Complications in Pediatric Regional Anesthesia

Benjamin J. Walker, Justin B. Long, Madhankumar Sathyamoorthy et al. J Neurosurg Pediatr. 2018;22:165–172

The low incidence of complications in regional anaesthesia makes quantifying risk difficult. This prospective, multi-centered observational study looked at complications of regional anaesthesia for 104, 393 blocks in the Pediatric Regional Anesthesia Network database between 2007 and 2015.

All blocks were performed or supervised by an anaesthetist, the majority of which under general anaesthesia (93.7%). Eighty-five percent placed in ASA 1-2 patients with an age range from neonates (1%), infants (23%) and children.

Caudals were the commonest block, followed by femoral, sciatic, popliteal and then supraclavicular block. Of those blocks utilizing a catheter epidural and caudal were most common. Higher ASA score was not associated with increased neurological complication.

25 patients were reported to have a neurologic complication (2.4:10,000) and 4 of these patients had multiple blocks. These were mainly sensory of which only 2 cases lasted longer than 3 months and no permanent motor deficit was recorded.
The risk was higher in children over 10 years old, possibility due to difficulties in diagnosing complications in young children, and higher in patients having blocks placed awake or under sedation (odds ratio 2.93, $P<0.01$). There was no difference between peripheral or neuraxial block or when using a catheter as compared to a single injection technique.

Of the 7 cases of LA toxicity, 3 were in children less than 6 months old. 4 presented as cardiac arrest and 3 with seizures. 11 additional cases of mild LA were reported in the post-op period.

These results confirm the safety of regional anaesthesia, even when performed asleep and will help to inform risk stratification when consenting parents.

Reviewed by: Paul Stevens

Introduction of severe traumatic brain injury care protocol is associated with reduction in mortality for pediatric patients: a case study of Children's Healthcare of Atlanta's neurotrauma program

Andrew Reisner, Joshua J. Chern, Karen Walson, et al. J Neurosurg Pediatr. 2018;22:165–172

The authors retrospectively reviewed the impact of introducing TBI treatment guidelines for all trauma patients with severe TBI, defined as a GCS of 8 or below, at 2 tertiary care centres. They compared patients pre and post implementation of guidelines, looking at mortality, length of time of raised ICP, hospital stay and time ventilated.

Data was collected from patients admitted between May 2009 to March 2011 (n=71) preimplementation and from April 2011 to March 2014 post implementation (n=121).

The two groups had similar demographics, mainly male, 59.1% vs 69.4%, mean ages of 6.4yrs vs 6.6yrs, mean Injury Severity Scores of 25.8 vs 23.8 and mean admission GCS scores of 5.1 vs 5.5.

Both groups had similar mean lengths of hospital stay and days ventilated. More patients in the post-guideline group had EVDs inserted (69% vs 54%, p=0.037) and underwent neurosurgery in the first 24hrs following admission (45% vs 27%, p=0.01).

The post-guideline cohort had significantly reduced times with a high ICP. ICPs were above 20mmHg 26.3% of the time pre-guideline introduction but only 15% of the time post (p=0.001) and above 40mmHg 14.7% of the time pre and 6.4% of the time post (p<0.001).

Mortality was significantly reduced from 32% to 19% (p=0.04) although survivor functionality (WeeFim scores) were similar.

The introduction of guidelines may have reduced practise variability and resulted in more stringent patient monitoring. Improved outcomes may be related to general improvements in care but this is unlikely over the relatively short time scale of the study.

Reviewed by: Paul Stevens

Clinical and echocardiograph risk factors for extubation failure with congenital diaphragmatic hernia

Schroder L, Reuter H, Gembruch U, et al. Pediatric Anesthesia. 2018;00:1-9.

This study sought to determine risk factors for failed extubation in children following congenital diaphragmatic hernia repair. It was conducted at the University Children's Hospital of Bonn, retrospectively analyzing 34 patients over a two-year period. An experienced neonatologist performed echocardiography within 48 hours of the initial extubation, and if this failed was repeated within 48 hours of the final extubation.

Pre-operatively, children were treated according to standardized parameters for ventilation, mean arterial pressure and pulmonary hypertension management. All patients received inhaled nitric oxide (iNO) pre-operatively. The timing of surgical repair was based on further standardized physiological targets and was performed at a mean of 7 days.

Appropriateness for extubation was not standardized but was based on the judgment of NICU physician. Mean extubation was performed at 7 days post-operatively. All children were extubated to CPAP with supplemental oxygen, with some requiring non-invasive support.

Reintubation criteria were standardized, and any performed within 72 hours of the original extubation was defined as extubation failure.

Thirty-five percent of children failed extubation. This was significantly associated with lower gestational age, high liver hernation rates, lower lung:head ratios prenatally, and higher ECMO requirements. This group was also significantly associated with higher ventilator requirements, hypercapnia, lower pre/postductal saturations and pleural effusions. Children who failed extubation had significantly higher rates of pulmonary hypertension, cardiac dysfunction, Sildenafil, iNO administration, duration of intubation, inotropic requirement and overall length of stay. Patch repair was significantly associated with failed extubation. The only significant differences between parameters for first and final extubation attempt were the rates of cardiac dysfunction and oxygenation. The authors acknowledge that study limitations might include retrospective design and small sample size.

Reviewed by: Victoria Buswell

Medication errors in a pediatric anesthesia setting: Incidence, etiologies, and error reduction strategies

Leathy I, Lavoie M, Zurakowski D, et al. Journal of Clinical Anesthesia. 2018;49:107-111

This is a retrospective study conducted at Boston Children's Hospital, USA. The authors examined all anaesthetic medication errors over an 8 year period, totaling 280, 000 cases. Prior to 2012 this was done by manually reviewing anaesthetic charts, after 2012 it was via the introduction of a self-reporting programme. During the study period, a number of safety measures were introduced including a Medical Safety Programme, a paediatric drug library for infusion pumps, increased pharmacy support including premixed syringes for some drugs, increased clinician drug checks and a 'zero' tolerance policy for errors.

105 medication errors were observed in 287, 908 cases. The majority of these (94/105) were self reported errors. Incidence of errors reduced from 7 per 10, 000 cases in 2009, to an average of 2.2 per 10 000 cases after 2012 (69% reduction). The fall in errors was not statistically significant before 2011 or in the year 2014, but was significant for all other years. Logistic regression suggested a 13% reduction in errors per year in the odds of an error occurring (p=0.004). The majority of errors were due to incorrect dosing (55%) or administration of the incorrect drug (28%).

The authors suggest that a proactive approach to error prevention is superior to reporting and discussing errors. They discuss the fine balance between punishment and blamelessness when adopting a 'zero tolerance' policy, however noted that self-reporting actually increased after the introduction. They also acknowledge the limitations of the study including a lack of control group and inconsistencies in the way physicians report errors. The authors conclude that whilst cause

and effect cannot be proven, the study highlights components of a successful medical safety programme as well as improvement in the rate of drug errors in a single institution.

Reviewed by: Victoria Buswell

Short-Term Neurodevelopmental Outcome in Congenital Diaphragmatic Hernia: The Impact of Extracorporeal Membrae Oxygenation and Timing of Repair

Danzer E, Hoffman C, D'Agostino J, et al. *Pediatric Critical Care Medicine* 2018; 19(1):64-74

This retrospective single centre study aimed to identify the neurodevelopmental difference in children with congenital diaphragmatic hernia undergoing ECMO who underwent repair on ECMO versus post-ECMO.

Methods: A retrospective review between June 2004 and February 2016 of children with congenital diaphragmatic hernia. All patients' perinatal and postnatal care was standardized to the unit policy. ECMO was indicated for hypoxia or hypotension refractory to inotropic support. Neonates less than 34 weeks or <2kg were excluded. The surgeon determined the timing of surgery. Neuro developmental outcomes were determined using the Bayley Scales of Infant Development and clinical evaluation.

Results: 212 children were included and assessed for neurodevelopmental findings at a median age of 22 months. Of those, 50 children mandated ECMO with 4 children being repaired pre-ECMO, 25 on ECMO and 21 children post-ECMO. Children requiring ECMO had lower neurodevelopmental scores than the general population. Children repaired on ECMO more likely to need a patch repair. They were more likely to develop neuromuscular hypotonicity and persistent pulmonary hypertension. They scored lower on their cognitive, language (receptive, expressive), motor (fine and gross) on neurodevelopmental testing. Children repaired within 8 days of being on ECMO did not differ in their neurodevelopmental scores or neurological hypotonicity than those repaired after day 8. Children who were repaired off ECMO had better neurodevelopmental outcomes. The authors suggest that delayed correction once off ECMO would decrease the chance of developing poor neurodevelopmental problems.

Reviewed by: Christa Morrison

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

Suresh S, Ecoffey C, Bosenberg A, et al. *Regional Anesthesia and Pain Medicine* 2018; 43(2):211-216

This practice advisory is a joint collaboration by ESRA and ASRA with the aim to establish best evidence for doses for local anaesthetics and adjuvants for regional anaesthesia.
Methods: A systematic review of the literature was performed and best evidence collated. Committee members gave expert opinion when no evidence was found.

Results: Local anaesthetics metabolism is not fully developed for bupivacaine until the age of 3 and for ropivacaine the age of 8.This means that their clearance is less. Due to the higher volume of distribution, cardiac output and volume of CSF LA's have shorter duration of action. Spinal anaesthetic drugs include Tetracaine, Bupivacaine and Ropivacaine with dose according to weight. A ¼ of children receive more than the recommended dose during caudal anaesthesia. Dosing should be according to the Armitage scale within the toxic limits. Ropivacaine/bupivacaine/levobupivacaine can all be used. Epidural continuous infusion dose is modified according to age. Bupivacaine/Levobupivacaine, Ropivacaine and Chloroprocaine can all be used. For upper limb, lower limb peripheral nerve blocks Bupivacaine and Ropivacaine can be used as a single dose or continuous infusion. Fascial plane blocks can be as a single shot or continuous infusion with limited data on dosing. Adjuvants include Clonidine, morphine and dexmedetomidine can all be used including the later for peripheral nerve blocks. Ketamine should be avoided intrathecallly in neonates/infants due to neuronal apoptosis. There is a lack of evidence for synthetic opioids and corticosteroids.

Reviewed by: Christa Morrison