



3-Dimensional Virtual Reality Versus 2-Dimensional Video for Distraction During the Induction of Anesthesia in Children to Reduce Anxiety : A Randomized Controlled Trial

Anesthesia & Analgesia, Samnakay S, et al, 141(3):p 629-638, September 2025.

DOI: 10.1213/ANE.0000000000007119

Summary

This study did not find 3D virtual reality (VR) to be superior to 2D tablet audiovisual distraction in reducing anxiety during induction for children undergoing emergency or elective surgery.

Methods

- Single-centre tertiary paediatric hospital, randomized, controlled, parallel-group trial
- 200 children (4-13 years) recruited from day-of-surgery admissions ward undergoing a broad range of elective or emergency surgery
- Randomly allocated to VR or tablet to watch a 5-minute underwater-themed video with breathing exercises in the anaesthetic room with 1 parent or carer
- Induction method at discretion of anaesthetist
- The only premedication permitted was clonidine (only 7 patients received this)

Primary outcome:

- Pre-operative anxiety at check-in and at induction (mYPAS-SF)

Secondary outcomes:

- Pre-operative “state” and “trait” anxiety (STAI-C)
- Induction compliance (Induction Compliance Checklist)
- Emergence delirium (CAP-D)
- Usefulness judged by anaesthetist, anaesthetic technician and parent (Likert scale)
- Child satisfaction (Likert-like faces)

Children were not selected on the basis of baseline anxiety, and only about one quarter to one third were classified as having “high anxiety” by the measures listed above

Findings

- No significant difference between VR and 2D tablet distraction on induction anxiety

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- Much larger and more consistent associations with reduced anxiety were age (9+), better child-reported tolerance of past procedures, and inhalation induction (unless inhalation selected for child 9+ years old)
- There were generally high usefulness and satisfaction ratings perceived by staff, parents and children for both VR and 2D distraction, and no difference detected in emergence delirium
- The few minor differences within the secondary outcomes at or near threshold statistical significance should be interpreted with extra caution, as these ordinal, skewed rating scales were analysed as continuous data with normally distributed residuals

Context

Previous studies in children have found:

- Higher perioperative anxiety is associated with emergence delirium
- Portable tech devices can reduce anxiety at induction
- Use of VR during medical procedures is associated with reduced peri-procedural anxiety
- With prior evidence that digital distraction can reduce procedural anxiety, this study chose not to include a control group without digital distraction. It assesses relative, rather than absolute benefit of VR vs tablet distraction

Strengths

- Novel head-to-head comparison of VR vs tablet during induction using established assessment tools where available
- Specific to induction, rather than a range of awake procedures such as IV access, burns dressing changes, oncology procedures etc.

Several aspects reflected real practice particularly well:

- Intention-to-treat analysis allowed for inclusion of the small number of children who experienced real-life technical issues with either device
- Patients were not introduced to the devices until just before induction
- Patients underwent a broad range of both elective and emergency surgeries, though it is not reported what proportion were elective vs emergency
- Clinically realistic exclusion criteria
- Induction method left to discretion of anaesthetist
- Comments were collected from staff, which identified issues with mask seal next to the VR device, and difficulty assessing depth of anaesthesia with eyes covered by the device

Limitations/caveats

- The statistics used are better suited to identifying the direction of effects, rather than the magnitude of the small effects seen in the study

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- It's not clear how many IV inductions included cannulation vs use of a pre-existing line, as can be the case in patients having emergency procedures. It would be reasonable to expect greater need for distraction during inductions involving cannulation.
- Both a strength and a limitation is that the distraction video was the same for everyone. This did not assess whether a more interactive program such as a game might be more effective in VR vs tablet format. It is common practice to allow children to choose their distraction on a tablet, and this was not available for either VR or tablet
- Not designed to find a subset of patients who might benefit more from VR vs tablet, for instance older children receiving an IV induction
- It would have been interesting to collect the free-text experiences of parents and older children. This may have revealed practical tips for digital distraction, as did the comments from staff
- It is reasonably left to the reader to decide whether they value more very high scores or fewer very low scores in evaluating the usefulness and satisfaction ratings
- Given the cost, training, and workflow implications of VR, a department might reasonably ask whether its use could be targeted to highly anxious children. This study does not answer that question. In the high-anxiety subgroup, the sample was underpowered to detect anything but a large effect, and the observed data suggest no meaningful difference between VR and tablet distraction

Final thoughts

When a standardized video is used at induction, VR does not reduce children's anxiety or increase satisfaction significantly compared to a tablet. It is interesting to wonder why. In simulation education, physical fidelity alone rarely determines immersion and effectiveness; psychological engagement and task relevance matter more.

What are the equivalent factors for induction anxiety? This study identifies multiple factors far more strongly associated with induction anxiety than distraction modality: age, mode of induction, and prior tolerance of procedures. Only one of these is modifiable in the induction bay. This is likely an incomplete list, as other contributors—such as parental anxiety—are well described elsewhere but were outside the scope of this study.

Several questions about VR's use for reducing induction anxiety remain:

- Are there specific subgroups—such as older children undergoing IV induction or those exposed repeatedly to anaesthesia—who may benefit more from VR?
- Is a more interactive VR app chosen by the child more effective than a similar tablet app?

Reviewed by Dr Tim Durack

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Quality Improvement Protocol to Reduce Excessive Postoperative Recovery Following Cleft Palate Repair

Kaur, B., Frawley, G., Chong, D. and Burge, J. (2025), Quality Improvement Protocol to Reduce Excessive Postoperative Recovery Following Cleft Palate Repair. *Pediatr Anaesth*, 35: 838-847. <https://doi.org/10.1111/pan.70019>

Summary

This Australian single-centre quality improvement (QI) study focussed on the anaesthetic management of children undergoing cleft palate repair with the primary aim of reducing PACU length of stay.

Methods

Participants were infants <36 months undergoing primary cleft palate repair (excluding cleft lip/anterior palate repairs, revisions, and pharyngoplasty). The primary outcome measure was mean PACU length of stay. Secondary outcomes were the incidence of pain or distress, airway obstruction, hypoxaemia, or unplanned intensive care admission.

The multidisciplinary QI team included anaesthetists, plastic surgeons, and PACU nurses.

The study consisted of four non-randomised sequential phases:

1. A retrospective baseline phase (May 2016 – September 2020)
2. Introduction of a standardised anaesthetic protocol, including paracetamol 20mg/kg, parecoxib 1mg/kg and clonidine 1- 2mcg/kg (October 2020 – January 2022)
3. Introduction of selective (rather than universal) above-elbow arm splints (February 2022 – November 2023)
4. Introduction of an intraoperative dexmedetomidine infusion (1 mcg/kg/hr) instead of clonidine (December 2023 – December 2024)

Results:

In total, 434 patients were studied (mean age 14.7 months; 10.1 kg), including 205 in the retrospective group, 71 in phase 2, 82 in phase 3, and 76 in phase 4. Compared with the retrospective group, all three interventions resulted in a reduction in mean PACU length of stay, achieving the project's predefined goal of at least a 10% reduction.

Standardisation of the anaesthetic approach resulted in 15% reduction (mean difference 23.6 minutes) in PACU length of stay, selective arm splint use resulted in 15% reduction (mean difference ~30.7 min) compared with phase 1, and dexmedetomidine infusion resulted in a 11% reduction (mean difference ~16.4 min) compared with phase 1.

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In terms of secondary outcomes, pain or distress requiring opioid rescue was 33% in the retrospective phase and was not significantly reduced in phase 2 (32%), phase 3 (32%) and phase 4 (26%). Postoperative respiratory events requiring intervention occurred in 30% in the retrospective phase and were reduced in phase 2 (18% $p = 0.06$), phase 3 (21%) and phase 4 (12%). The incidence of postoperative paediatric intensive care involvement reduced from 7.3% in the retrospective phase to 1.2% and 1.3% in phase 3 and 4 respectively.

The standardised anaesthetic protocol did not increase costs and was readily accepted by anaesthetic staff. The more selective use of arm splints was not associated with an increased incidence of bleeding or wound damage.

Commentary

This study demonstrates that standardised intraoperative analgesia can reduce PACU length of stay following cleft palate repair. Substantial reductions in total PACU time were compromised by prolonged wait times between being ready for PACU discharge and ward admission. Interestingly, pain outcomes did not improve significantly with the different interventions, possibly reflecting limitations of FLACC scoring in distinguishing pain from distress, agitation, and hunger in this patient group.

The authors acknowledge that regional anaesthetic techniques such as suprazygomatic maxillary nerve blocks may represent an opportunity for prolonging time to first rescue analgesia. However, they were not incorporated into the study due to infrequent use at the study institution. Balancing measures were reassuring, with no observed increase in bleeding or wound complications.

Take home message

Standardised anaesthetic intraoperative analgesia, including paracetamol, parecoxib and clonidine was shown to be associated with a reduction in PACU length of stay and post-operative respiratory events following cleft palate repair. The addition of selective use of arm splints and replacement of clonidine with dexmedetomidine infusion was not associated with a further reduction in PACU length of stay.

This paper provides a practical and transferable framework for centres seeking to optimise postoperative recovery in this population.

Given the sequential quality improvement design, the observed improvements should be interpreted as associations rather than evidence of direct causality. The findings are most appropriately viewed as reflecting the cumulative effect of pathway standardisation and evolving practice over time, rather than the isolated impact of individual interventions.

Reviewed by Dr Tom Walker

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Comparison of analgesic efficacy and safety of caudal dexmedetomidine versus intranasal dexmedetomidine in paediatric infraumbilical surgeries : A randomised controlled trial

Agarwal, Ayushi et al. European Journal of Anaesthesiology 42(10):p 899-906, October 2025. | DOI: 10.1097/EJA.0000000000002228

Summary

This randomised, double-blind non-inferiority trial compared the analgesic efficacy and safety of caudal dexmedetomidine versus intranasal dexmedetomidine as an adjunct to a single-shot caudal block in children aged 1-8 undergoing infraumbilical surgery. The primary outcome was the duration of postoperative analgesia. Secondary outcomes included postoperative pain (FLACC), intra-operative fentanyl requirement, haemodynamics, postoperative sedation, emergence delirium, recovery profile, and 24 hour side effects.

A total of 64 children were randomised (32 per group) with no dropouts. Both groups received 0.2% ropivacaine 1 mL.kg⁻¹ caudally; Group C additionally received caudal dexmedetomidine 1 µg.kg⁻¹ and intranasal saline, whereas Group N received intranasal dexmedetomidine 1 µg.kg⁻¹.

The duration of postoperative analgesia was similar between groups (545 ± 90 min intranasal vs. 527 ± 83 min caudal, P = 0.422). Postoperative FLACC scores were comparable at most time points, though marginally higher at 6 h and ward arrival in the caudal group. Intra-operative fentanyl supplementation and 24 hour paracetamol use were similar.

Haemodynamics were mostly comparable, although the caudal group demonstrated more episodes of intra-operative hypotension (P = 0.016) without requiring vasopressors. Sedation scores were higher in the caudal group for the first 2 hours postoperatively, but recovery times and Modified Aldrete scores were similar. No adverse events (PONV, urinary retention, bradycardia, desaturation, respiratory depression, motor block) were reported in either group.

Commentary

Dexmedetomidine has become a commonly used analgesic adjunct in paediatric anaesthesia, with both caudal and intranasal routes increasingly utilised. This study is valuable in directly comparing the two methods when used alongside a caudal block, which is an evidence gap previously noted in the literature.

Overall, this well-designed noninferiority trial demonstrates that intranasal dexmedetomidine at 1 µg.kg⁻¹ provides postoperative analgesia equivalent to caudal dexmedetomidine when used as an adjunct to a single-shot caudal block in infraumbilical surgery. Intranasal administration

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avoided the transiently higher sedation and hypotension seen in the caudal dexmedetomidine group and produced a similarly smooth recovery profile, suggesting it may be a useful alternative route, particularly when minimising haemodynamic fluctuation or sedation is desirable.

However, several limitations warrant consideration. The study does not report cumulative intra-operative anaesthetic dosing, which represents a potential confounder for both the sedation profile and recovery characteristics. The proposed mechanism of action of caudal dexmedetomidine is direct action on the spinal nerves, whereas intranasal works by systemic absorption, possibly providing a degree of sedation and reduction in anaesthetic requirements. The observed difference in early postoperative sedation could therefore relate, at least in part, to variations in anaesthetic depth rather than the route of dexmedetomidine administration.

Another limitation is that the homogeneous, predominantly male, urogenital surgical population limits generalisability. Hernia repair, for example, is a common neonatal procedure where caudal anaesthesia is frequently used, and comparative data in this younger cohort would be clinically meaningful.

Furthermore, although no adverse events were observed, the sample size (64 patients) is insufficient to draw any robust conclusions regarding safety, particularly for rare but clinically important complications. Patient or carer centred outcomes such as satisfaction or quality of recovery were also not captured and would have strengthened the clinical relevance of the findings.

Future trials could examine pharmacokinetic comparisons between routes, include larger and more diverse paediatric populations, and address measures of parental satisfaction with both techniques. While this trial supports intranasal dexmedetomidine as a potentially feasible alternative to caudal administration, the small sample size and limited generalisability mean that practitioners who routinely use caudal dexmedetomidine may reasonably await further evidence before altering their current practice.

Reviewed by Dr Matt Hart

Effects of Dexmedetomidine-Remifentanyl on Neurodevelopment of Children after Inhalation Anesthesia : A Randomized Clinical Trial

Ji, Sang-Hwan et al, *Anesthesiology* 143(4):p 827-834, October 2025. | DOI: 10.1097/ALN.0000000000005634

Overview/Summary:

This prospective, double-blind RCT compares the neurodevelopmental effect of a single GA exposure using different doses of sevoflurane in children under 2 years of age. Children were

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randomised to two different GA techniques: sevoflurane alone or lower-dose sevoflurane in combination with dexmedetomidine and remifentanyl infusions. The results of the neurodevelopment assessment at 30 months of age are reported in this paper. The primary outcome of Full-Scale IQ assessment at 5 years of age will be reported at a later date.

Methods:

The participants were ASA 1 or 2 children between 1 month and 2 yrs of age undergoing GA for elective, nonstaged and nonrepetitive procedures (urologic, orthopaedic, general, plastic, otolaryngologic, and thoracoscopic surgeries). Exclusion criteria included a history of previous GA, known genetic or chromosomal abnormalities, developmental delay, and a range of major medical conditions. Participants were withdrawn from the study if an additional GA was required during the follow up period.

Following IV induction with thiopentone and rocuronium, both groups received maintenance anaesthesia with sevoflurane. From induction through to the end of surgery, the DEX-R group received dexmedetomidine (1 mcg/kg loading dose, followed by 1 mcg/kg/hr) and remifentanyl (0.1-0.2 mcg/kg/min), whereas the control group received normal saline at equivalent volumes. In both groups, sevoflurane concentration was adjusted to maintain BIS values 40-60. Participants were assessed at approximately 30 months of age using the Korean version of the Leiter International Performance Scale (standardised nonverbal intelligence assessment tool, administered by a clinical psychologist) and the Child Behaviour Checklist (completed by a primary caregiver)

Results:

- A total of 400 participants were randomised; 345 participants were included in the final analysis (12 had unexpected additional surgeries, 42 lost to follow-up, 1 did not complete full developmental testing for unexplained reasons)
- No significant differences between groups in terms of baseline participant characteristics (mean age approximately 11 months); parental age, educational level and socioeconomic status; distribution of surgical types; duration of anaesthesia (approximately 75 minutes) or surgery; or mean BIS values
- The control group received significantly higher mean end-tidal sevoflurane concentration (2.6% +/- 0.6% vs 1.8% +/- 0.5%, $p < 0.001$)
- No significant difference between the groups in any of the measured neurodevelopment outcomes
- DEX-R group demonstrated lower HR and systolic BP. Only one patient in each group received vasoactive medication

Context of this study:

The important issue of whether GA causes relevant neurotoxicity in children can only be properly addressed with RCTs, as these minimise the effect of confounding factors. However, as GA is

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usually required for surgery in children, there are limited clinical scenarios in which children can be randomised to GA vs no GA. To date, the GAS trial is the only RCT comparing GA vs no GA exposure. The GAS trial randomised infants having inguinal hernia repair to GA (median GA duration of 54 minutes) or awake regional anaesthesia and found no difference in neurodevelopment outcome at 5 years of age.

The CF-GAIN study evaluated children with cystic fibrosis randomised to care with differing exposure to GA in early childhood. The study enrolled children who previously participated in an RCT comparing bronchoalveolar-lavage (BAL)-directed therapy (requiring repeated GAs) to standard therapy (not requiring repeat GAs) up until 5 years of age. There were no differences in neurodevelopmental outcome between the groups at approximately 13 years old despite the BAL-directed group undergoing more GA exposures in early childhood.

The RCT discussed in this review adds to the literature by evaluating the neurodevelopmental effect of a single exposure to standard- vs lower-dose sevoflurane GA. The TREX trial, the primary results of which will be reported in the next few years, has a similar trial design, albeit with longer GA duration.

Strengths:

- This trial addresses a topic of great public interest.
- It is only the second RCT designed to specifically address the neurotoxicity of sevoflurane GA in young children.

Limitations:

- There was limited separation of treatment (i.e. difference in sevoflurane concentration) between the low dose sevoflurane group and control group (mean end tidal sevoflurane concentration of 1.8% vs 2.6%). This separation is significantly less than what was achieved in the TREX trial (end tidal sevoflurane concentration 0.8% vs 2.5%). This limited dose difference may be insufficient to see an effect.
- 30 months old is relatively young for assessing neurodevelopment. Assessment at 5 years old (primary outcome) may be more sensitive for detecting neurodevelopmental differences, with the potential downside of losing more patients to follow up at this later stage.
- This study does not address the potential neurotoxicity of longer sevoflurane GAs (i.e. > 2 hours), or propofol-based GAs.

Take home message:

The preliminary results of this trial found no neurodevelopmental differences at 30 months of age between young children exposed to a single lower-dose sevoflurane GA (supplemented with dexmedetomidine and remifentanyl) compared with a single standard- dose sevoflurane GA.

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These results show no evidence that lower-dose sevoflurane GA is less neurotoxic, or that dexmedetomidine or remifentanyl are neuroprotective in this setting.

The primary outcome results of this trial (to be assessed at 5 years of age) and the similar TREX RCT are awaited.

Reviewed by Dr Andrew Hughes

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