance claims, which, while accessible, do not capture actual consumption of opioids, why they were taken or if the intended patient took them. The study did not address the supply/demand and return/disposal of opioids; it did not look at the "pool" of unused prescription opioids that would be available for potential misuse, overdose or redirection.

Some included studies also had patients with pre-existing chronic pain or prior opioid use, potentially over-estimating the incidence of POUS in opioid-naïve populations.

Lastly, all data came from North America, possibly limiting the generalisability to Australian and New Zealand healthcare systems/cultural contexts.

Take home message

The study's main relevance for paediatric anaesthetists in Australia and New Zealand is that it gives some risk factors for POUS (adolescent/young adult, female sex, history of chronic pain and peri-operative opioid use) to be aware of that should guide and shape our peri-operative opioid prescribing in this population.

We must be mindful that acute pain is not under-treated whilst opioid stewardship is maintained.

Reviewed by Dr Maximiliane Beck

References:

1) Bell, Jane et al. Prescription opioid dispensing in Australian children and adolescents: a national population-based study. The Lancet Child & Adolescent Health, Volume 3, Issue 12, 881 - 888

The Influence of Electroencephalographic Density Spectral Array Guidance of Sevoflurane Administration on Recovery From General Anesthesia in Children. A Randomized Controlled Trial

de Heer IJ, Raab HAC, de Vries J, Karaöz-Bulut G, Weber F. The Influence of Electroencephalographic Density Spectral Array Guidance of Sevoflurane Administration on Recovery From General Anesthesia in Children. A Randomized Controlled Trial. Paediatr Anaesth. 2025 Apr;35(4):287-293. doi: 10.1111/pan.15065. Epub 2025 Jan 13. PMID: 39803999; PMCID: PMC11883516.

Study type

Single centre, prospective randomised controlled trial conducted at Sophia Children's Hospital, a tertiary paediatric hospital in Rotterdam, Netherlands, between September 2022 and March 2024

Methods

A. Inclusion criteria

- Children aged 6 months – 12 years scheduled for elective surgery under GA supplemented with caudal analgesia.
- Dutch-speaking parents/guardians for informed consent

B. Exclusion criteria

- Chronic use of drugs influencing the EEG (anti-epileptics, psychotropic medications)
- Premedication with Midazolam or Clonidine

C. Secondary exclusion criteria

- Protocol violation
- Failed caudal anaesthesia

Patients were randomised to two groups:

- Group SC: received end-tidal sevoflurane concentration of 2.3% (group SC – standard care in the author's paediatric anaesthesia department)

- Group DSA: received sevoflurane anaesthesia titrated to maintain a characteristic Density Spectral Array (DSA) pattern using the Narcotrend EEG monitor, defined as consisting of delta and alpha activity, and possibly beta activity.

Findings

96 children were analysed per-protocol which included 44 in group SC and 52 in group DSA.

Primary outcome:

The time interval between discontinuation of sevoflurane and when discharge criteria from the operating theatre were met (Steward score of 3 or more) were shorter in group DSA with a difference between medians of 6 minutes (95% CI -7 to 0, p = 0.041) (group DSA 6mins [13[4-16.8]]); group SC 12mins [18[6-24.3]]).

Secondary outcomes:

No statistically significant difference was found between the two groups in time from discontinuation of sevoflurane to discharge from post anaesthesia care unit (Steward score of 6).

Differences in depth of hypnosis during the procedure were found between the two groups. Group DSA had higher proportion of patients with DSA pattern representing general anaesthesia (46/52 vs 24/44) and too light sedation (2/52 vs 0/52), and lower proportion of patients with patterns suggesting too deep anaesthesia (4/52 vs 20/52).

The mean end-tidal sevoflurane concentration during procedure was lower in group DSA 1.8%(0.34) vs 2.3%(0.1) in group SC (95% CI 0.4-0.7, p<0.001).

Group SC had 3 patients with blood pressure drop of more than 2 standard deviations, which resolved with a 10ml/kg fluid bolus. No incidences of post-operative delirium, awareness, or other adverse events were reported.

Discussion

The limitations associated with the use of index-based EEG monitoring in children is not as prominent when using Density Spectral Array, due to age and anaesthesia-specific EEG expressions of the DSA pattern. However, not much is known about the benefit of using DSA in children.

The clinical relevance of a shorter time to discharge from operating theatre by 6 minutes demonstrated in this study as its primary outcome is up for debate. It could mean one extra patient per day in a busy day care setting. However, discharge criteria from operating theatre differ between institutions. For example, in our institution, a spontaneously breathing child can

be brought to PACU with a supraglottic airway device in situ without waiting for a certain level of recovery; a shorter turnaround time in this setting may be of less clinical relevance.

The study demonstrated that dosing of sevoflurane purely based on MAC value is more likely to result in a greater depth of anaesthesia; which did not show a resulting negative outcome in this study. The author did not report whether the three patients with hypotension were in this group of DSA pattern, but all of those resolved after the fluid bolus. Unnecessary anaesthetic exposure through a vapouriser to target a higher end tidal concentration than required also has a negative environmental impact.

A limitation of this study is the relatively large number (10) of secondary exclusions due to protocol violations in the standard care group. Eight patients had end-tidal sevoflurane concentration erroneously maintained at 1.9% rather than 2.3%, two patients had co-administration of Propofol during maintenance of anaesthesia. As a result, the target number of 51 participants per study group were not achieved, hence underpowered based on the initial power analysis.

In addition, the team chose a per-protocol analysis to identify a treatment effect under optimal condition. As the protocol violations were patient independent, confounding due to exclusion of an outcome related factor is less likely.

Take home message

There is a paucity of data published about the benefits of using Density Spectral Array analysis in children. This study provides initial evidence of an added value of DSA monitoring in regards to speed of recovery and allowing lower doses of sevoflurane during maintenance. However, larger studies with greater clinical relevance (at least for our institution) is required to warrant routine use of DSA guidance in sevoflurane anaesthesia.

Reviewed by Dr Sharon Eow

Edited by Dr Su May Koh