Anaesthesia News

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Innovation issue:

Vaccine to artificial intelligence – innovation in medicine and surgery

Exovent: an accelerated innovation journey in 2020

Arterial blood glucose error and insulin overdose: cause and solution

Preventing dual humidification errors in ventilation circuits

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Welcome

Dear Reader,

'Innovation is seeing what everyone has seen and thinking about what nobody else has thought' - Albert Szent-Györgyi.

Recently, during my second COVID vaccination a conversation with one of my colleagues allowed me to reflect on our multifaceted speciality. Even vaccine clinics are staffed with anaesthetists to allay the fears of patients about potential reactions to the said vaccine. COVID-19 has raised significant awareness of the importance of anaesthesia and critical care in the hospital setting, as well as the multitude of scientific advances within the speciality.

In this issue I invite you to admire, wonder and marvel at the plethora of innovations made in the field of anaesthesia and critical care. Whether it be designing negative pressure ventilators in record time, systems to prevent humidification errors, or preventing arterial blood glucose errors, the importance of innovation has been highlighted during the ongoing pandemic. Adaptation of any innovation depends on the health benefits, safety, economy and complexity. The Association of Anaesthetists has promoted innovations in anaesthesia, critical care and pain through research grants, their annual Innovation Award, and engagement with industry.

As I was walking back from work in the evening, the fading sunlight and the blooming daffodils reminded me of a better time. Just as innovations bring optimism, we hope life will be normal and beautiful again soon.

Ravishankar Rao Baikady
Consultant in Anaesthesia and Peri-operative Medicine
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Correction: in Particles (March 2021 issue, page 29) in the Results and Discussion sections the units were erroneously given as ml (don't try this at home, boys and girls) rather than l.

The text should read:

Results
Increasing fresh gas flow from 1 l.min^{-1} to 6 l.min^{-1} increased the mean time to CO_2 absorbent exhaustion and reduced cost by > 90%, with minimal change in environmental impact. At 6 l.min^{-1}, the GWP100 was 0.14 kg CO_2 equivalent.h^{-1}.

Discussion
The authors conclude that, using a circle system without anaesthetic gases, a flow of 6 l.min^{-1} reduces costs and has minimal impact on the environment compared with low flows.

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Vaccine to artificial intelligence – innovation in medicine and surgery

In the rich history of medicine, various innovations have made significant differences to humanity. Each one of those discoveries has contributed to understanding the complexities of disease management including prevention of diseases, accurate diagnosis and saving millions of lives. In the current global pandemic, innovations in medicine and technology are even more significant in the treatment of diseases and improved patient outcomes.

Some of the most impactful innovations in the last 250 years of medicine are summarised in Box 1. The greatest innovation according to many experts was the development of vaccines for infections affecting the global population. It is a testament to our scientific researchers that at least 10 vaccines were developed in a record time to fight the current COVID-19 pandemic.
The second most significant innovation was the discovery of anaesthesia in 1846. The discovery of various anaesthetic drugs and equipment over the years has made significant contributions to safe surgical practice and better patient outcomes.

Edward Jenner

Innovations in surgery

Surgical innovation is an integral part in our practice of anaesthesia. In the last few decades significant discoveries have been made in surgical technology and practice, including minimally invasive surgery; as a result anaesthesia and critical care teams have quickly adapted to different ways of patient management that have made a noticeable impact on patient outcomes.

The Royal College of Surgeons in England has published an independently commissioned report on the 'Future of surgery' in the UK (www.futureofsurgery.rcseng.ac.uk). The commission has considered the likely changes in surgical care in the next 20 years, with the most impactful technological innovations being:

1. Minimally invasive surgery and further advances in robotic and laparoscopic surgery.
2. Imaging, virtual reality and augmented reality: advances will focus on training; newer imaging techniques from static anatomical displays to dynamic organ function will lead to more remote support for complex surgery in many surgical specialities. 3-Dimentional planning and printing will be used in training and simulation.
3. Big data, genomics and artificial (augmented) intelligence: analysis of data will facilitate the understanding of many chronic diseases. Genomics will help to target therapies and precision medicine in many specialities such as cancer. Artificial intelligence will play a big role in diagnosis and population-based risk assessment. Augmented intelligence will minimise surgical errors.
4. Specialised interventions: 3-dimensional bioprinting of tissues, nano surgery, artificial organs and animal-human transplants are some of the advances expected in the next decade that will change the way we practise surgery.

Anaesthesia and critical care teams must make the necessary changes to adapt to these new surgical practices.

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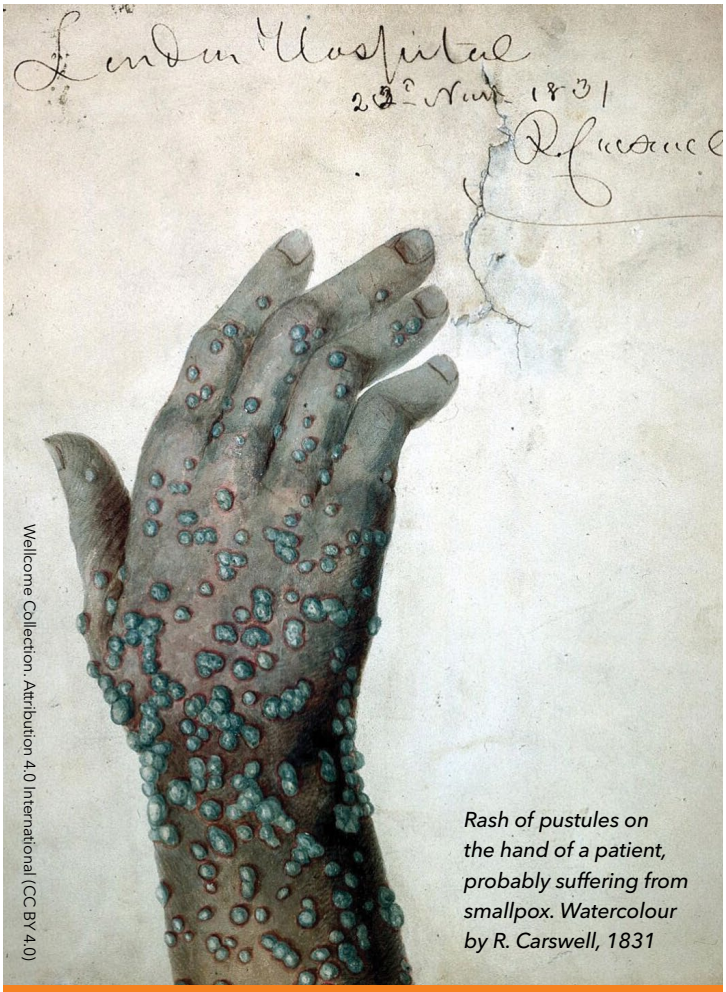

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Rash of pustules on the hand of a patient, probably suffering from smallpox. Watercolour by R. Carswell, 1831

Box 1 – significant medical discoveries in the last 250 years

1. Vaccines (1796): Edward Jenner's vaccine for smallpox.
2. Blood transfusion (1818): James Blundell performs the first successful transfusion of human blood.
3. Anaesthesia (1846): William Morton, delivery of ether anaesthesia.
4. Germ theory (1861): Louis Pasteur discovers living pathogens.
5. Medical imaging (1895): Wilhelm Conrad Roentgen, discovery of X-rays for medical imaging.
6. Antibiotics (1928): Alexander Fleming identifies the antibiotic penicillin.
7. Organ transplants (1954): Joseph Murray and David Hume, the first kidney transplant
8. Antiviral drugs (1960): development of antiviral drugs for HIV/AIDS, Ebola, rabies.
9. Stem cell therapy, immunotherapy (1970): treatment of leukaemia, bone marrow transplantation, a new era in cancer therapies, vaccines for specific cancers and research into many chronic diseases such as Parkinson's disease and Alzheimer's disease.
10. Augmented artificial intelligence (2010): powerful analytical tool to diagnose, treat and prevent diseases.

Barriers to innovation

Successful innovations will require inquisitive minds to develop ideas, research prototypes and implement technology for wider clinical practice and support change. However, to achieve this there are significant challenges. The common barriers to innovation are:

1. Fear of failure is one of the biggest reasons why many ideas never materialise. However, failure is part of learning, development and progress in science and technology.
2. Commitment and leadership: innovation must be led from the top, and organisations should be committed to the development of innovations.
3. Resources: innovation will require funding for research, capacity and industry support to bring technologies to practice.
4. Time: clinicians and scientists should have dedicated time to bring new innovations to clinical practice.
5. Collaboration and engagement: collaboration between various teams, and engaging users during development, are key to successful outcomes.
6. Vision: organisations and researchers require clear vison on what to achieve, the impact of discoveries, and how to deliver innovations.

The pace of innovation is increasing in surgery and anaesthesia. Over the last decade our Association has encouraged progress in anaesthesia, critical care and pain through the annual Innovation Award. Some of these developments are already part of our day-to-day practice. Innovation in anaesthesia will also depend on advances in medicine and surgery. As our history suggests, anaesthetists have always been great innovators, and we will see much progress in the next few years.

Ravishankar Rao Baikady
Elected Board Member, Association of Anaesthetists
Consultant Anaesthetist
Royal Marsden NHS Foundation Trust, London

Editor's note - Lest we forget: vaccines

Our cover illustration this month is by Eoin Kelleher, a regular contributor, who says it "depicts the efforts of anaesthetists working together during COVID to help in all areas of healthcare, not just ICU. It's based on a famous David Low cartoon from WW2."

Dr Ravi Rao Baikady emphasises the importance of vaccination in his article on innovation. To those afflicted by smallpox, the acute disease was terrible, and the extensive disfigurement that often resulted must have sometimes made them wonder if survival was worthwhile. In one sense it is unfortunate that COVID doesn't have visible markers of infection, and may even be asymptomatic: this allows malicious or naïve persons to deny the significance (even the presence) of the disease and its impact. By the way, if anyone wants to seek the hide of Blossom, the cow that infected the milkmaid from whom Edward Jenner took the pock fluid which he used to inoculate his gardener's son, thereby launching the practice of vaccination in the UK, you can find it at St George's Hospital Medical School library in Tooting, London.

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Exovent: an accelerated innovation journey in 2020

2020 was an exceptional year for the Exovent team. It has been an unusual year for everyone with a global pandemic disrupting life, while putting enormous strain on the NHS. This backdrop created an environment and an imperative for innovation that is unique within the 21st Century, leading to extraordinary achievements in the areas of vaccines and ventilators at a time when much of the world's population and businesses have been adapting to online interaction. We describe the innovation journey for Exovent, a negative pressure ventilation support device developed in record time by a UK charity with a small volunteer team of clinicians and engineers, working alongside the UK's largest privately owned aerospace & defence company, Marshall ADG.

How did it start – the power of Facebook

The original idea came from Dave McKeown, a civil engineer in Cornwall working for the Environment Agency on flood defences. As the pandemic gathered momentum in March 2020, Dave asked himself what he could do to protect his family if the NHS was overwhelmed. After discarding several possibilities, he came up with a modern lightweight version of an iron lung using a wooden enclosure over the chest. He realised it could be built in large numbers quickly and cheaply, so on the 19th March he wrote to the Cabinet Office asking for support to turn the idea into reality. Although there was no reply to his letter, that same day an unknown person shared it on a Facebook post that was circulated widely amongst doctors and beyond. Suddenly Dave found himself being contacted by anaesthetists, critical care specialists, surgeons and engineers, all keen to turn his idea into reality. The Exovent team was born and had its first call the very next day.

Rapid proof of concept

Driven by the urgent potential need for the device, the pace of work was intense, often with multiple daily calls, working late into the evening and weekends. Within days, several of the team had built working prototypes at home based on plywood boxes, drysuit neck seals, vacuum cleaners and simple control systems, proving that a powerful system could be produced easily. All the time the Exovent network was expanding, broadening the team's strengths and capabilities; everyone was working with other disciplines with no hierarchy. Most fitted the activity around their day jobs, including NHS clinicians who would join meetings after long days working in hospital. Early on the team moved from phone calls to Zoom meetings.

Developing a professional system

The team needed partners to help turn the Exovent system into reality. Progress came at the end of March when Warwick University High Value Manufacturing Catapult was introduced to Exovent who, in turn, introduced Marshall ADG. Using specifications provided by the Exovent team, Marshall ADG set about creating a system. With accelerated design control processes allowing parallel engineering and development activity, they produced the first system within three weeks, and a week later a fully working second iteration incorporating design improvements from Exovent clinicians. On the 29th April Professor Anil Patel, a consultant anaesthetist at the Royal National Throat Nose and Ear Hospital, UCLH became the first Exovent team member to test the unit.

Ups and downs

Early on it became clear that the UK Ventilator Challenge covered only positive pressure ventilators, so fast track support was unavailable. The team continued undeterred because they believed that the benefits of negative pressure ventilation are not limited to COVID-19, but may be indicated for patients with a variety of acute and chronic respiratory diseases. By reducing the

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Figure 1. Professor Anil Patel in an Exovent

Figure 2. The Marshall-Exovent

work of breathing, increasing the surface area for gas exchange, and preserving right ventricular output, negative pressure can not only help the deteriorating patient but recovering patients too, with potential benefits to weaning and recruitment, although much work needs to be done to substantiate these aspirations [1]. The focus, therefore, moved to full medical device approval and it was clear that we lacked the specific skills necessary to navigate the medical device approval process. Coincidentally, Michael Rose, a product management specialist in the medical device industry filled the gap at just the right moment.

Medical device approval and clinical trials

Under normal circumstances it takes over three years for a medical device to gain approval. Exovent plan to achieve this in half that time, producing an approved device by September this year. In 2020 there were additional complications, Brexit uncertainty and replacement of the Medical Devices Directive with the more complicated and challenging Medical Device Regulations. After much analysis of the regulations and examination of all the predicate negative pressure devices, we now believe that approval can be achieved without the need for a clinical trial, albeit with extensive documentation. We also needed a manufacturer on board for submission, and are delighted that this will be Portsmouth Aviation.

Once the system has achieved regulatory approval, Exovent will conduct clinical trials as part of our post-market clinical follow-up plan. This should provide data to extend the use of the system to patients with a wider range of respiratory disorders. Much of the planning for these trials has already been completed by clinicians at the University of Southampton Hospital under the leadership of Professor Mike Grocott. This is a major undertaking, and Exovent will be applying for grants from a number of funding sources.

Summary

It took six weeks from concept to a fully functioning negative pressure ventilator that could have been produced in large quantities had the UK faced a major shortage of ventilators during the COVID-19 peak. Ultimately that was not needed, but the work highlighted the benefits of negative pressure ventilation; it is more physiological than positive pressure ventilation and allows the patient to remain conscious throughout, making it ideal for low-income countries where access to sophisticated medical care is difficult. The Exovent team are committed to delivering an approved UK-manufactured system in record time, and are working with teams around the world to help them develop their own versions. We want everyone that needs breathing support to have access to it.

Ian R. Joesbury
Exovent CEO and professional engineer

Professor David Howard
Consultant and Professor of Head and Neck Oncology
Imperial College NHS Hospitals, London

Jim Roberts
Consultant Anaesthetist and Clinical Lead,
Royal National ENT and Eastman Dental Hospitals, UCLH, London and the Exovent Team

Twitter: @IanJoesbury; @ExoventNPV

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Exovent: a new development from old technology

Few contemporary anaesthetists imagining negative pressure ventilation would picture a modern, lightweight, torso-only device, and fewer still would imagine it being described as "extremely pleasant" by a wide-awake subject who was able to eat, drink and talk freely during exhalation (Figure 1). Yet, this is the Exovent experience, as published last month in *Anaesthesia* journal [1]. Unlike its 'iron lung' predecessors, the Exovent can deliver the full features of negative pressure respiratory support on a standard hospital bed. Continuous negative extrathoracic pressure (CNEP) delivers the negative pressure equivalent of CPAP, and negative pressure ventilation (NPV) can be augmented with negative end-expiratory pressure (NEEP), the negative pressure equivalent of PEEP.

From the iron lung to positive pressure ventilation

True collaboration between doctors and engineers is the backbone of medical device development; the first effective iron lung was designed by the Drinker brothers, one a physiologist and the other an engineer. This template was used to treat pneumonia as well as to save tens of thousands of poliomyelitis victims (Figure 2). However, these cumbersome 300 kg, 2 m long devices were largely abandoned when small positive pressure ventilators were introduced in the mid-20th Century. Though it was recognised that positive pressure ventilation (PPV) would reduce cardiac output and require paralysis, sedation, and tracheal intubation, these were considered an acceptable price to pay. Seventy years later, we are increasingly aware of ventilator-associated lung injuries cause by PPV and ventilator-associated pneumonia caused by intubation.

The physiology of NPV

The physics of driving gases down the trachea towards the alveoli through distensible airways produces very different stresses to the lung microstructure and patterns of alveolar expansion compared with gas being drawn into the lungs by the alveolar distension generated by negative pressure. The patchy atelectasis seen with PPV may result from distension of the proximal alveoli compressing the small airways of more distal lung segments. The more evenly distributed forces generated by NPV may explain the rarity of pneumothoraces. In essence, NPV mimics 'natural' breathing more closely.

Applying extrathoracic negative pressure efficiently to healthy humans or animals affects lung volumes and gas exchange in a similar manner to positive pressure. Increasing 'background' inspiratory pressure using CNEP drives similar increases in the functional reserve capacity (FRC) as CPAP, and equivalent NPV and PPV inflation pressures produce similar tidal volumes. However, when animals are ventilated after lung damage from saline lavage or pulmonary artery oleic acid infusion, NPV produces better oxygenation, less atelectasis (Figure 3), less alveolar oedema, and less inflammation than PPV [2]. COVID-19 pneumonia brings the added concern that PPV stimulates the expression of ACE2, the SARS-Cov-2 virus receptor [3].

Positive pressure and negative pressure also have different physiological impacts on the circulation. Raised intrathoracic pressures during CPAP and PPV may cause an ≈ 20% fall in cardiac output by impeding systemic venous return, leading to a smaller ventricular stroke volume. PPV may also have an impact on the pulmonary microcirculation by compressing acinar vessels and shunting blood away from aerated alveoli. CNEP or NPV do not produce detectable haemodynamic sequelae.

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Figure 1. A volunteer in an Exovent

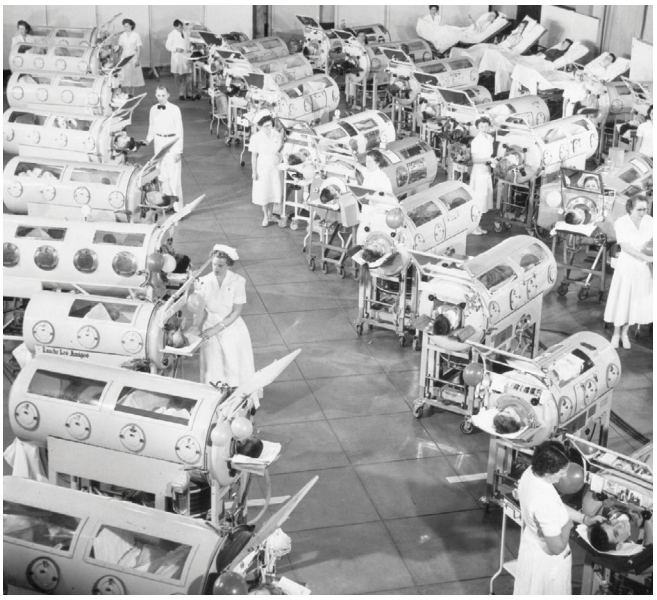

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Figure 2 . Iron lungs in a polio ward

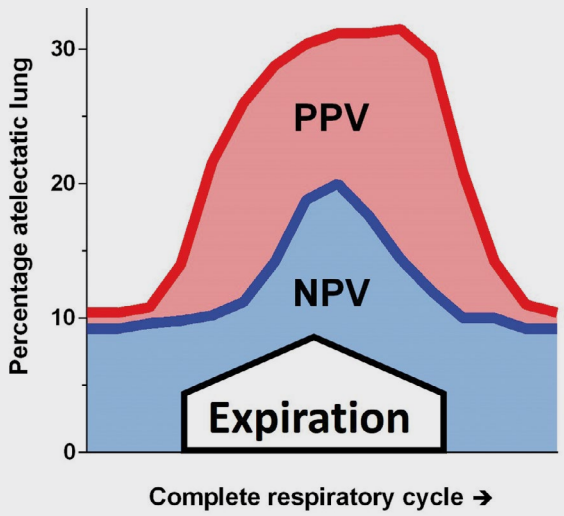

Figure 3. Percentage of atelectatic lung during positive and negative pressure ventilation in surfactant depleted rabbits, adapted from reference [2]

Building a small but effective NPV device

There are four basic NPV designs: whole-body tanks ('iron lungs'); 'wrap' and 'shell' cuirasses; and torso-only tanks such as the Exovent (Figure 4). The efficiency of iron lungs varied between models, but slowly rising inspiratory pressures were difficult to avoid with the then-available suction pumps acting on large tank volumes, limiting their capacity to generate high tidal volumes.

In 'wrap' cuirasses, anorak-type material is laid onto a frame over the patient's torso, and sealed below the axillae and at the hips. Unfortunately, they lose efficiency at low pressures because the material balloons in and out with every breath, and air leaks are difficult to prevent at higher pressures. 'Shell' cuirasses are light and portable, and seal directly onto the anterior chest, abdomen, and lateral rib cage. Applying suction reduces the intrathoracic pressure, but also pulls the shell edges down more firmly, risking restricting diaphragmatic and thoracic wall movement.

The Exovent base with its own internal mattress is placed on a bed, the cover is placed over the torso and arms, and the neoprene neck (hyperboloidal) and hip seals fitted. Its chamber is larger than a cuirass but much smaller than a whole-body tank, which allows the pump to generate almost square inspiratory pressure waves. Members of the Exovent development team (a volunteer group of engineers, doctors and nurses) found it comfortable to use supine at 30° head-up, or prone. It did not produce dyssynchrony so long as the volunteer was instructed to relax and not 'fight it'. Just -5 cmH_2O of CNEP increased the FRC by over 5 $ml.kg^{-1}$, and less than -4 cmH_2O of NPV was sufficient to generate resting tidal volumes of 11.4 $ml.kg^{-1}$ (Figure 5). This compares with typical chamber pressures of -20 to -40 cmH_2O for most previously-reported NPV devices.

What clinical contributions could Exovent make?

The Exovent allows healthy adults to receive the negative pressure equivalents of CPAP, and ventilation plus PEEP, comfortably. The enclosure can be removed quickly by two people if needed, and the window and self-sealing portholes allow for clinical monitoring and undertaking procedures. Despite fears to the contrary, users have not found the chamber claustrophobic. This may be because they can move relatively freely inside and can easily breach the seals with their hands, either producing a momentary pressure drop or releasing the vacuum completely.

We have not yet trialled the Exovent in patients, but this is planned. However, the extensive history of NPV suggests that it may provide a useful tool alongside conventional therapies in treating people with COPD, pneumonia including COVID 19, and neuromuscular weakness. In particular, we wonder if a key advantage may be the ability to move patients seamlessly between CNEP and NPV without the need for tracheal intubation, as even relatively high extrathoracic pressures remain comfortable. This contrasts with the intolerance of pressures sometimes required for CPAP or conventional non-invasive ventilation, which may then require tracheal intubation. This may offer a benefit to patients with a ceiling of treatment.

Finally, there are resource considerations. A UK version is anticipated to cost approximately £8000, considerably cheaper than conventional positive pressure devices, and we aim to produce a low-cost version for low and middle income countries for less than £500. It also has the potential to reduce oxygen usage as it is powered by electricity (potentially including batteries), so patients will only need facemask or nasal oxygen. It is an ambition of the Exovent charity (1189967) to improve access to negative pressure ventilation globally.

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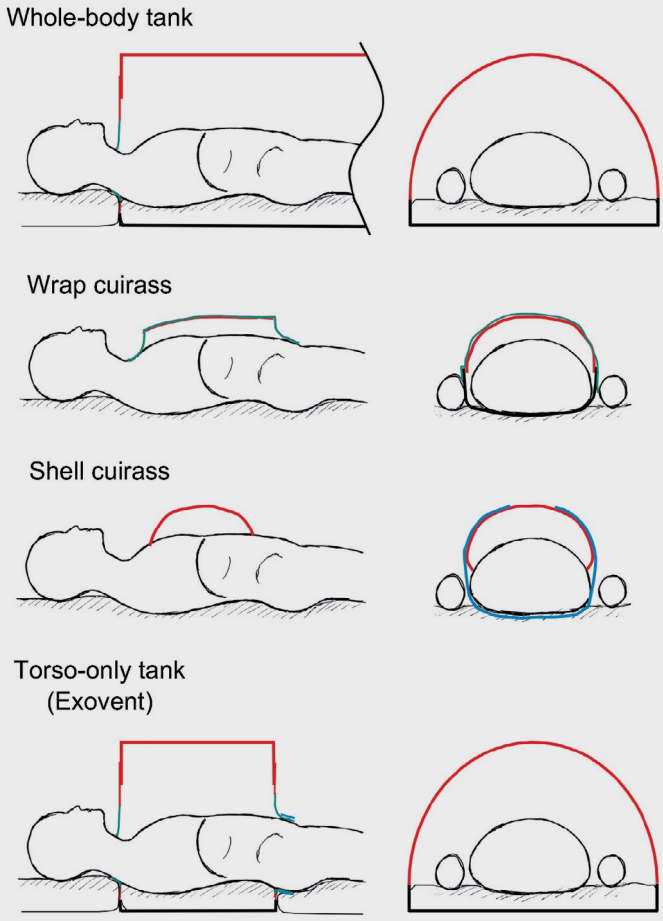

Figure 4. Types of negative pressure ventilator chambers. Red - rigid material; green – cloth or flexible material; blue - velcro band

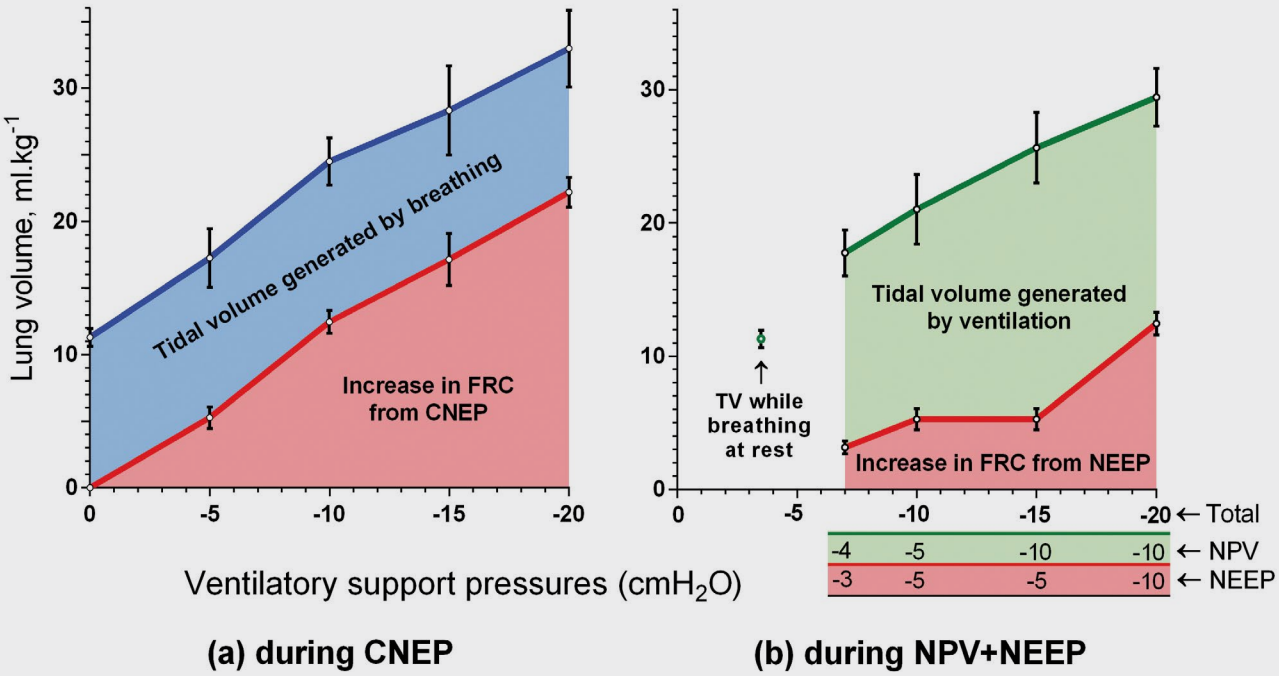

Figure 5.Tidal volumes during NPV and NEEP, and increases in FRC during CNEP generated by the Exovent in six healthy volunteers, from reference [1]. Error bars = 1 SD

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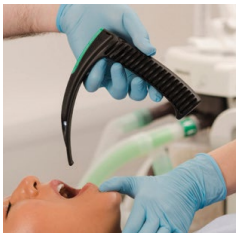

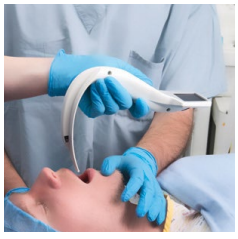

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Preventing dual humidification errors in ventilation circuits

Artificial humidification systems are a vital component of ventilation circuits in order to condition cold and dry medical gases before they enter the lungs. They are designed to approximate the physiological functions of the upper respiratory tract, which warm and saturate air to 37°C and 44 mg $H_2O.l^{-1}$. Should these functions be bypassed, poorly conditioned medical gases cause iatrogenic harm from drying of secretions, reduction in mucociliary function, and inflammation of the respiratory mucosa, which in turn can lead to mucous plugging and ventilator-associated pneumonia.

Active heated humidifiers and passive heat and moisture exchangers (HMEs) are two humidification systems in widespread use. HMEs incorporate a fine hygroscopic membrane that absorbs heat and moisture during the expiratory phase and exchanges it with inspired air (Figure 1A). Heated humidifiers pass medical gases over sterile heated water to achieve a physiological gas temperature close to 37°C and a relative humidity close to 100% (Figure 1B). There is a lack of consensus over their comparative efficacy, which means that both systems are likely to be available for use in many settings.

Heated humidifiers and HMEs are not designed to be used simultaneously (Figure 1C); should this occur the fine hygroscopic membrane of the HME becomes saturated with water vapour from the heated humidifier during the inspiratory phase. A 2015 MHRA Patient Safety Alert reported 76 incidents with outcomes including respiratory distress and loss of consciousness [1]. A postal study of English ICUs showed that 25% of the 56 responding units had suffered from dual humidification errors. The same authors demonstrated in a bench model that critical airway occlusion occurs within 24 hours in simulated ventilation circuits that contain both humidification systems [2].

The 2015 alert recommended extra safety checks and educating staff about the error by encouraging them to read the manufacturer's safety instructions. However, solely operator-focussed solutions rank unfavourably in the hierarchy of intervention effectiveness in human factors terms. System changes, such as using only heated humidifiers on the ICU and reserving separately-stored HMEs for use in patient transfers, are an alternative approach. Our ICU suffered a dual humidification error in 2016, and we decided to implement both the operator-focussed and system changes highlighted above. Six months on, we conducted a 'forced-error' simulation to assess whether our changes had worked by leading participants through a clinical scenario with an intubated manikin incorporating both humidification systems. Participants were directly asked to examine the ventilation circuit and comment on any errors as part of a wider scenario designed to mask the data points of interest. Only 30% of clinicians identified both humidification systems [3].

The Humidicare HME (Medovate, Cambridge, UK) is a novel safety-engineered device that assists clinicians in the early identification of dual humidification errors. The device looks and functions as a normal HME, but also incorporates a temperature-dependent warning sign that activates when the HME is inadvertently placed in a warm circuit containing a heated humidifier (Figure 2). In a bench study, seven Humidicare devices were found to activate reliably within the temperature range of 28.9°C - 30.9°C. Importantly, all seven devices remained inactive below 28.5°C; the temperature in a non-humidified dry circuit should remain below this threshold even during prolonged surgery with low-flow general anaesthesia [4]. Conversely, all seven HMEs underwent a full colour change by 32°C, and given that wet circuits containing a heated humidifier would typically operate between 34°C - 41°C, the Humidicare systems would be expected to activate reliably in dual humidified circuits.

In a follow-on simulation study, 20 ventilation circuits were set up using a manikin model (Figure 3). Half of the circuits incorporated both a Humidicare HME and a heated humidifier, whilst the other half incorporated a Humidicare HME only. All Humidicare HMEs in the dual humidified group activated the colour change warning sign within 98 s, whilst no HMEs activated in the control group. This finding remained consistent over 24 hours. This rapid colour change has important human factor implications, as this is more likely to direct clinicians towards an equipment issue [5].

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Figure 1.

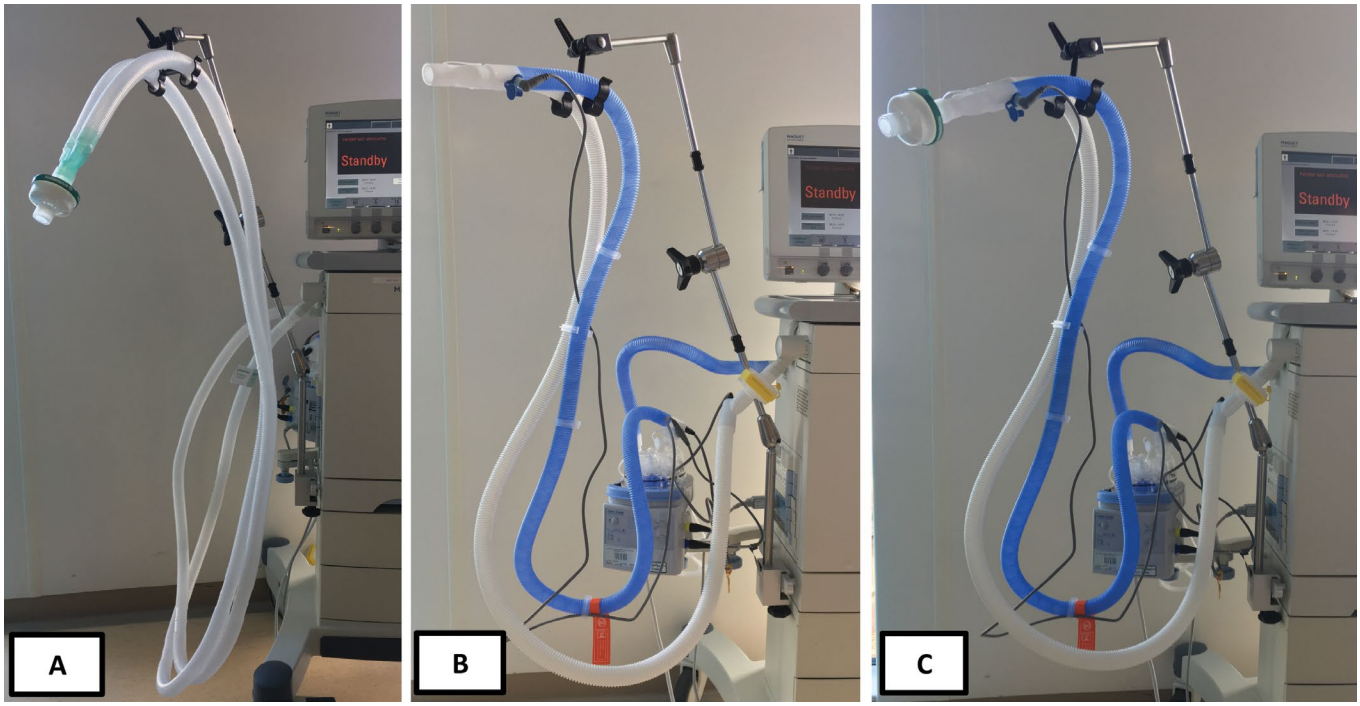

Figure 2: Humidicare HME. Left - as supplied; right - activated

With our own dual humidification error, we found that operator-focussed safety interventions combined with system changes had a limited impact on staff awareness. Conversely, the Humidicare HME removes the need for staff to rely on previous education and training alone when a dual humidification error occurs, and instead provides a rapid visual prompt at the critical moment of circuit connection in order to warn staff about an equipment issue. It performs reliably in simulated conditions, and is inexpensive to implement. Ultimately no single intervention can eradicate all errors, but the Humidicare HME acts as an extra safety barrier to facilitate early identification of dual humidified circuits and thus prevent iatrogenic harm. The Humidicare is currently undergoing device regulation.

Declaration of interest: MM is the inventor of the Humidicare (US patent number 20200405985).

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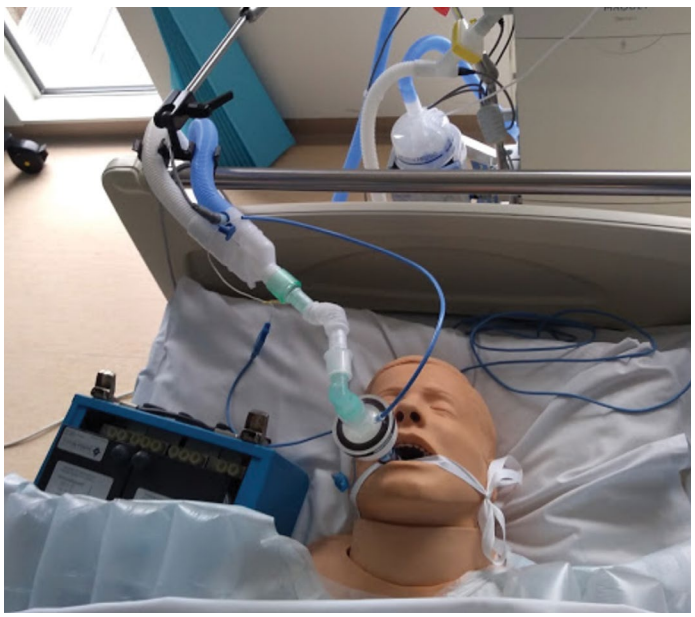
Figure 3.



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Arterial blood glucose error and insulin overdose: cause and solution

Arterial lines are normally kept patent with a 0.9% sodium chloride flush solution. If a dextrose-containing solution is used instead, contamination can falsely elevate glucose measured from an arterial blood sample (5% dextrose contains 278 mmol.l^{-1}, the upper limit of blood glucose is 7.8 mmol.l^{-1}). If this error is not spotted, treatment of hyperglycaemia can result in hypoglycaemia and neuroglycopaenia. This was the likely cause of the death of Susan Warby in West Suffolk Hospital, whose case gained wide social and mainstream media attention in 2020 [1].

A report from the National Patient Safety Agency included 84 reported errors associated with using the wrong flush solution for arterial lines, with glucose-containing solutions being the most common [2]. Two of those incidents led directly to patient deaths. A further 169 errors were reported between July 2008 and May 2011 [3].

National reports and guidelines have been issued raising awareness of this problem and encouraging various preventative measures [4, 5], but despite this, dextrose-containing solutions continue to be incorrectly connected. A survey conducted in 2013 across adult ICUs in the UK found that 69 of 228 (30%) units reported errors with arterial lines, with 21 reporting the use of wrong flush solutions [3]. This error continues to result in patient deaths [6]. Furthermore, iatrogenic hypoglycaemia in ICU patients has been shown to increase ICU length of stay and mortality [7], suggesting that even errors that at the time seem clinically inconsequential have the potential to result in adverse outcomes.

The solutions suggested to prevent this error mainly focus on clinicians: raising staff awareness and providing further training; local policies for arterial line use; and more checking procedures [5]. Few suggestions have taken a systems approach and addressed the environment, such as storing saline for flushing arterial lines away from other intravenous fluids. After a near-miss incident at Queen Elizabeth Hospital, King's Lynn, members of staff were sent emails raising awareness of the error and received further training. Six months later, we tested the effectiveness of these interventions using a simulated ICU scenario of a manikin with an arterial line being flushed with a dextrose solution. We found that 90% of the participants did not recognise that the high glucose readings from arterial blood samples resulted from the arterial line being wrongly flushed with a dextrose-containing solution, and they continued or increased the insulin infusion [8].

Safety issues in healthcare are often tackled by focussing on staff education and implementing a checklist. This may not be effective for rare errors, as staff are likely to become complacent. Psychologists describe the phenomenon of inattentional blindness, which is the failure to notice a fully-visible but unexpected object because attention is engaged on another task. As highlighted by Hales and Pronovost, overuse of checklists can have an impact on quality and speed of delivery of care, especially in a high-pressure environment such as ICU [9]. We risk overburdening staff, making routine tasks more time-consuming, and having an adverse impact on other aspects of care. In the long term, this is likely to lead to poor compliance.

One approach to tackle rare errors is to provide solutions that eliminate the possibility of error; for instance, we have suggested a device that produces a sudden change (e.g. colour) when connected to a dextrose-containing flush solution [8]. The GlucoSave™ is currently being developed on behalf of the NHS.

Using engineering approaches to look at healthcare errors requires expertise, time and initial expense compared with education and checklists; however, there is the potential to eliminate risk completely. Forcing functions are described as having the highest leverage on the 'hierarchy of interventional effectiveness', whereas rules, policies and education have the lowest. An example of such an engineered solution is the WireSafe™, an equipment set for insertion of central lines that makes it impossible for a guidewire to be retained [10], an error reported to account for 50% of Never Events in emergency medicine [11].

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We should encourage more clinicians to be involved in innovation and collaborate with engineers to tackle issues of patient safety. Use of technology to improve healthcare delivery is often neglected [12], but it has the potential to eliminate medical errors that checklists and teaching sessions have been struggling to eradicate for years.

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*Retrospective review of the medical notes of 70 patients undergoing surgery at Royal United Hospital, Bath, UK.[6] †Maximum dose: 20 mg/kg body weight.[7,8] IV, intravenous.

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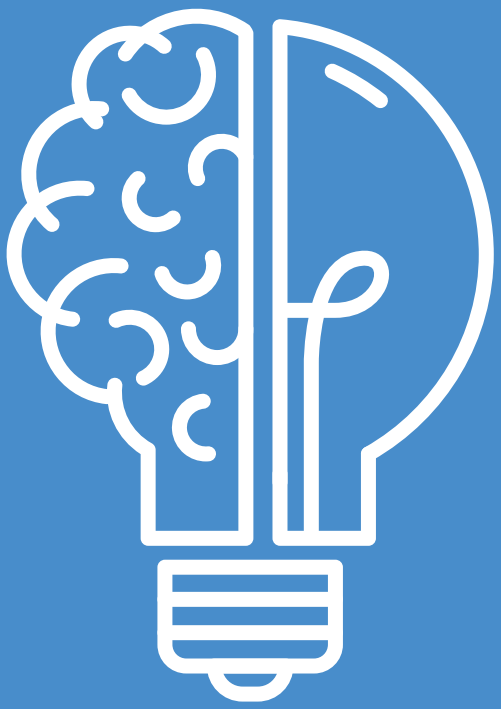
Embrace the change

As anaesthetists, we manage a large spectrum of patients from neonates to centenarians. These increasingly complex cases, with a range of co-morbidities, require us to be at the forefront of innovation. Novel ideas, methods, drugs and technology are continually being introduced into our practice with the aim of improving patient care. Whether it is a new management guideline, a safer muscle relaxant, a sophisticated piece of airway equipment or a more advanced ventilator, anaesthetists have to ensure that their practice evolves along with the current evidence. Something that was popular one day can easily go out of fashion the next. I remember my first experience of neuroanaesthesia as an ST4. The union of remifentanil and desflurane was a widely used anaesthetic combination. I returned to the same hospital not quite three years later, and as I reached to turn on the desflurane the consultant looked at me as though I had killed his cat! It amazed me that something so commonplace only a short while ago was now frowned upon. This highlights the dynamic nature of our speciality - there will always be new and exciting ways of delivering patient care.



Innovation brings great promise but it also necessitates change. People are creatures of habit. We are hardwired to resist new approaches, behaviours and practices [1]. I know that I am guilty of being reluctant to try something new, instead choosing the more familiar option. We have all worked with someone who declares that they 'never' use a particular drug or 'always' use a specific type of tracheal tube. This mind-set only worsens the culture of resistance. Although finding a method that works for you and delivers the best care to the patient is vital, it is also important not to shy away from the opportunity to try something new.

As anaesthesia trainees, we are in the privileged position of being able to learn from a large number of experienced consultants and senior colleagues on a regular basis. We are also exposed to several different hospitals as we rotate. We have no choice but to embrace new computer software, equipment and guidelines every time we move. We have to be flexible in our approach, continually adapting and developing as we progress through training. How do we ensure that this resilience remains with us throughout our careers?

Firstly, we need to be aware of these challenges and take advantage of our training from the start. Personally, I look for opportunities to use something different such as an item of equipment to secure the airway. The best place to start is on an elective list with a consultant. If you experiment with alternative methods under supervision, you will feel more confident to do this alone. Occasionally, I opt for a different drug to my normal practice. This fosters adaptability, so I won't be out of my comfort zone if my usual drug is absent or in short supply. Don't be afraid to step forward and try something new. View it as a chance to hone your technique and improve patient care.

Anaesthesia will always be a progressive and forward-thinking specialty, so let us create good habits now that will see us through our 40-year careers - that's 40 years of innovation! Let's start early, learn to be flexible anaesthetists, and relish the change so that we can reach our full potential.

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Twitter: @TaraByott

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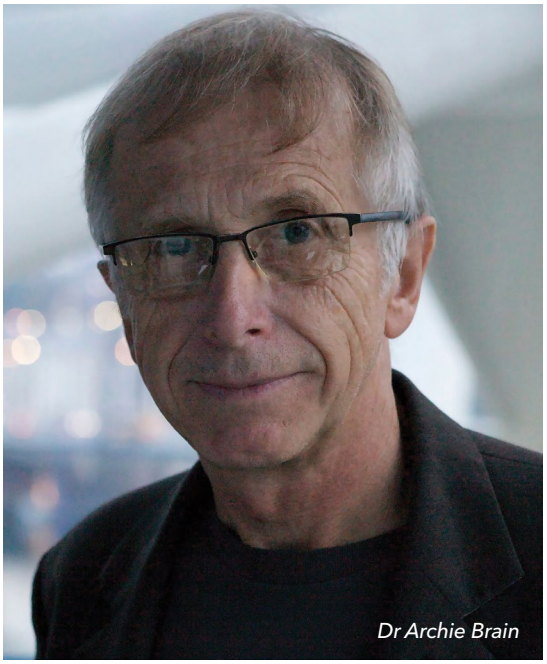
Archie Brain: celebrating 30 years of development in laryngeal mask airways

T.C.R.V. van Zundert, J.R. Brimacombe, D.Z. Ferson, D.R. Bacon and D.J. Wilkinson

Summary
The practice of anaesthesia was revolutionised by the ideas of Archie Brain. The routine use of a facemask to manage the airway was not a hands-free technique, despite the development of various harnesses, and made adequate record-keeping difficult. The tracheal tube was frequently associated with morbidity, which some felt was unsuitable for day surgery. Brain developed an airway management device that was less stressful to the patient than tracheal intubation, yet was, however, as safe as using a facemask and airway. Brain also hoped his device would function for cases where mask ventilation was particularly difficult and thus give anaesthetists a safer alternative to a complex intubation, especially in emergency scenarios.



Dr Archie Brain

Before the invention of the Laryngeal Mask Airway® (LMA) by Brain in 1981, the airway was maintained by tracheal intubation or facemask +/- oropharyngeal airway. The 30 years in the review title covers the period from the publication of his first clinical trial until the introduction of the LMA® Supreme™, and describes his drive to develop the LMA from the initial concept to a clinically usable device, and then to multiple diverse products with specific functions besides providing a patent airway. He sometimes tested more than one prototype (some of which are pictured in the article) in a day, and the time required to manufacture these resulted in the failure to publish significant amounts of his work.

The article notes that "(ethics) approval in those days carried no constraint with regard to the number of patients studied…. the practice took several years. It would be difficult to do this today", and so the early clinical trials were open-ended as different prototypes were assessed. However, this exhaustive process meant that, when factory manufacturing in a range of sizes commenced in 1987, the device was fully functional [1] and its use spread rapidly in the UK over just a few years.

Besides its use as a primary airway device, the potential of the LMA for rescue after failed intubation shortly became apparent, especially in obstetric cases. This led to the Intubating LMA (now LMA® Fastrach™), which again could be used both electively or as a rescue device, but with much improved success rates for tracheal intubation. Continued development led to the LMA® Supreme™, combining features of the Intubating LMA with increased airway seal pressure and an oesophageal venting lumen, and research continues to this day [2]. Since this review by van Zundert, even more variants have emerged.

For the majority of UK anaesthetists, the pre-LMA days are ancient history, and the LMA (or other supraglottic airway devices) are preferred so comprehensively that the skills of tracheal intubation and facemask-holding are considered to be inadequately acquired. A massive change brought about by one man!

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Consultant Paediatric Anaesthetist, Birmingham Children's Hospital.

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Join us at the UK's leading scientific conference for anaesthetists in training, first year consultants, foundation doctors and medical students.

Trainee Conference 2021 goes hybrid

8-9 July 2021, St James' Park, Newcastle

As restrictions start to lift, there is a great desire to get back to attending conferences in person, so the Association is planning to hold its forthcoming Trainee Conference 2021 as a hybrid event.

Experience the Association's very first hybrid conference, as we present to you a spectrum of innovative educational activities for anaesthetists in training, first year consultants, foundation year doctors and medical students.

- Attend in person in Newcastle upon Tyne, or virtually through the Trainee Conference 2021 online platform to learn, network and socialise safely!

What you can expect by attending

Your learning experience begins the moment you register for the Trainee Conference 2021 platform, as you'll immediately become part of a connected community engaging with your peers before, during and after the conference dates.

The beauty of a hybrid conference means that you will not be limited by time or geographical location. You can choose to attend face-to-face in Newcastle or virtually from anywhere worldwide, while learning live or on-demand. Plus, all delegates booked onto Trainee Conference 2021 will have priority access to all of the conference content straight after the event to watch at their leisure for up to 3 months.

Tailored learning

- Access Trainee Conference 2021 scientific programme, designed specifically for those starting out in their career as an anaesthetist.
- Catch up on the latest developments in anaesthesia, sustainability and wellbeing.
- View the hundreds of e-posters submitted for Trainee Conference 2021.
- View our live symposia and meet our virtual exhibitors.

Some confirmed sessions

- ICU
- Pain
- Peri-operative medicine
- Sustainability
- Artificial intelligence

COVID-19

We are closely following the UK government guidance on mass gatherings. We are planning for a hybrid conference in the hope that guidance allows us to run the face-to-face element by the time the conference takes place.

The event will comply with the most up-to-date government COVID secure guidance. This inevitably might change the conference experience, but will not affect the delivery of high-quality educational content.

Join us at Trainee Conference 2021

As is customary, members of the Association benefit from special booking rates, including a special early booking discount.

For booking, and to find out more about the first hybrid Trainee Conference, go to **anaesthetists.org/TraineeConference**. Alternatively, follow the conversation via social media at **#TC2021**.

Companies who are interested in sponsorship or exhibition opportunities should contact the Association of Anaesthetists Events Team events@anaesthetists.org

"While training may have been affected due to COVID-19, learning has not! Trainee Conference 2021 in Newcastle will not be dwelling on missed opportunities, but celebrating what we have learned about ourselves and our art. Book your place on the first hybrid (face-to-face and virtual) anaesthetic conference that the Association of Anaesthetists have ever held! Keep your eyes peeled for the programme, and get your study leave booked!"
Dr Dick Burnham, Chair, Local Organising Committee

"Thank you for a conference that tackled so many current concerns. The Association really have their finger on the pulse of their members, and all the lectures I attended were so helpful in formulating my thinking. Again, I repeat my gratitude in supporting us every step of the way in these demanding times."
Delegate, WSM 2021

"Trainee Conference 2021 is an exciting new way to learn that puts you in control. You have the flexibility to chose to attend face-to-face or from the comfort of your own home or work. Dip in and out of live sessions, and engage in real time with sessions, speakers, peers and exhibitors. And don't forget, all of this can be viewed on demand, any time after the event. Learning has never been so convenient or flexible."
Mr Zack Puttock, Events Manager

Association of Anaesthetists

Book online today

anaesthetists.org/TraineeConference

There's some old guy in my shaving mirror (just don't catch his eye)

Well that sucked. Boris said three weeks. I definitely got the impression it was all going to be over by Christmas, although that's been said before in even graver circumstances than those in which we just found ourselves. So when can we start to take stock of the strangest yet most featureless year that most of us have lived through to date? Perspective depends on viewpoint, so hats off to the guys at the pointy end of this pandemic. Maybe the only way to measure one's contribution towards battling the Bat Flu was the hours one spent in PPE, because before PPE, the life of a jobbing anaesthetist or intensivist was pretty cushty, if we're honest. Sure, there were minor irritations such as surgeons, trainees, medical students and trying to understand the pension scheme, but that was about it. There is a theory that given an infinite number of medical students and an infinite number of cannulae, one of the little treasures will eventually get one in a vein, if just by accident. However, the Pangolin Pandemic swept everything normal away. The medical students went off to have a crash course in medicine and became de facto doctors overnight. The trainees all disappeared to ITU, and, well, it's not entirely clear what the surgeons got up to. One local Trust furloughed the vast majority of their surgeons, just to make it appear official.

In 2020 BC (Before COVID), anaesthetic departments could be broadly divided into three groups; the intensivists (work one week, followed by four off; what do you mean that's not fair?); the generalists (work all the time but not particularly hard) and the chronic pain guys (answer emails, but no positive sightings in years). In 2020 BC, all previous norms were flung out the door. The departmental laminator, usually the exclusive preserve of the keen to impress locum consultant, became central in the fight against the pandemic as a means of propagating the everchanging COVID-19 protocols. I'm not saying that if you've read one COVID-19 theatre protocol, you've read them all, but the incentive to digest one when you know the updated one is likely to appear the next day is low. Long-departed colleagues returned from retirement to dispense wisdom, bonhomie and apologies that, as they technically belonged to the highly vulnerable group on account of their age, they regretfully could only anaesthetise elective patients, of which there were few. The return of the retirees was interesting for the restless and slightly jaded group of anaesthetists who are coming up to retirement. Just a few years younger, we still think we've got it. The danger signs are obvious. In departmental meetings, or, God help us, national or international meetings, we'll pop up our hands in the 'any questions' section after a lecture and offer some 'helpful' historical context to the matter under discussion. I still think that if I put on some sunglasses, I bear an uncanny resemblance to Tom Hardy, although the last time I accidentally caught my reflection in a shop window (and it's always accidental nowadays) it looked like Mr. Potato Head had bought himself some Ray-Bans. I see why vampires avoid mirrors - if I was 700 years old I'd avoid them too. Another issue is the use of outdated idioms. Using terms such as 'belt and braces' as a reference to your copper-bottomed approach to safety to a generation who wear their jeans below their greater trochanters is unlikely to make much sense. Ditto the term 'copper-bottomed'. It's also unlikely 'dotting the i's and crossing the t's' means much to them as the computer or tablet tends to do that for you. Don't get me started on dancing on departmental nights out (remember them?). The two clear signs that you have probably drunk too much and are now in the wrong place doing the wrong thing are typified by thinking to yourself 1) "I'm dancing particularly well tonight, I've still got it", and 2) "What I need to take my dancing to the next level is an enormous brandy".

Just go home. Run if necessary.

Where we do have a role, away from the protocol-writing and laminating, is as a safe and avuncular (the female equivalent is materteral) presence in theatre so that novice anaesthetists, despite trying their utmost to bring the operating list to its knees, can learn the fine art of anaesthesia in full safety. I was explaining my own start in anaesthesia to a new trainee the other day, explaining how I'd been paired up with two elderly consultants, both close to retirement. And in a rare act of insight, I realised I was describing myself. Sometimes you don't need a mirror to catch your reflection.

The Hedgehopper

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Anaesthesia

75 ANNIVERSARY

Peri-operative medicine, critical care and pain

Special online supplement:

The importance of women's health in peri-operative care

Published online 8 March 2021

Anaesthesia Digested

May 2021

Observational study of pre-operative intravenous iron given to anaemic patients before elective cardiac surgery

Evans ER, Jones R, Phillips G, Greene G, Phillips M, Morris-Clarke R.

The role of the anaesthetist as peri-operative physician entails optimisation of physiological parameters and management of chronic disease prior to scheduled surgery to increase the likelihood of positive outcomes. In this retrospective cohort study, data from 447 patients who were pre-assessed and eventually underwent elective cardiac surgery between 2015 - 2017 were analysed to assess the impact of a new pre-operative anaemia protocol on day of surgery haemoglobin and blood transfusion requirements in the peri-operative period. According to the 'Cardiff Pathway', patients identified pre-operatively with iron deficiency anaemia received a single dose of 20 $mg.kg^{-1}$ intravenous iron; those without iron deficiency anaemia did not receive iron. At the time of pre-assessment, one-third of patients were anaemic, and approximately half of these patients received intravenous iron; of the patients who received iron, one-third were treatment responsive and were no longer anaemic by the time they arrived for surgery. In between pre-assessment and surgery, one in 15 non-anaemic patients became anaemic. Patients who were not anaemic pre-operatively and treatment-responsive patients were equally likely to avoid blood transfusion in the peri-operative period.

Evaluation of N95 respirators, modified snorkel masks and low-cost powered air-purifying respirators: a prospective observational cohort study in healthcare workers

Clinkard D, Mashari A, Karkouti K, Fedorko L.

The COVID-19 global pandemic has tested supply chain reliability for personal protective equipment in every facility that has cared for COVID-19 patients. With shortages of disposable N95 masks a fairly common occurrence early in the pandemic, clinicians and innovators took to designing their own reusable respirators. One such example is the 'snorkel mask', which consists of a commercial underwater snorkelling mask and disposable high-efficiency filter connected by a custom adapter. The snorkel mask can also be upgraded to a powered air-purifying respirator (PAPR) with the addition of relatively low cost parts and 3D-printed adapters, but this device had not been rigorously tested against the gold standard of disposable N95 masks. In this volunteer study, quantitative fit testing was performed in a sample of 51 healthcare workers for the N95 mask, snorkel mask with high-efficiency filter, and snorkel mask with PAPR upgrade. The snorkel mask with PAPR had the lowest failure rate, and the fit of the snorkel mask with or without PAPR was higher than the N95 mask. Despite passing qualitative fit testing with the N95 mask, 35% of participants failed overall quantitative fit testing and 59% failed an individual step. In comparison, 8% of participants wearing the snorkel mask with high-efficiency filter failed the overall quantitative fit test, and 20% failed an individual step. There were no failures with the PAPR and snorkel mask. This study raises concerns regarding the reliability of qualitative fit testing, and supports the use of PAPRs for consistent respiratory protection.

N.B. the articles referred to can be found in either the latest issue of *Anaesthesia* or on Early View (ePub ahead of print)

Edward Mariano, Editor, *Anaesthesia*

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Connected for your learning

We're delighted to bring you exciting news that we are planning for this year's Trainee Conference and Annual Congress to take place as **new hybrid events**. Attend online or face to face and stay connected for your learning and CPD. You'll also receive online access to all of the conference content to watch back.

Trainee Conference

#TC2021

8-9 July 2021, Newcastle

Trainee anaesthetists, first-year consultants and medical students, there has never been a better time to book your place for **Trainee Conference!** Join us online or in person. Special rates for Association members.

Book today: **anaesthetists.org/TraineeConference**

Annual Congress 2021

#AC2021

***22-24 September 2021, ACC Liverpool**

This September the Association's flagship conference comes to Liverpool and you're invited! As a new hybrid event, you are able to attend in person or online. Booking opens soon. Special early rates for members.

Register your interest today at **anaesthetists.org/AnnualCongress**

*The number of days for Annual Congress may be subject to change.

Association of Anaesthetists

Association conferences and COVID-19

We are closely following UK government guidance on mass gatherings. We are planning for hybrid conferences in the hope that guidance allows us to run the face to face element by the time these meetings are due to take place. These conferences will comply with the most up to date government COVID secure guidance. For more information visit our website.

anaesthetists.org

Out of Programme Fellowship in Environmentally Sustainable Anaesthesia

The Association of Anaesthetists, Newcastle upon Tyne Hospitals NHS Foundation Trust and the Centre for Sustainable Healthcare are seeking to appoint a **fellow in environmentally sustainable anaesthesia**. This is an exciting 12 month out of programme experience post (OOPE). The fellowship will start in August 2021.

The aim of the fellowship is to improve the evidence base underpinning environmentally sustainable anaesthesia, establish what best practice looks like, define and remove barriers to best practice implementation and to share these findings with the wider anaesthetic and medical communities. The role will comprise a split of 50:50 clinical to academic work with on-call commitments.

This role would be suitable for a trainee at any stage of anaesthetic training. The fellow will work closely with the Association's Environment and Sustainability Committee.

The Centre for Sustainable Healthcare will provide educational supervision and advice and support for the fellow, in addition to allowing access to their in-house resources and networks.

For further information and an application form please visit **https://anaesthetists.org/Home/About-us/Staff-vacancies** or contact **secretariat@anaesthetists.org**.

Closing date for applications: **17:00 on Tuesday 1 June 2021**. Interviews will be held on Friday 25 June 2021 at the Freeman Hospital.

Association of Anaesthetists

NHS
The Newcastle upon Tyne Hospitals
NHS Foundation Trust

CENTRE for SUSTAINABLE HEALTHCARE
inspire • empower • transform

The Barema & Association of Anaesthetists Environment Award 2021

The Barema and Association Environment Award is an annual prize awarded to the single best initiative or project related to anaesthesia, intensive care or pain management that has had and will continue to have a measurable beneficial effect on the environment.

The winner will receive a cash prize and a grant for further support and development of the project and will be invited to present their work at Annual Congress 22-24 September 2021.

For more information, please visit
https://anaesthetists.org/Home/Get-involved/Grants-awards-and-prizes/Barema-Association-Environment-Award.

The deadline for submissions is **23:59 on Wednesday 2 June 2021**.

Association of Anaesthetists

barema

Particles

Kaufner L, von Heymann C, Henkelmann A, et al.

Erythropoietin plus iron versus control treatment including placebo or iron for pre-operative anaemic adults undergoing non-cardiac surgery

Cochrane Database of Systematic Reviews 2020. DOI: 10.1002/14651858.CD012451.pub2.

Background

Between 27% - 39% of patients undergoing non-cardiac surgery have pre-operative anaemia [1]. This is a risk factor for adverse outcomes and frequently results in the need for peri-operative blood transfusion. Recombinant human erythropoietin with iron supplementation has been used to increase pre-operative haemoglobin concentration, with the aim to reduce complications and specifically the need for peri-operative blood transfusion [2].

Methodology

The authors reviewed and statistically combined all available published randomised controlled trials comparing erythropoietin plus iron therapy (enteral or parenteral) with control treatment in anaemic adults undergoing non-cardiac surgery. Anaemia was defined as < 13 $g.dl^{-1}$ in males and < 12 $g.dl^{-1}$ in females. The controls comprised placebo, no treatment, or 'standard therapy' with or without iron. Erythropoietin was classed 'low dose' (150-300 $IU.kg^{-1}$ body weight) and 'high dose' (500-600 $IU.kg^{-1}$). The primary outcome was the need for red cell transfusion intraoperatively, or within 5 days of surgery. The secondary outcomes were: pre-operative haemoglobin concentration; number of red cell units transfused; mortality; length of stay; and adverse events.

Results

Twelve eligible trials were included with 1880 patients. Most studies included patients with mild anaemia (Hb 10-12 $g.dl^{-1}$) undergoing orthopaedic, gastrointestinal or gynaecological procedures. Erythropoietin dosing regimens ranged from once daily to once weekly for varying periods pre-operatively.

Pre-operative erythropoietin plus iron reduced the need for red cell transfusion (risk ratio 0.55; 95%CI 0.38-0.80), or 231 fewer patients received transfusion per 1000 participants. In those transfused, the number of units received remained mostly unchanged with a mean difference (MD) -0.09 (95%CI -0.23 - 0.05). Pre-operative haemoglobin concentration was increased in those receiving high dose erythropoietin, MD being 1.87 $g.dl^{-1}$ (95%CI 1.26 - 2.49), but not with low dose. There was little or no evidence of a difference in 30-day mortality, adverse events, and hospital length of stay between intervention and control groups.

Quality of the evidence, using the GRADE score, was deemed moderate for need for red cell transfusion, number of RBC units transfused, mortality, and adverse events. It was deemed low for pre-operative haemoglobin concentration, sub-groups, and hospital length of stay.

Discussion

The generalisability of the findings are limited by the fact that the participants were from a limited number of surgical specialities, no participants had anaemia with a haemoglobin < 10 $g.dl^{-1}$, there was variation in erythropoietin treatment regimens and in the route of iron supplementation. The cause of pre-operative anaemia was not established for the participants, and iron status was not a factor in the decision to provide iron supplementation.

Conclusion

This carefully conducted and reported Cochrane systematic review provides evidence describing one option for the management of pre-operative anaemia. The translation of this research into improving our peri-operative anaemia pathways and blood conservation strategies could make a difference for the peri-operative care of patients and for conserving our finite blood resources.

Henry Collier
ST6 and Cochrane Clinical Dissemination Fellow
Manchester Royal Infirmary

Christopher Darwen
ST5 and Cochrane Clinical Dissemination Fellow
Wythenshawe Hospital

References

1. Musallam KM, Tamim HM, Richards T, et al. Preoperative anaemia and postoperative outcomes in non-cardiac surgery: a retrospective cohort study. *Lancet* 2011; **378:** 1396-407.
2. Canadian Orthopedic Perioperative Erythropoietin Study Group. Effectiveness of perioperative recombinant human erythropoietin in elective hip replacement. *Lancet* 1993; **341:** 1227-32.

Your letters

Send your letters to: The Editor, *Anaesthesia News* at **anaenews.editor@anaesthetists.org**

Please see instructions for authors on the Association's website **www.anaesthetists.org**

Dear Editor

Defective valve in a Venflon™ cannula

A woman presented for elective caesarean section. She had difficult venous access, but eventually a 16-G BD Venflon™ Pro Safety was sited in the left antecubital fossa. Attempts at spinal anaesthesia failed, so general anaesthesia was induced. Following injection of propofol and rocuronium through the injection port of the cannula, there was immediate reflux of blood. Although we were concerned that a quantity of the drugs had been lost, the patient appeared anaesthetised and paralysed; laryngoscopy and intubation were completed uneventfully. Blood continued to flow freely out of the closed injection port of the cannula, in spite of attempting to occlude the tip of the cannula through direct pressure. A second cannula was placed in the right hand, and the defective cannula was removed. The case continued without further incident.

There appeared to be a problem with the one-way valve in the injection port, which only leaked after the induction injections. The incident was explained to the patient, and reported locally in our hospital and to the MHRA.

The cannula was returned to BD for analysis; they found that the injection one-way valve had moved in the cannula hub, causing the problems that we experienced.

Christina McCarroll
ST7 Anaesthesia
Health Education North East

Amir Rafi
Consultant Anaesthetist
University Hospital of North Durham

BD have been contacted for a response.

A reply from MHRA:

MHRA ref CSC 36607: MHRA is an arm's-length government organisation responsible for overseeing the regulation of medical devices used in the UK. The regulatory system contributes to the overall need to protect public health and increase patient safety, while facilitating the safest access to medical devices used to treat and care for patients.

The MHRA noted a safety signal in November 2020 for the BD Venflon Pro Safety device, and in collaboration with the manufacturer we initiated a rapid investigation. The manufacturer subsequently found the cause for port leaks was an internal valve failure, and has revised procedures and implemented corrective actions for the manufacture of devices across their range of cannulae.

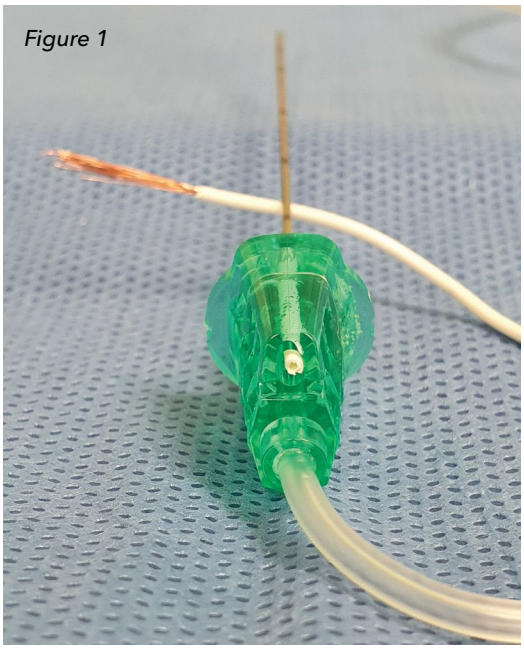
In our discussions with the manufacturer, we agreed the clinical imperative for these devices took precedence over the small risk of leaks occurring during use, even though they could pose a significant hazard should a leak occur. Therefore, the MHRA recommended the manufacturer should publish an advisory Field Safety Notice (FSN) to alert UK healthcare professionals of the potential problem. This publication included advice for them to follow when using these devices. The MHRA continues to work with the manufacturer while they implement their safety actions to remove this identified risk from the UK healthcare system. As is normal in such circumstances, we will actively monitor the situation and, if necessary, we will adapt our approach if any new information emerges which requires us to do this. To assist us in our endeavours, the MHRA would very much welcome reports of any further or similar incidents coming to the attention of the anaesthesia community. As always, we are extremely grateful to them for the fruitful collaboration we normally enjoy, as part of their well-recognised commitment to patient safety.

Dear Editor

Diagnostic problem during ultrasound-guided supraclavicular block – an iatrogenic cause.

We use Stimuplex® Ultra 360 nerve block needles (B. Braun, Melsungen, Germany) for ultrasound-guided nerve blocks. It is common practice in our department to tear off or cut the stimulator wire if it is not being used so that it does not enter the block field (Figure 1).

Figure 1



After doing this on one occasion during supraclavicular block, air was aspirated into the syringe, and continued even after changing the needle position. We ruled out pneumothorax as the needle tip was well clear of the pleura. We proceeded with local anaesthetic injection, the block was satisfactory, and no complications ensued.

After the procedure, we tested the needle by aspirating while the tip was immersed in liquid, and again air bubbles appeared. The air was entrained through the hole left where the stimulator wire passed through the hub.

Pneumothorax is a significant complication of supraclavicular block. It is worth abandoning any practice that might contribute to diagnostic confusion in this regard.

Ahmed Shehata
Anaesthesia Registrar

Victoria McMullan
Consultant Anaesthesiologist
Tallaght University Hospital, Dublin, Ireland

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Your letters

Send your letters to: The Editor, *Anaesthesia News* at **anaenews.editor@anaesthetists.org**

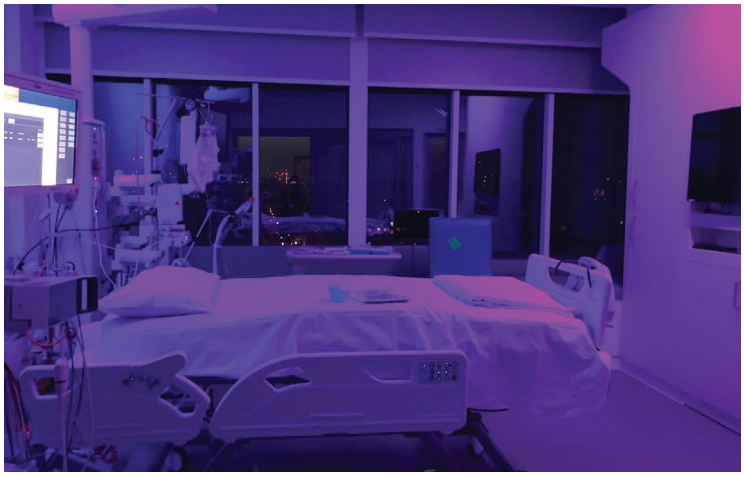
Please see instructions for authors on the Association's website **www.anaesthetists.org**

Dear Editor

High-'lighting' a potential airway safety issue

Continuous low-level violet light may be employed in ICUs at night to provide staff with sufficient illumination to undertake interventions, while minimising disturbance of patients' sleep and circadian rhythm (Figure 1). We wish to report a potential for serious error in emergency airway management, similar to the effect of blue-green operating theatre lighting used during laparoscopic surgery on the appearance of colour-coded drug labels [1].

Figure 1



The tracheostomy bedhead sign, with its emergency management algorithm, has a standard green colour (Figure 2) and the laryngectomy sign is pink (Figure 3). However, the tracheostomy sign appears pink under violet light (Figure 4). We suggest that the colour of the bedhead signs provides staff with the critical visual cue about the type of 'neck-breather' they are attending in an airway-related emergency such as dislodgement or obstruction, and the misleading effect of violet light on colour perception might lead to life-threatening delays or mistakes in airway management.

All staff working in ICU overnight should be made aware of this potential problem. Additionally, handovers between staff should always identify patients who are neck-breathers, and distinguish between those with tracheostomy or laryngectomy. This is particularly relevant during the COVID-19 pandemic, when ICUs may be staffed by less experienced staff who have been redeployed.

Xiaoxi Zhang
Specialist Trainee in Anaesthesia

Linsey Christie
Consultant Anaesthetist and Intensivist

Patrick Ward
Consultant Anaesthetist and Airway Lead
Chelsea & Westminster Hospital, London

References

1. Miu K, Chin J, Harding L. Theatre lighting: a potential cause of drug errors. *Anaesthesia News* 2018; **Issue 374:** 31.

Figure 2

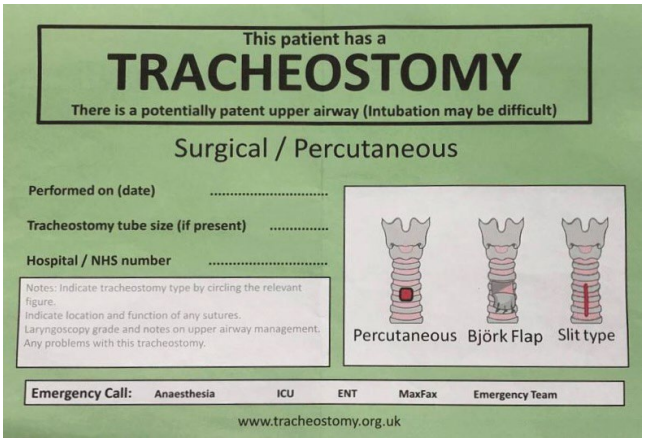


Figure 3

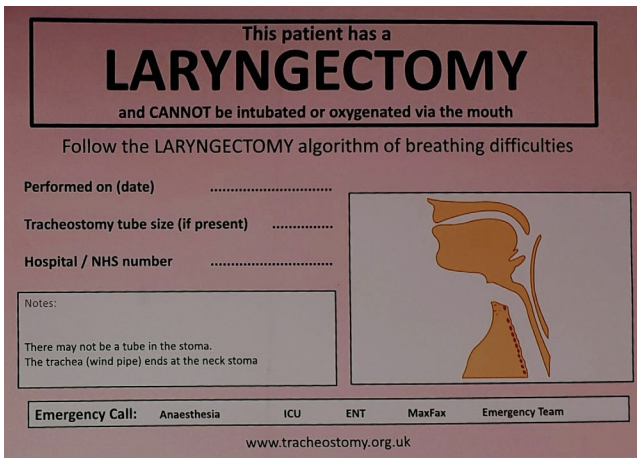
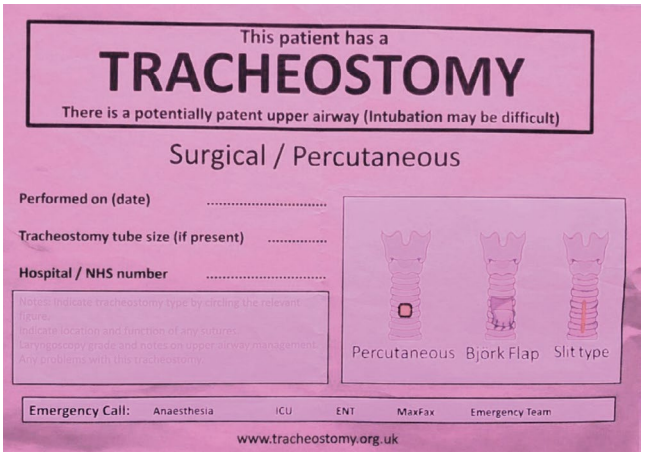


Figure 4



Congratulations to Patrick Ward for winning May's Letter of the Month prize.

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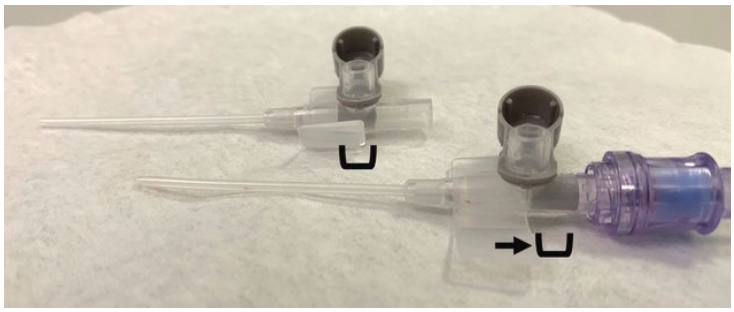
Dear Editor

If you feel a pop, stop!

We anaesthetised a patient undergoing a temporal craniotomy with propofol and remifentanil TCI using a 20-G peripheral venous cannula located on the patient's forearm. Subsequently, we sited a second 16-G cannula in the left saphenous vein to use for the TCI infusions, as this would be in close proximity to the anaesthetic machine and always visible [1]. This was flushed with saline from a 20 ml syringe via the injection port. After a few millilitres had been administered, there was a tactile 'give' and an audible 'pop'. When the syringe was removed, blood refluxed out of the injection port. The cannula was removed and another cannula was sited in the patient's right leg; there were no further problems.

Upon review of the cannula, we found that the valve for the port had become dislodged distally (Figure 1). Subsequent testing revealed that anything administered through the hub of the cannula flowed out through the hub.



This case highlights the importance of carefully checking cannulae used for TIVA. Both tactile and audible abnormalities highlighted the issue in this case. We recommend that both the hub and injection port are flushed before declaring a cannula safe, and a quick visual assessment is performed after each drug administration.

Mark Parson
Jamie Gibson
Anaesthetic Registrars
Royal Sussex County Hospital, Brighton

Twitter: @jamielgibson1; @biopsychosoc

References

1. Nimmo AF, Absalom AR, Bagshaw O, et al. Guidelines for the safe practice of total intravenous anaesthesia (TIVA). Joint Guidelines from the Association of Anaesthetists and the Society for Intravenous Anaesthesia. *Anaesthesia* 2019; **74:** 211-24.

Letter of the Month prize

It's your *Anaesthesia News*… and we'd love to encourage more of our readers to share their opinions and experiences. A Letter of the Month prize will be awarded to the best letter each month. The winner will receive a £50 voucher to use against the cost of one of the Association of Anaesthetists educational events.

To increase your chances of winning:

- Keep it short (no more than 300 words)
- Be clear and accurate
- Use humour where appropriate
- Keep it topical

The award will be made at the discretion of the Editor, and his/her opinion will be final. No cash alternative will be available. The voucher will remain valid for 12 months.

Send your letters to:The Editor, *Anaesthesia News* at **anaenews.editor@anaesthetists.org**

Dear Editor

Syringes are not the only route

"What constitutes a problem is not the thing, or the environment where we find the thing, but the conjunction of the two." - from Oranges are not the only fruit by Jeanette Winterson

In January's *Anaesthesia News*, David Whitaker illustrates that there is still much to do in medication standardisation in anaesthesia [1]. The kaleidoscope of ISO 26825:2008 for syringe labels is now commonplace, but every medicine interaction is a point at which error and harm may occur and should be minimised. As a speciality though, we seem wedded to delivery of medicines in syringe form. Am I the only person who has an ODP roll their eyes when I ask for yet another 50 ml syringe of _____?

Syringe infusions are fine for short anaesthetics, but less so for long complex ones. Who hasn't repeatedly drawn up propofol into a syringe, whereas in ICU it will be delivered direct from the vial via an accurate gravity-fed, volumetric pump? When depleted, a vial is re-spiked with no delivery fluctuation. The same could be true for vasopressors, with no perilous double-pumping or hot swapping risking haemodynamic instability [2].

Isn't a TCI volumetric pump well overdue? The reduction of clinical time wasted and diverted from patient care in syringe preparation and changeover would improve safety. We can already deliver our vasopressors this way.

Some hospitals have already taken steps to address these issues by preparing ready-to-administer infusions in pharmacy. Lord Carter's report says "acute trusts should ensure their pharmacists and clinical pharmacy technicians spend much more time on clinical pharmacy services than on other activities, such as supply chain" [3]. So where commercially-made products that are licensed, ready to administer, and with long shelf lives, are offered, we should use them – they are now increasingly available.

Justin Kirk-Bayley
Consultant Intensivist & Anaesthetist

Naomi Boyer
CT2 Anaesthesia
Royal Surrey NHS Trust, Guildford

Twitter: @PARADicmSHIFT

References

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Your letters

Send your letters to: The Editor, *Anaesthesia News* at **anaenews.editor@anaesthetists.org**

Please see instructions for authors on the Association's website **www.anaesthetists.org**

Dear Editor

We recently surveyed the anaesthetics trainee body at our NHS Trust, to explore attitudes towards COVID-19 vaccination. Junior anaesthetists continue to be actively involved in caring for the most unwell hospital in-patients with COVID-19; this could influence strength of feeling towards accepting vaccination whilst also positioning them as relatively early adopters of a new intervention.

We aimed to ascertain trainee vaccine uptake, intent to have a vaccine if not already vaccinated, any reasons for not intending or being able to have a vaccine, and any additional thoughts or concerns. We designed and circulated an online survey to anaesthetic trainees of all grades in our Trust in early January 2021, shortly after the initial introduction of the Pfizer-BioNtech® COVID-19 vaccine.

Of 57 trainees, there were a total of 42 responses split evenly across training grades. The survey revealed widespread uptake of COVID-19 vaccination amongst anaesthetic trainees in our Trust, with the majority of trainees expressing no concerns regarding vaccine safety or efficacy. The survey was circulated around the time that the COVID-19 vaccination schedule was revised to extend the interval between doses from 21 days to 12 weeks, and captured opinions relating to this. Of note, a number of trainees expressed significant anxieties around potential delays to the second vaccine dose in the context of ongoing exposure to critically ill patients with COVID-19. We feel there is an argument for continuing to monitor trainee attitudes to COVID-19 vaccination as new candidate vaccines are approved and introduced, additional data regarding efficacy and safety are reported, and differing mutant-variants of COVID-19 are identified – particularly in the context of potentially profound changes in COVID-19 incidence and prevalence as the national vaccination programme progresses. The impact of changing protocols for protective therapies on the mental wellbeing of staff needs to be acknowledged.

Dr Julian Cumberworth
CT2 Anaesthesia

Dr Abhijoy Chakladar
Consultant Anaesthetist
Brighton & Sussex University Hospitals NHS Trust

Twitter: *@Chakladar_A*

Dear Editor

Fluid resuscitation for clinicians' recovery from the Coronavirus pandemic

Many NHS staff have been directly involved in the clinical management of patients suffering from COVID-19. As we look towards the end of lockdown, clinicians may be looking towards their own recovery. It is well established that clinicians working on ICU are often dehydrated, risking acute kidney injury [1]. We therefore propose some potential options for fluid resuscitation:

1. Rum-Desivir may be of use early in recovery, although the efficacy is yet to be proven in more chronic settings.
2. Dex-on-the-beach is perhaps the most widely accepted remedy and may mitigate against the development of severe symptoms.
3. Toci-eela Slammer and Prona-colada may be indicated if the individual develops a critical situation despite initial therapies.
4. Long Covid Ice Tea may have a role in some protracted cases with lingering symptoms.
5. Quarantini may be instituted at any stage in the recovery where necessary.

Of course, in the era of personalised medicine, clinicians will have their own unique needs and preferences. There may be several other cocktails and mocktails that can aid individuals' recovery. We invite our colleagues in the anaesthetic community to propose their own remedies.

Simon Cais
CT1 Anaesthetics

Barnaby Dykes
ST3 Anaesthetics
Frimley Park Hospital, Camberley

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Ann-Marie Crowe
Paediatric Anaesthesia Fellow
CHI, Crumlin, Dublin

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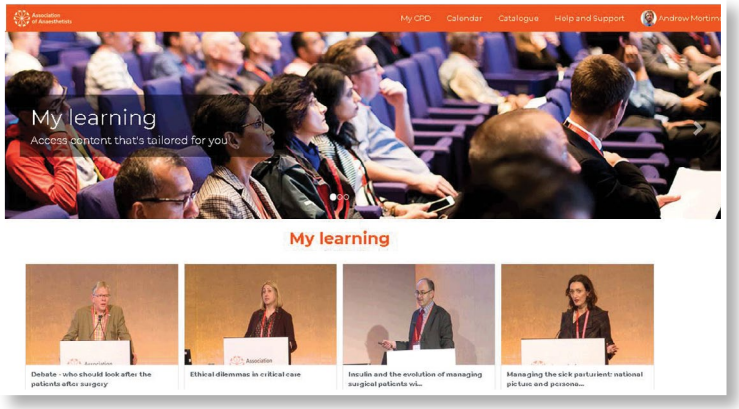

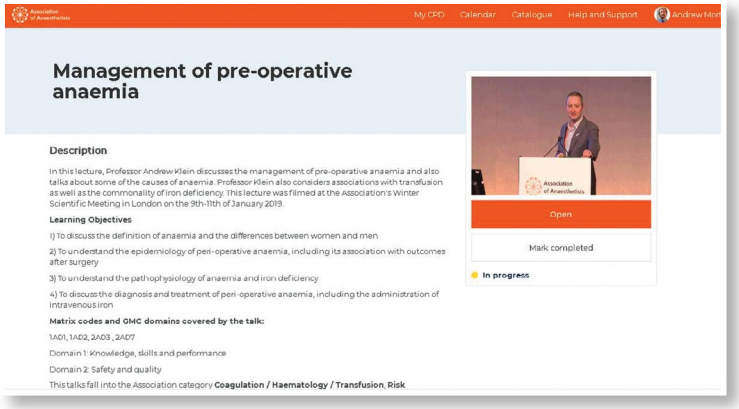

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Call for nominations for the Featherstone Professorship

Nominations are sought for the Association's 2021 Featherstone Professorship, which is awarded to practising clinicians and scientists who have made a substantial contribution to anaesthesia and its related subspecialties in the fields of safety, education, research, innovation, international development, leadership, or a combination of these.

Applications should be submitted using the application form available on the website **https://anaesthetists.org/Home/About-us/Honours-awards/Featherstone-Professorship**. Completed forms should be emailed to **honsecretary@anaesthetists.org** by **17:00** on **Friday 21 May 2021.**

The Association's Honours and Awards Committee will consider nominations at its meeting on 4 June 2021, and will make recommendations to the Board of Directors, which will determine the recipient of the 2021 Featherstone Professorship (if any) at its meeting on the same date. The successful nominee will be informed shortly afterwards. The award will be made at an Association conference.

Featherstone Professorships are held for two years, during which the holder will be required to deliver a Featherstone Oration at a major Association meeting.

Association of Anaesthetists

Call for nominations for the Association of Anaesthetists Award

The Association of Anaesthetists award is made by the Board to those who have made significant contributions to the Association of Anaesthetists and its charitable foundation, its objects and goals, or its members. The award is not restricted to members of the Association. The combined current objectives of the Association of Anaesthetists and its charitable foundation are:

a) to advance and improve patient care and safety in the field of anaesthesia and disciplines allied to anaesthesia in the UK, Ireland and worldwide;
b) to promote and support education and research in anaesthesia, medical specialties allied to anaesthesia and related sciences and the publication of the results of such studies and research;
c) to represent, protect, support and advance the interests of members;
d) to encourage and support worldwide co-operation between anaesthetists;
e) the advancement of public education in and the promotion of those branches of medical science concerned with anaesthesia, including its history.

Nominations should be submitted using the Honours and Awards nomination form available on the website, and should include a short description of the nominee's contributions (maximum 500 words). Self-nomination is acceptable. If you nominate someone else, you should gain their approval for your nomination. Nominations should be emailed to honsecretary@anaesthetists.org by **17:00** on **Friday 21 May 2021**.

Association of Anaesthetists

The Association's Honours and Awards Committee will consider nominations at its meeting on 4 June 2021, and will make recommendations to the Board, who will determine the recipients of the 2021 awards. The successful nominees will be informed shortly afterwards.
For more information visit **https://anaesthetists.org/Home/About-us/Honours-awards**

SAS professional development grant 2021

Up to £2,000

The Association of Anaesthetists awards this grant to enthusiastic SAS doctors who are Association members, for training and professional development opportunities.

The grant is intended to enhance the individual's experience, for example in attending clinical management, leadership and other educational skills courses or acquiring new skills which are relevant to the workplace, in particular where this improves the quality of patient care and improves service development. The total fund available is £2,000 and the awarding Committee may decide to grant multiple awards within the total available but in exceptional circumstances may award the full amount to one applicant.

The grant must not fund routine CPD activities which should be funded through normal study leave budgets, nor examination fees, exam preparation courses or college related fees.

For more details and to apply visit the website **http://anaesthetists.org/sas-grant**

Association of Anaesthetists

The closing date for applications is 30 September 2021 for consideration at the autumn meeting of the SAS Committee.

Anaesthesia Trainee Fellowship

Applications are invited for a 1-year Fellowship attached to the Journal, starting at the Journal Editors' meeting in November 2021.

The appointment will run concurrently with the Fellow's usual anaesthetic training programme.

The Fellow's roles will include involvement in general journal business including handling submissions (but not with direct responsibility). The Fellow must also:

- Attend the 6-monthly Editors' away days and Editorial Board meetings during their term;
- Attend the Association's Winter Scientific Meeting in January 2022, and **either** the Trainee Conference in July 2022 or Annual Congress in September 2022, and assist in the programmes as required.

The Fellow will be answerable to and supervised by three designated editors on a rotational basis throughout their Fellowship, and the Editor-in-Chief and Editorial Board. There will be no payment or honorarium but reasonable travel expenses to attend the above meetings will be met, according to usual Association policy. The Fellow and Editors/ Editor-in-Chief will compile a brief report at the end of the Fellowship, to be submitted to the Editorial Board and School of Anaesthesia/Deanery as appropriate.

Association of Anaesthetists

Suitable applicants must:

- Be post-FRCA (or equivalent);
- Not have a substantive non-training appointment offered or accepted at the time of taking up the post;
- Be a member of the Association of Anaesthetists;
- Have an interest in, and commitment to, advancement of the specialty via the areas described in the Association research strategy (http://www.anaesthetists.org/research);
- Undertake to maintain strict confidentiality regarding all journal/ Association activities;

Selection will be by a panel comprising the Editor-in-Chief, an Editor and a Trainee Committee representative.

Applications should comprise:

1. A brief (maximum one A4 page) CV, to include your current position, Association membership number and CCT date;
2. A summary (max. 300 words) of a) how you meet the criteria; b) what you can bring to the Fellowship; and c) what you hope to gain from it;
3. In your covering email, please include: i) the name and email address of your current or immediate past Educational Supervisor, who must be available to respond within a few days if contacted shortly after the closing date; ii) a statement that you hereby commit to informing the Editorial Office if you are offered or take up a non-training position between the date of application and the beginning of the Fellowship.

Applications must be received via email by **midnight on 31 May 2021** to **anaesthesia@anaesthetists.org**

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