

Anaesthesia Research Review™

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Issue 19 - 2021

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Abbreviations used in this issue:

AAGBI = Association of Anaesthetists of Great Britain and Ireland;
ASA = American Society for Anesthesiologists; **BMI** = body mass index;
CI = confidence interval; **COVID-19** = coronavirus disease 2019;
ICD-10 = International Statistical Classification of Diseases and Related Health Problems 10th Revision; **NAP** = National Audit Projects;
OR = odds ratio; **RR** = relative risk.

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Welcome to issue 19 of Anaesthesia Research Review.

The COVID-19 pandemic has shaken the world profoundly, affecting virtually everybody. Research institutions and researchers have certainly felt its impact as well, bringing unforeseen challenges due to social distancing, keeping researchers away from their lab spaces, and delaying projects by months. Even the funding landscape for research is more unstable than ever. While the pandemic has wreaked havoc with research timelines, one positive outcome is that public trust in the work of researchers and science has increased more than ever, confirming its important role in society. As shown in this issue of Anaesthesia Research Review, a stream of research on anaesthesia topics still finds its way to the publisher. We are indebted to our anaesthesia staff for devoting their time to comment on some of the recently published articles. We hope you will enjoy reading their choices.

Kind Regards,

Professor André van Zundert

andre.vanzundert@researchreview.com.au

Thermal suit connected to a forced-air warming unit for preventing intraoperative hypothermia: A randomised controlled trial

Authors: Lauronen S-L et al.

Summary: This randomised, prospective clinical trial looked at whether forced-air warming (FAW) units connected to thermal suits are better at preventing intraoperative hypothermia during breast resection or unilateral mastectomy compared to commercial FAW blanket and warming mattress in 40 patients under general anaesthesia. All patients received FAW intraoperatively set to 38°C after surgical draping with an additional warming mattress set to 37°C for the hospital gown group. Core and skin temperatures were continuously measured up to 1 hour post-operatively with zero-heat-flux sensor and skin temperature probes. There were no differences in mean core temperatures at anaesthetic induction or admission to recovery room (primary endpoint), but intraoperatively (secondary endpoint) 1 (5%) patient in the thermal suit group became hypothermic compared to 6 (32%) in the normal hospital clothes group ($p = 0.04$; 95% CI 1.9-49). Mean skin temperatures were higher among the thermal suit group during anaesthesia and two patients sweated.

Comment: (Dr Tonchanok Intaprasert) Intraoperative hypothermia is common, as patient's normal thermoregulatory defences are impaired in surgery and anaesthesia. This increases the risk of coagulopathy, wound infections, myocardial ischaemia and delayed recovery. Warming techniques are used to prevent hypothermia with active warming more efficacious than passive insulation. This study investigated if active warming using FAW connected to a thermal insulating suit is superior to conventional lower body FAW blanket and warming mattress. The study population's characteristics such as age, BMI, ASA status, duration of anaesthesia and surgery were adequately matched between groups. However, only females undergoing unilateral mastectomy or breast resection with BMI between 25-40 kg.m⁻² were included. These strict inclusion criteria and small sample size limit the validity and generalisability to males, differing BMIs or other surgical procedures. Based on this study, there are no advantages of using FAW connected to thermal suits compared to conventional FAW methods. However, the hypothermic patient in the thermal suit group stayed hypothermic much longer (60 minutes and into her post-operative phase) compared to the other group which regained normothermia after 30 minutes on average. Future studies should be mindful of the groups' differences in ability to correct hypothermia, adopt broader inclusion criteria, and include an assessment of hyperthermia as they can also adversely affect outcome. Until then, any FAW attachments along with pre-operative warming can be used to lower incidences of intraoperative hypothermia as alluded to by the authors.

Reference: *Acta Anaesthesiol Scand.* 2021;65;176-181

[Abstract](#)



Using activity theory to transform medical work and learning

Authors: Engeström Y & Pyörälä E

Summary: The key concepts of activity theory and expansive learning are used to build on the cultural-historical activity theory (CHAT) that was designed to study the complexities and contradictions of workplace environments. Current activity in health is the result of a long culture and history. Present problems in healthcare activity includes fragmentation of care and disturbances in collaboration between healthcare experts. By using the Change Laboratory intervention as a formative tool, future healthcare activities can be transformed by engineering a care agreement for the complex patient. This process expands the learning from activities of health into its zone of proximal development by providing opportunities for change of medical expertise.

Comment: (Dr Kersi Taraporewalla) This article published in Medical Teacher focuses on using current activity in healthcare and understanding its current problems based on a cultural and historical perspective. Current activity in healthcare is fragmented with a lack of collaboration between the various healthcare experts. These result in conflicts between the needs of the community, administration rule regarding cost-efficiency, solo responsibilities, primary care, and the patient resulting in detriment of patient care. Healthcare faces a foundational change in medicine with a greater proportion of elderly patients, with chronic multi-system disease, and the need for long-term care. Using a concept from education of the zone of proximal development (ZPD), the system can only transform into its ZPD. This transformation can be scaffolded using a formative tool known as the Change Laboratory. The tool first collects data on the activity of the system, questions it, analyses it, models a new solution, examines and tests the model prior to its implementation, and reflects on the process. By using the tool, fragmented care of a complex patient has been transformed by the generation of a care agreement. This process could be utilised by anaesthesia as it faces challenges in providing complex care in the COVID-19 era with video pre-operative assessment and optimisation, complex monitoring, multifaceted anaesthesia delivery, and post-operative analgesic care in the sicker, older patient. Activity theory and CHAT can be used to identify current issues and the ZPD for anaesthesia. The Change Laboratory tool can be used to transform anaesthesia for the future. The article provides useful ideas and views for development. However, it does not address the resistance and inertia to change that must be overcome to achieve the transformation.

Reference: Medical Teacher 2021;43(1):7-13

[Abstract](#)

Patient and surgery factors associated with the incidence of failed and difficult intubation

Authors: Schnittker R et al.

Summary: A lack of denominator data, biased reporting and under-reporting prevents a comprehensive population-based assessment of the rate and risk-factors for difficult airway intubation. This analysis of an established state-wide dataset in Victoria, Australia examined the incidence of failed and difficult intubations (2015-17) and associated patient and surgical risk-factors. Among, 861,533 general anaesthesia episodes, 4092 patients with difficult or failed intubation were identified. The crude incidence rates were 0.52% (2015-16) and 0.43% (2016-17), most commonly in patients aged 45-75 years and decreased among older age groups, with lower risk in patients aged >85 than patients aged 35-44 years. Risk of failed or difficult intubation increased in patients undergoing emergency surgery (OR 1.80), obese patients (OR 2.48), those with increased ASA physical status, and those with increased Charlson Comorbidity Index. Nervous system (OR 1.92) and endocrine system (OR 2.03) procedures had the highest risk of failed/difficult intubation.

Comment: (Dr Martin Culwick) This article notes that many of the studies into difficult intubation such as NAP4 do not include denominator data for patient demographics. However, it should be noted that this paper was accepted in December 2019 before the Anaesthesia Airway Audit project in Australia and New Zealand was published. The key points of the article were that difficult or failed intubation had incidence rates of 0.52% (2015-2016) and 0.43% (2016-2017). Difficult/failed intubations were most common in patients aged 45-75 years, involving emergency surgery, obese patients, increased ASA physical status, and increased Charlson Comorbidity Index. Using the ICD-10, difficult and failed intubation was more common (0.48%) than that reported in NAP4, where airway events of all types were noted as one in 21,598 (0.005%) and of those involving intubation was reported as one in 12,120 (0.008%). The article concludes that administrative databases have the potential to improve our understanding of the risk of rare events.

Reference: Anaesthesia 2020;75(6):756-66

[Abstract](#)

Monitoring the anaesthetist in the operating theatre – professional competence and patient safety

Author: Larsson J.

Summary: This review was inspired by the 2015 AAGBI guidelines on monitoring during anaesthesia which noted 'the presence of an appropriately trained and experienced anaesthetist is important for patient safety during anaesthesia'. It provides a structured description of competence comprising five dimensions; the first two being the classical attributes of practical skills and theoretical knowledge. The third dimension (non-technical skills) is the skills necessary for ensuring good team-work in the operating theatre, while the final two are intuitive expert knowing, what the work is about and appreciating different aspects of the anaesthetist's role. "Intuitive expert" knowing enables quickly finding a working solution for most clinical problems. The core message is the importance of regularly assessing competence among anaesthetists throughout their career.

Comment: (Margarette Somerville RN) The article begins with the acknowledgement that a patient expects the anaesthetist to meet their needs before, during and after the operation. This begins with introduction of self, building rapport and reassuring the patient that they will be cared for when they have no control, in the same way passengers trust an aircraft pilot. The first two dimensions cover the skills learnt in medical school, that of practical and technical skills. The further dimensions were first recognised in the 1990s and are more difficult to assess, but just as important to competence. Technical skills can be learnt and practiced in the simulation environment. Talking through each aspect of the process of anaesthesia and responding to deviations from the norm in a supportive, non-harming environment. A career-long development that provides the confidence and skills to manage complex situations when they become messy. Few trainee anaesthetists will state they want to be "good" at their job, most aim to be experts. Indeed, the expert will also aim to teach the next generation of trainees, complementing the theory with the practical. The difficulty arises when the aim to ensure the experts are passing onto others the skills of dimensions three to five, in a constructive environment while maintaining their own learning needs. Lifelong learning and assessment are a priority, anaesthetic technical competence is assessable, non-technical skills remain unassessed despite templates being available. The anaesthetist remains a focal part of patient safety, the ability to communicate well in a team, reassure the patient when they put their life in your hands and be aware of the physical environment are all critical skills not assessed once but ongoing.

Reference: Anaesthesia 2017;72(Suppl 1):76-83

[Abstract](#)

Anaesthesia Research Review™

Independent commentary has been provided by Dr Martin Culwick, Dr Gihan Hapuarachchi, Dr Tonchanok Intaprasert, Dr Geoff Messer, Margarette Somerville RN, Dr Kersi Taraporewalla, Dr Tim Tran, and Professor André Van Zundert.

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Association between neuraxial anaesthesia or general anaesthesia for lower limb revascularisation surgery in adults and clinical outcomes: Population based comparative effectiveness study

Authors: Roberts DJ et al.

Summary: This large (n = 20,988), Canadian, multi-centre, retrospective, cohort-based study used linked, validated, population-based databases to examine the relationship between neuraxial anaesthesia or general anaesthesia and clinical outcomes, length of stay and readmission with the primary outcome of 30-day all-cause mortality for lower limb revascularisation surgery in adults. The period under study was approximately 13 years up until March 2015. The main finding was a 1.2% lower 30-day all-cause mortality rate (3.2%) amongst the neuraxial block cohort (n = 6453), which comprised approximately one-third of cases. The almost two-thirds of cases who had general anaesthesia (n = 14,535) had a 30-day mortality rate of 4.4%. In comparing the two groups, the general anaesthesia group had a higher rate of cardiac valvular disease, coagulopathy and critical urgency, all of which individually may be expected to be associated with a higher mortality. Interestingly, duration of surgery was not compared across groups, as the administrative database used did not contain that level of detail. The authors concluded that the association may have validity and it would equate to a number needed-to-treat of 139 to avoid 1 excess death. The authors also noted that the use of neuraxial block declined by approximately 17% over the study period, but were not able to provide an explanation.

Comment: (Dr Geoff Messer) This very large retrospective study looked at an interesting clinical question, should patients presenting for lower limb revascularisation have a neuraxial technique? The authors suggest that they have not provided a definitive answer, and that to do so, a randomised controlled trial with at least 5000 study participants would be required, which is unlikely to be performed in the near future.

Reference: *BMJ. 2020; 371:m4101*
[Abstract](#)

Balanced opioid free anaesthesia with dexmedetomidine versus balanced anaesthesia with remifentanyl for major or intermediate noncardiac surgery

Authors: Beloeil H et al.

Summary: This French blinded, multicentre, randomised controlled trial evaluated whether opioid-free anaesthetics featuring a dexmedetomidine infusion (n = 156) improved postoperative outcomes in major and intermediate non-cardiac surgery, compared with anaesthetics with a remifentanyl infusion plus morphine (n = 156). The trial was terminated prematurely because of five cases of severe intraoperative bradycardia, three with asystole, in the dexmedetomidine group. The primary composite outcome of opioid-related adverse events (hypoxemia, ileus, cognitive dysfunction) occurred in 122 (78%) dexmedetomidine versus 105 (67%) remifentanyl recipients (RR 1.16; 95% CI 1.01-1.33; p = 0.031). Postoperative hypoxaemia (within 48 hours of extubation) occurred in 110 (72%) of 152 dexmedetomidine versus 94 (61%) of 155 remifentanyl recipients (RR 1.19; 95% CI 1.02-1.40; p = 0.030). Dexmedetomidine recipients had lower cumulative postoperative morphine consumption from 0-48 hours (11 vs 6 mg) and less postoperative nausea and vomiting (37% vs 24%; RR 0.64; 95% CI 0.45-0.90) than remifentanyl recipients. There were no differences 48 hours post-extubation of ileus or cognitive dysfunction. Dexmedetomidine recipients had more delayed extubation and prolonged post anaesthesia care unit stay.

Comment: (Dr Tim Tran) In contrast to earlier studies that reported limited postoperative outcome benefits from opioid-free anaesthesia, the opioid-free group in this trial experienced more adverse effects, despite a lower overall opioid consumption postoperatively compared with the remifentanyl group. It may well be that the trial's weight-based infusion rate of 0.4-1.4 µg/kg/hr of dexmedetomidine was too high, and led to both increased incidences of intraoperative bradycardia and postoperative hypoxaemia, the latter potentially through excessive sedation. Unfortunately, the optimal dosage of dexmedetomidine under general anaesthesia is yet to be ascertained, particularly with regards to providing the haemodynamic stability traditionally provided by intraoperative opioids. Four of five bradycardic episodes in the dexmedetomidine group happened during carbon dioxide insufflation for laparoscopic surgery, this raises important questions regarding the safety of dexmedetomidine infusions in laparoscopic surgery.

Reference: *Anaesthesiol. 2021;134:541-551*
[Abstract](#)

Pre-oxygenation using high-flow nasal oxygen vs tight facemask during rapid sequence induction

Authors: Sjöblom A et al

Summary: This multinational, randomised trial compared high-flow nasal oxygen (HFNO; n = 174) with standard facemask pre-oxygenation (n = 175) in non-pregnant adult patients undergoing emergency surgery requiring rapid sequence induction. There was no difference in the number of patients desaturating (defined as oxygen saturation <93%) in the high-flow versus facemask groups (2.9% vs 3.4%) during the pre-oxygenation and peri-intubation period (measured until one minute post intubation). There was also no difference in end tidal CO₂ levels in the first breath after tracheal intubation (4.64 vs 4.56 kPa)

Comment: (Dr Tim Tran) The use of high-flow nasal oxygen as an aid to preoxygenation has become increasingly widespread, due to the favourable effects of increased apnoea time. This study suggests that high flow is a suitable method for pre- and peri-oxygenation to maintain adequate oxygen levels during rapid sequence induction, as an alternative to traditional facemask pre-oxygenation. Unfortunately, this study was very underpowered with regards to aspiration. Aspiration was identified clinically during intubation, but radiological signs weren't incorporated. This study excluded pregnant patients and those with a BMI >35. These populations are high-risk for desaturation during apnoea due to both low functional residual capacity and increased metabolic demand, and at elevated risk of having a difficult airway. It would be useful to see if these patients would also benefit from HFNO in pre- and peri-oxygenation.

Reference: *Anaesthes. 2021;Feb 18 [Epub ahead of print]*
[Abstract](#)

The Bowtie diagram: A simple tool for analysis and planning in anaesthesia

Authors: Culwick MD et al.

Summary: The Bowtie diagram depicts critical incidents and has been used in high-risk industries since 1979. It displays, in five steps, the progression from latent factors to potential harm. It combines the concepts of a fault tree and an event tree with the adverse event (the 'top event') separating the sections. The fault tree is similar to a Swiss Cheese diagram and the event tree resembles an emergency management algorithm. Preventive barriers to avoid and escalation measures to detect and trap abnormal states are represented on the left side of the diagram. In the case of failure, events proceed to a crisis leading to the 'top event', a time for making decisions. The following rescue state is an emergency state mandating immediate life- or limb-saving management. The aftermath state represents a time for reflection and learning with ultimate outcomes represented.

Comment: (Professor André Van Zundert) Analysis of anaesthetic incidents typically takes the form of root cause analysis. This has the potential disadvantage of hindsight bias and typically focusses on a small number of issues often involving human factors. The Bowtie diagram provides a simple tool with five steps to display all the factors surrounding an incident, which is named a top event and allows the latent factors relating to the event to be addressed. Bowtie diagrams have an advantage over existing methods to analyse and understand critical incidents as they combine all possible causes and all methods to prevent similar events in the future, with management strategies and learning from outcomes. In this way, all the aspects of a critical incident are combined into a single diagram, which can be used as an educational tool, as an analysis summary, as a risk management tool, or a document to assist with safety and quality improvement. A video extract explaining the concepts is viewable at: <http://links.lww.com/COAN/A68>

Reference: *Curr Opin Anaesthesiol. 2020;33(6):808-814*
[Abstract](#)

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Femoral artery block (FAB) attenuates thigh tourniquet-induced hypertension: A prospective randomized, double-blind, placebo-controlled trial

Authors: Wahal C et al

Summary: The precautionary alarm of pneumatic tourniquet devices is a sound well known to the anaesthetist facilitating an orthopaedic list. Unlike the alarm, however, tourniquet hypertension (TH) is a phenomenon which is not attenuated with ease. The authors of this study postulated injection of local anaesthetic at the anteromedial aspect of the femoral artery would decrease TH incidence mediated by the adventitial nerve plexus ensheathing the blood vessel. It was also hypothesised the dose of antihypertensive medication required to treat the TH response would be decreased. Thirty ASA 1-3 patients between the ages of 18 and 75 undergoing elective total ankle arthroplasty were recruited for the prospective, double-blind, randomised placebo-controlled clinical trial. Premedication of oral acetaminophen 975 mg was given to all patients in addition to sedation titrated to effect with ≤ 2 mg of midazolam and 100 μ g of fentanyl (unclear if some patients did not receive any opioid at all). The peripheral nerve blocks included popliteal sciatic and adductor canal catheter placement under ultrasound guidance with a total of 30 mL of 0.2% ropivacaine with 1:400000 adrenaline. The study intervention then took place with 15 mL of 1.5% mepivacaine with 1:400000 adrenaline for the experimental group (to reduce toxicity risk presumably) or 15 mL 0.9% saline for placebo group. All regional injections appear to have been placed by consultant physicians. Subsequent anaesthesia was induced intravenously and maintained with oxygen, air and sevoflurane titrated to a bispectral index monitor. Baseline systolic blood pressure (SBP) was defined as the average of three consecutive SBP readings measured immediately prior to tourniquet inflation (interestingly this was after anaesthesia induction as opposed to pre-operative readings). If SBP increased $>30\%$ of baseline for two consecutive readings, treatment was standardised to intravenous esmolol until SBP returned to normal with no opioid or alternative antihypertensive use permitted. The only modifiable variables were therefore esmolol and sevoflurane administration; however, it is unclear whether clinicians were able to augment the volatile in response hypertensive changes prior to the second SBP reading. TH was observed in 93.3% of placebo recipients versus 33.3% of block recipients. Mean SBP at 120 min and 150 min of tourniquet time was also higher in placebo recipients. Esmolol requirement (95.3 vs 8.0; $p \leq 0.001$) was also higher among placebo recipients.

Comment: (Dr Gihan Hapuarachchi) This is a promising novel study that supports the multimodal analgesia model in a world rife with opioid use. Despite this, however, the authors concede various limitations including: a) small sample size and a predominance of Caucasian males highlighting the lack of female and other ethnic group representation b) adrenaline used only in the experimental arm and potential albeit unlikely confounding c) inadvertent treatment of the somatic component of TH by another mechanism e.g., systemic absorption of local anaesthetic. Of further note, the ASA breakdown of patients shows a predominance of ASA 2 and 3 classifications, yet it is unclear what co-morbidities were present and the distribution between arms. Future research could expand on sample size, ensheathing the target vessel from multiple angles and consider co-morbidity allocation in place of ASA.

Reference: *Reg Anesth Pain Med.* 2021;46(3):228-232

[Abstract](#)

Head rotation reduces oropharyngeal leak pressure of the i-gel and LMA® Supreme™ in paralyzed, anesthetized patients: A randomized trial

Authors: Chaki T et al.

Summary: This randomised study examined the effect of 0°, 30° and 60° head rotation on oropharyngeal leak pressures (OPLP) of the i-gel® (n = 34) versus the LMA® Supreme™ (n = 36) second-generation supraglottic airway (SGA) devices. OPLPs from the i-gel® and LMA® Supreme™ both decreased as head rotation angle, increased; the mean difference of 0° versus 30° head rotation with the i-gel® was 3.5 (95% CI 2.2-4.8; $p < 0.001$) while for 30° vs 60° it was 2.0 (95% CI 0.6-3.5; $p = 0.002$) and for 0° vs 60° it was 5.5 (95% CI 3.3-7.8; $p < 0.001$), with the LMA® Supreme™ the mean differences were 4.1 (95% CI 2.6-5.5; $p < 0.001$), 2.4 (95% CI 1.1-3.7; $p < 0.001$), and 6.5 (95% CI 5.1-8.0; $p < 0.001$). Differences were also observed in expiratory tidal volume and ventilation score between 0° and 60° head rotations in the i-gel® group and in ventilation scores between 30° and 60° head rotations in the LMA® Supreme™ group. There were no differences in any outcome measures between the two devices.

Comment: (Professor André Van Zundert) An optimal anatomical fit of a correctly sized SGA device results in a better functional airway, sealing the respiratory tract (1st seal) and gastro-oesophageal tract (2nd seal). The second-generation SGA sits correctly if the cuff (inflated or not) occupies the hypopharynx, with the distal cuff sitting in the entrance of the oesophagus, the epiglottis flattened between the posterior part of the tongue and the proximal cuff of the SGA, and with alignment of the tip of the epiglottis and the rim of the proximal cuff. As such the SGA results in adequate gas exchange, with no airway leakage or airway obstruction. When the OPLP is measured, it most likely will show pressures of 25 cm H₂O or above. Once in place, the golden standard is to check the OPLP, with cuffs inflated to 40-60 cm H₂O, confirming the correct position of the airway *in situ*. Kumar et al., ([Acta Anaesthesiol Scand.](#) 2020;65:142-5) extensively covered the issue of OPLP recently and questioned its value if the SGA is not in an optimal position in the hypopharynx. In this study, Chaki T et al., showed in 70 patients undergoing surgery and anaesthesia with an i-gel® or LMA® Supreme™ that head rotation reduces OPLP. Indeed, it is not surprising that besides patient factors influencing the OPLP, there are also provider factors and mechanical reasons. Indeed, pulling on the SGA tube, movements of head rotation (sideways and in flexion-extension) have a significant impact with major changes in the OPLP. Following these movements, both the intracuff pressure needs to be checked (and adjusted if needed) and the OPLP needs to be measured to see whether the device is safe enough to undergo the surgical procedure under anaesthesia. Also, the transmembrane diffusion of the gases through the cuff, used during the maintenance of anaesthesia, and the warming up of the gases, may result in higher OPLP. This obviously occurs only with cuffed SGA devices. The authors acknowledged the need to repeat the clinical trial using different brands of SGA devices.

Reference: *Anesth Analg.* 2021;132:818-826

[Abstract](#)

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