1. Ventilation in Extremely Preterm Infants and Respiratory Function at 8 years

Doyle LW, Carse E, Adams AM, et al. Victorian Infant Collaborative Study Group

New England Journal of Medicine 2017; 377(**4**): 329-337

The aim of this longitudinal follow-up study was to look at the effect of changes in assisted ventilation and oxygen therapy across 3 time periods. This study hypothesised that the respiratory outcomes of extremely preterm infants (<28 weeks of gestation) improved over time, with less oxygen dependence and improved lung function at 8 years of age.

The authors note that assisted ventilation has evolved significantly since the 1970s and various medical advances in forms of non-invasive ventilation (e.g. nasal CPAP) are perceived as being less damaging to immature lungs versus endotracheal ventilation.

The team recruited all surviving extremely preterm infants born in Victoria, Australia in three periods: 1991-1992 (n=225), 1997 (n=151) and 2005 (n=170) at birth and followed them longitudinally. Data were collected prospectively and included duration and type of assisted ventilation, duration of oxygen therapy, and oxygen requirement at 36 weeks. Expiratory airflow was measured at 8 years of age, with correction for prematurity and the respiratory clinicians were blinded to clinical details of the participants.

There was an increase in the duration of assisted ventilation with time and particularly an increase in the duration of nasal CPAP. Though less invasive ventilation increased over time, the duration and the rate of oxygen dependence at 36 weeks rose, and the airflows at 8 years of age were worse in the 2005 cohort than in earlier periods.

It is possible that the threshold for commencing nasal CPAP may be low due to its non-invasive nature and prolonged periods of oximetry may also lead clinicians to intervene unnecessarily. The assumption that nasal CPAP is less injurious than endotracheal ventilation is incorrect.

2. Premedication with salbutamol prior to surgery does not decrease the risk of perioperative respiratory adverse events in school-aged children

Ramgolam A, Hall GL, Sommerfield D, et al.

British Journal of Anaesthesia 2017; 119(**1**): 150-157

This single centre, double-blinded randomised controlled trial investigated whether inhaled salbutamol premedication decreases perioperative respiratory adverse events (PRAE) compared with children receiving placebo in children at risk of PRAE; PRAE being the most common cause of paediatric anaesthetic complications.

The study recruited children undergoing elective surgery between the ages of 6-16 years of age. All had at least two parentally reported risk factors for PRAE. Participants were randomised to receive pre-operative salbutamol 0.2mg or a placebo. Conduct of anaesthesia was left to the discretion of the attending anaesthetist though all the children had maintenance with sevoflurane via an LMA.

Complete datasets from 462 children (median age 12 years) were analysed. There was no statistical difference in episodes of PRAE observed between the two groups. *Post hoc* analysis showed that children in the salbutamol group who had PRAE spent significantly less time (12 less minutes) in the PACU when compared with PRAE children in the placebo group.

The investigators concede that the use of sevoflurane may have provided baseline bronchodilation. They also accept the median age of the children in this study was higher than that associated with the greatest incidence of PRAE. Also anaesthetists were aware the population were at increased risk of PRAE and may have adjusted their anaesthetics accordingly. They conclude premedication with salbutamol for children between 6 and 16 years and at high risk of PRAE did not reduce the risk of PRAE.

3. Cerebral Oxygen Saturation in Children with Congenital Heart Disease and Chronic Hypoxemia

Kussman BD, Laussen PC, Benni PB, et al.

Anesthesia and Analgesia 2017; 125(1): 234-240

Near-infrared spectroscopy (NIRS) offers non-invasive, real-time monitoring of tissue oxygenation, with cerebral figures mostly between 63 and 84% representing the venous compartment. This study aimed to look at the association between cerebral tissue oxygen saturations (ScO_2) and arterial-cerebral oxygen saturation difference with arterial oxygen saturations and Hb in children with congenital heart disease (CHD). They hypothesised that cerebral tissue saturations are within normal range and the difference with arterial saturations is reduced due to a raised Hb.

Children undergoing elective cardiac catheterisation between the ages 1 month and 18 years were recruited at a single American centre between June 2008 and July 2009.

57 Children were included in the study the majority of which underwent catheterisation under general anaesthesia with bilateral NIRS probes applied. Simultaneous samples from arterial and jugular venous bulb were taken for co-oximetry, calculation of ScO_2 and estimation of cerebral oxygen extraction (COE). COE estimated by the difference between arterial and jugular bulb O_2 content was not different for cyanotic and acyanotic patients.

Children with compensated chronic hypoxaemia should have ScO_2 values within the normal range. A low ScO_2 baseline should not be interpreted as normal and the cause should be considered. The haemoglobin is of greater importance in cerebral O_2 delivery in the cyanotic child and the threshold for transfusion should be appropriate to this.

4. Using quality improvement methods to reduce clear fluid fasting times in children on a preoperative ward

Newton RJG, Stuart GM, Willdridge DJ, et al.

Pediatric Anaesthesia 2017; 27: 793-800

With MRI and ultrasound evidence that there is no difference in the gastric volume if starved for 1 hour or 2 hours of fluids, rare aspiration rates in children and less morbidity secondary to aspiration compared with adults, a single centre set a target for 75% of children to have clear fluids within 4 hours prior to surgery when admitted on the day of surgery. This was a QI project conducted over 2 years. Initial audits facilitated a key driver diagram. A failure modes and effects analysis (FMEA) process map was also developed.

Key interventions: 1. Correct information about fasting times to parents; revision, unification and standardisation of preoperative letters for parents and a phone call service to families the night before surgery to reinforce fasting advice. 2. Accurate record keeping so further improvements could be seen. Reductions in clear fluid fasting times were small with these 2 interventions. The third intervention was introduction of drinks on arrival to hospital with adoption of a 1-hour clear fluid standard operating procedure. Volumes were based on age bandings. An electronic dashboard highlighted children with fast times over 4 hours and ward staff were empowered to call theatres for permission to offer a drink.

Results: Initially only 19% of children were clear fluid fasted for under 4 hours; mean fluid fasting time 6.3 hours (SD 4.48). End of study 72% of children received drink within 4 hours; mean fluid fasting reduced to 3.1 hours (SD 2.33). There was no increase in aspirations or cancellations reported since introduction of the changes.

5. Development and Validation of a Risk Scale for Emergence Agitation After General Anesthesia in Children: A Prospective Observational Study

Hino M, Mihara T, Miyazaki S, et al.

Anesthesia & Analgesia 2017; 125(**2**): 550-555

Article on the development and validation of a predictive emergence agitation (EA) risk scale for incidence of EA in children receiving sevoflurane anaesthesia. This was a Japanese study with retrospective analysis of phase 1 data (120 children) and a prospective observational phase 2 (100 children). Phase 1 looked at ASA 1-2, children (1.5-8 years) undergoing GA. Induction agents: sevoflurane & nitrous oxide. Maintenance: sevoflurane. No premedication. Analgesia: paracetamol, fentanyl +/- nerve block. Trained personnel determined the incidence of EA using the Pediatric Anaesthesia Emergence Delirium (PAED) scale. From 10 predictors of EA, through logistic regression analysis and stepwise selection, 4 were determined to provide the optimal combination

to predict EA and assigned a score (age, paediatric anaesthesia behaviour score, anaesthesia time and operative procedure). These formed the EA risk scale, 1 – 23 points. The predictive ability of the EA risk scale was assessed by a receiver operating characteristic (ROC) curve. The area under the ROC curve (c-index) was calculated with a 95% confidence interval (CI).

The incidence of EA was 34.2% in phase 1 and 39% in phase 2. The c-index of phase 1: 0.84 (95% CI, 0.74–0.94), and the c-index of phase 2: 0.81 (95% CI, 0.72–0.89). Best cut-off point EA risk scale was 11 (sensitivity = 87% and specificity = 61%). The gray zone was 10-13 points and represented 38% of patients. The c-index exceeded 0.8 and 62% of patients were outside the gray zone, where sensitivity and specificity of predicting EA went over 90%. However, single centre, small size study and needs validity testing outside this hospital. Cause of EA not determined, only used for predicting agitation not delirium and no time component of EA in study.

6. **Effects of intraoperative liberal fluid therapy on postoperative nausea and vomiting in children—A randomized controlled trial**

Ashok V, Bala I, Bharti N, et al.

Pediatric Anesthesia 2017; 27: 810–815

This was a randomized controlled trial conducted in India. 145 ASA 1 children undergoing general anaesthesia for lower abdominal and penile surgery less than 60 minutes, age 3 -7 years, were assigned to the “Restricted group” (10 mL kg−1 h−1) or the “Liberal group” (30 mL kg−1 h−1) with Ringer's lactate solution intraoperatively. The children had standard starvation times of 6hours for food and 2hours for water, and analgesia was by caudal block and intravenous paracetamol, with no opioids, antiemetics or muscle relaxants being administered. Anaesthesia was maintained with 0.5-2% sevoflurane and 60% N_20. Assessors in the 24 hours post-operatively were blind to group allocation.

The incidence of vomiting was significantly less in the liberal group (27.4%) compared to the restricted group (45.8%) (RR 0.59, 95% CI: 0.38-0.93, P=.021). The adjusted odds ratio of PONV for the liberal group vs. restricted group was 2.24 (95% CI: 1.12-4.48, P=.022). Within the first 6 hours postoperatively fluid intake was significantly higher in the restricted group. 83% of children in the restricted group complained of thirst as compared to 17% children in the liberal group (RR 0.19, 95% CI: 0.18-0.33, P=.0001). Pain scores and rescue analgesia were comparable between the groups. Parental satisfaction was higher in the liberal group and there were no complications noted secondary to liberal fluid intake.

Conclusion: 30 mL kg-1 h-1 fluid Intraoperatively for lower abdominal and penile surgeries resulted in significantly less PONV and thirst post operatively than 10 mL kg-1 h-1.

7. Effects of intravenous fentanyl around the end of surgery on emergence agitation in children: Systematic review and meta-analysis

Kim N, Park JH, Lee JS, et al.

Pediatric Anesthesia 2017; 27: 885-892

Fentanyl has been proposed as an agent to prevent emergence agitation (EA). However its efficacy and disadvantages for this purpose have not been fully reviewed. **Aim**: Primary end point: To determine whether the use of fentanyl around the end of surgery reduces the incidence of EA. Secondary end points: to determine whether administering fentanyl at this time effects awakening time, recovery time and PONV. **Methods:** Literature search of randomised controlled trials comparing intravenous fentanyl 1mcg/kg and placebo towards the end of surgery to prevent EA, 0-14years. All trials used sevoflurane maintenance anaesthesia and the incidence and severity of EA were assessed by various scales including the paediatric anaesthesia emergence delirium (PAED) scale and 5-step emergence agitation scale (EAS). **Results:** 10 randomised controlled trials were analysed (718 patients, 357 of them received fentanyl). Overall fentanyl towards the end of surgery significantly reduced the incidence of EA (EA: relative risk 0.43, 95% CI 0.35 to 0.53, I^2=0.0%; severe EA: relative risk 0.50, 95% CI 0.31 to 0.81, p=.005, I^2=0.0%). Fentanyl at the end of surgery was associated with an increase in recovery time (weighted mean difference 6.09, 95% confidence interval 2.77 to 9.41, I^2=58.6%) and significant increase in PONV (relative risk 2.61, 95% confidence interval 1.58 to 4.33, I^2=32.4%). However fentanyl 10-20minutes before the end of surgery was *not* associated with increased recovery time (weighted mean difference -1.15, 95% CI -5.15 to 2.85, I^2=89.0%) or increased PONV (relative risk 1.32, 95% CI 0.66 to 2.66, I^2=0.0%).

Conclusion: Fentanyl towards the end of surgery reduced the incidence of EA after sevoflurane anaesthesia. Administering it 10-20 minutes before the end meant PONV was not increased and EA was still reduced. With comparable prevention to propofol, fentanyl adds analgesia.

8. The role of ultrasound in appropriate endotracheal tube size selection in pediatric patients

Altun D, Orhan-Sungur M, Ali A, et al.

Pediatric Anesthesia 2017; 27(**10**): 1015-1020

Aim: A prospective study to investigate the role of ultrasound in determining the appropriate paediatric cuffed endotracheal tube (ETT) sizes compared with more conventional formulas using height and age. **Methods:** Patients aged 1-10 years old, undergoing general anaesthesia for adenotonsillectomy were enrolled. During apnoea the transverse diameter of the subglottic area at the level of the cricoid cartilage was measured using ultrasound and used to choose the outer

diameter of ETT. An age-based (Motoyama-Khine) and height-based (Broselow) ETT size was calculated for each child and recorded. The ETT was replaced with internal diameter (ID) 0.5mm smaller if there was resistance to passage or an airway pressure >25 cmH_20 was required to detect a leak and replaced with a 0.5mm larger ETT if there was a leak at airway pressure <10 cmH_2O, peak pressure >25 cmH_20 or a cuff pressure > 25 cmH_2O required to form a seal. The best-fit tube met these criteria. **Results:** 152 patients were analysed. 88% of ultrasound determined ID ETTs were the same as best-fit ETTs. There was a better correlation between best-fit ETT and ultrasound determined ETT size than with conventional formulas. Broselow tape calculated ETTs were in better agreement with ultrasound selected ETTs than age-based decisions. 14 patients needed their ETT upsizing, and 4 patients needed their tube down sizing. There is no data on postoperative respiratory complications. **Conclusions:** Ultrasound is more likely to underestimate ETT size than over estimate, which allows for the cuff bulk. The ultrasound measured subglottic diameter predicted the best-fit ETT more reliably than conventional age and height based formulas.

9. What do recent human studies tell us about the association between anaesthesia in young children and neurodevelopmental outcomes?

O'Leary JD and Warner DO

British Journal of Anaesthesia 2017; 119(**3**): 458-464

Aim: To provide an overview of the pre-clinical and clinical literature focusing on new evidence since 2015 and provide an insight into the application of these findings to paediatric anaesthetic practice.

Pre-clinical evidence: Most experimental models have shown neurotoxicity following anaesthesia exposure in infant animals, but a specific pathway has not been identified. Cell age has been suggested as a central factor for anaesthesia neurotoxicity and parts of the brain undergoing neurogenesis may be particularly vulnerable throughout childhood and not just during infant brain development. Raper et al. and Coleman et al. found that infant macaques exposed to sevoflurane and isoflurane for greater than 3hrs showed increased anxiety at 6 months (Raper) and motor reflex deficits at 1 month (Coleman) and again anxiety at 12 months of age (Coleman).

Clinical Studies: The GAS and PANDA Study showed that relatively short sevoflurane anaesthesia during infancy does not negatively affect neurodevelopmental outcomes by 2 years of age (GAS) and by 8-15 years (PANDA). However, Canadian and Swedish studies found that both single and multiple exposures to anaesthesia show a tendency to worse neurodevelopmental outcomes compared to unexposed children. Although in the Canadian studies, age of exposure and dose-response were not factors, which could indicate confounding, and the 2 Canadian studies found different areas of neurodevelopment were affected.

Conclusions: Any effects demonstrated are modest and there is no evidence that the risk is greater in younger children. Any risk appears to be much smaller than other factors such as maternal education level and sex, though anaesthesia is a potentially modifiable factor.

10. Videolaryngoscopy versus Fiber-optic Intubation through a Supraglottic Airway in Children with a Difficult Airway: An Analysis from the Multicenter Pediatric Difficult Intubation Registry

Burjek NE, Nishisaki A, Fiadjoe JE, et al.

Anesthesiology 2017; 127(**3**): 432-440

Aim: This observational multi-centre study compared first attempt intubation success rates of fiber-optic intubation through a supraglottic airway (FOI-SGA) with videolaryngoscopy in children with predicted difficult airways. A secondary outcome was complication rates of both techniques. Methods: Data was extracted from the Pediatric Difficult Intubation (PeDI) Registry with entries from 14 American hospitals, 2012-2015. 2 subgroup analyses were also planned; where FOI-SGA or videolaryngoscopy was the first equipment used (no direct laryngoscopy preceding), and children under 1 year.

Results: 114 FOI-SGA and 786 videolaryngoscopy patients. They had similar first attempt success rates (59% FOI-SGA vs. 51% videolaryngoscopy; odds ratio 1.35; 95% CI, 0.91 to 2.00; P = 0.16). In those less than 1 year of age FOI-SGA was more successful than videolaryngoscopy (54% vs. 36%; odds ratio, 2.12; 95% CI, 1.04 to 4.31; P = 0.042, and still significant when adjusted for confounding factors). The complication rates were similar.

Conclusions: First attempt success of intubation is higher with FOI-SGA than with videolaryngoscopy in infants with difficult airways, but across all ages, they had similar first attempt success rates. Perhaps the difference is apparent in infants because an excellent view with videolaryngoscopy does not remove the difficulty positioning a tube with an anterior larynx and long floppy epiglottis.

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