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Latex aeroallergen pollution in the operating theatre: should latex allergic patients be scheduled first?

Charles Tacquard¹, Anh Poirot², Charles Nicolini¹, Thibault Verger¹, Martine Ott², Hervé Bouaziz³, Arnaud Florentin⁴, Frédéric De Blay^{2,5} and Paul Michel Mertes^{1,*}

¹Department of Anaesthesia and Critical Care, Strasbourg University Hospital, Strasbourg, France, ²Chest Diseases Department, Strasbourg University Hospital, Strasbourg, France, ³Department of Anaesthesia and Critical Care, Nancy University Hospital, Nancy, France, ⁴Department of Hygiene, Environmental Risks and Healthcare Associated Risks, Nancy University Hospital, Nancy, France and ⁵Federation of Translational Medicine, FHU Homicare, University of Strasbourg, Strasbourg, France

*Corresponding author. E-mail: paul-michel.mertes@chru-strasbourg.fr

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Editor—Latex allergy is a major problem in the operating theatre, although its incidence has been reduced by implementation of primary and secondary prevention measures.^{1,2} One of these secondary prevention measures consists in scheduling latex-allergic patients first on the operating list,³ although this can lead to organisational problems when the risk has not been correctly identified or in case of emergency surgery. This recommendation is based on the assumption that latex aeroallergen levels are lower at the start of the day. However, the effectiveness of this measure has never been confirmed by studying these levels.

We performed airborne latex allergen measurements in two operating theatres with different air filtration levels: an International Organization for Standardization (ISO) 5 operating theatre used for thoracic surgery (133.4 m³; 30 air changes h⁻¹) and an ISO 7 operating theatre used for urological surgery (151.2 m³; 16 air changes h⁻¹). Operating theatre air samples were taken from a polytetrafluoroethylene (PTFE) membrane using a cassette (Merck Millipore, Molsheim, France) connected to a pump (Fisher Scientific, Illkirch, France). The PTFE membrane was placed at the patient's head position for 10 working days. The air was sampled for 2 h at different times: at the start of the operating schedule (7 a.m. to 9 a.m.), between 11 a.m. and 1 p.m., and at the end of the day between 3 p.m. and 5 p.m. Additional samples were taken before the opening of the operating theatre (5 a.m. to 7 a.m.) in the ISO 7 operating theatre. Airborne latex allergen concentrations (*Hevea brasiliensis* [Hev] b1, Hev b3, Hev b5, and Hev b6.02) were measured using a monoclonal assay (Fitkit[®]; Ico-sagen, Tartu, Estonia).

During the study period, surgery was regularly performed in both operating theatres with a median opening of 9 [6–13]

and 7 [2–8] new non-powdered gloves in the first period and 2 [0–5] and 2 [0–7] non-powdered gloves in the last period, in the ISO5 and ISO7 operating theatres, respectively. The levels of Hev b5 and Hev b6.02 were consistently below the detection range in all samples. The levels of Hev b1 and Hev b3 according to filtration level and time of day are shown in Figure 1. In the ISO 5 operating theatre, the median [inter-quartile range] levels of Hev b1 and Hev b3 were 0 [0–29] and 20 [18–24] ng m⁻³, respectively, and remained constant between the three periods ($P=0.35$ and 0.76 , respectively). In the ISO 7 operating theatre, the level of Hev b1 increased significantly between the three periods from 75 [0–246] ng m⁻³ in the first period to 208 [0–348] ng m⁻³ in the last period ($P=0.04$). Before the start of the operating programme, Hev b1 was undetectable in seven of 10 of the samples and its median level was 0 [0–134] ng m⁻³ (detectable values: 92, 255, and 439 ng m⁻³). The concentrations of all latex allergens in latex non-powdered gloves from the same lot as those used in the ISO 7 operating theatre during the sampling period were highly variable with median levels of Hev b1, Hev b3, Hev b5, and Hev b6.02 of 0 [0–265], 228 [117–301], 320 [0–390], and 311 [253–317] ng g⁻¹, respectively.

Our study showed that despite a high level of air filtration and the standard use of non-powdered gloves, the major latex aeroallergens were still detectable regardless of the level of air filtration. Considering that the median latex allergen level was below the detection threshold before the opening of the operating theatre on most days, placing latex-allergic patients first on the operating list remains the safest strategy. The level of latex aeroallergens remained constant in the ISO 5 operating theatre and was well below the level of latex aeroallergens observed in the ISO 7 operating theatre, which increased progressively over the day. Three samples were

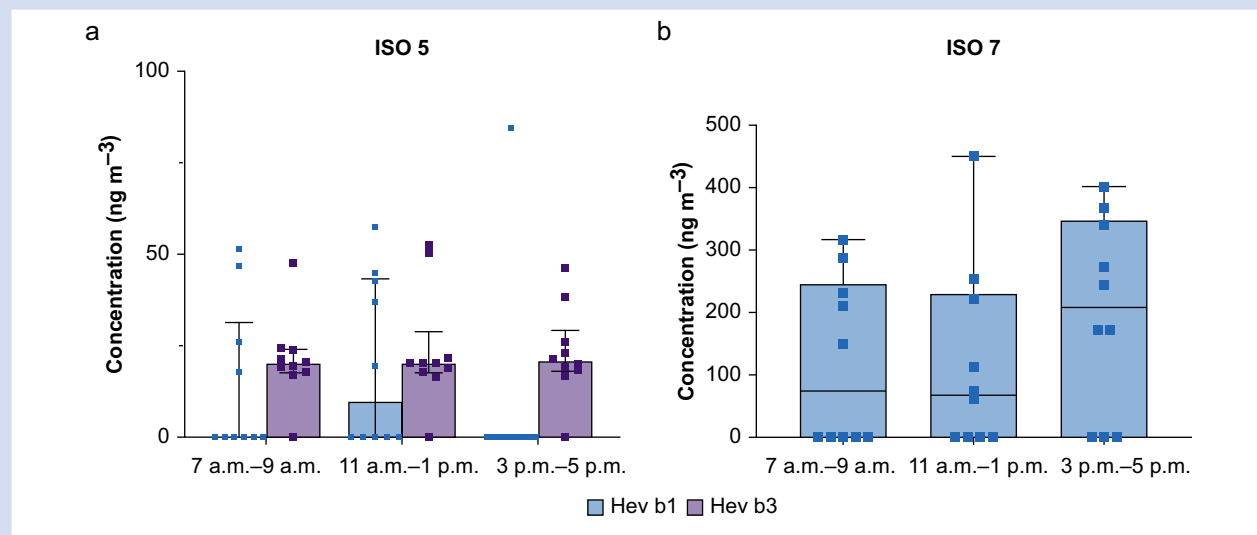


Fig 1. Daily changes in Hev b1 and Hev b3 levels in (a) ISO 5 and (b) ISO 7 operating theatres. Results are expressed as median with interquartile range.

above the detection threshold before the start of the list. As the ventilation in this operating theatre switches from a standby mode at night to a regular mode during the day during this period, turbulence may have resuspended latex particles.

The amount of latex allergens needed to cause a reaction is controversial with only limited data available. Most studies have focused on the level of air pollution. Baur and colleagues⁴ reported that 0.6 ng m^{-3} of latex allergens was sufficient to cause clinical signs of latex allergy, but that a latex level of $39\text{--}311 \text{ ng m}^{-3}$ was generally required to cause asthma or anaphylaxis.^{4–6} The methodology used to define these thresholds is highly questionable, and the lack of established data makes it difficult to correctly assess the risk of airborne latex-related allergic reactions. The level of latex aeroallergens observed in the ISO 5 operating theatre could be below this trigger level, allowing patients to be scheduled at any time of day.

The wide variability of our results is partly explained by the ballistic trajectory of latex particles, and therefore depends on the positions of the gloves and pump inlet. Hev b5 and Hev b6.02 are mainly present on the inner surface of latex gloves, which may explain why they were not found in our samples.⁷ Hev b3 was only found in the ISO 5 operating theatre. Hev b3 has a higher molecular weight and is more negatively charged than Hev b1.⁸ Thus, Hev b3 is less likely to be dispersed far from the source. As the ISO 5 operating theatre was used for thoracic surgery, the surgeon was closer to the patient's chest, and therefore much closer to the filter used to capture the latex particles. No other source of latex was identified in either operating theatre. The distribution of allergens in the gloves used in the ISO 7 operating theatre was variable, even when these gloves came from the same lot. The gloves in the ISO 5 operating theatre were another brand, and we were unable to analyse these gloves. Nevertheless, as reported by Peixinho and colleagues,⁹ most of the sterile latex surgical gloves had the same allergen content profile as the one we observed.

In conclusion, latex-allergic patients should still be placed first on the operating list whenever possible. If an emergency procedure needs to be performed on a latex-allergic patient, our results showed that the ISO 5 operating theatre offers a low and constant level of latex aeroallergens that allows surgery to be performed with minimal allergic risk, regardless of time of day.

Declarations of interest

The authors declare that they have no conflicts of interest.

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Avoiding aberrant paracetamol prescriptions in paediatric patients

Jacinth Y. X. Tan* and Stephen A. Roberts

Alder Hey Children's Hospital, Liverpool, UK

*Corresponding author. E-mail: jacynthtan@doctors.org.uk

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Editor—Since its introduction in 2004, intravenous paracetamol has become routinely used in anaesthetic practice for the management of acute pain. However, the National Patient Safety Agency issued a SIGNAL alert in 2010 that highlighted the risk of inadvertent overdose associated with its use with 206 incidents relating to paracetamol i.v. described, two resulting in severe harm and 14 in moderate harm.¹ Indeed, the errors highlighted by the Safe Anaesthesia Liaison Group include accidental overdose in children associated with 100 ml vials, 10-fold drug calculation errors, confusion between drug dose in milligrams and dose volume in millilitres, and dose duplication between the ward and operating room.²

Despite these national safety alerts and repeated reminders for anaesthetists to exercise caution when administering paracetamol i.v. in theatre, double-dosing and overdosing incidents persist in our institution. A push towards nurse-administered preoperative enteral paracetamol has reduced parenteral paracetamol use, but the i.v. formulation remains essential in our analgesic armamentarium for children who cannot or will not take enteral medications, or who undergo long operations. Paracetamol i.v. errors in theatres are likely to persist because of the regular arrival of new trainees on rotation who have limited paediatric drug dosing experience, yet who possess a perceived familiarity with paracetamol use. Regardless of experience, the systemic lack of medication checks with a second person that is inherent in anaesthetic practice is likely the root cause of this recurrent yet preventable problem.

In response, our anaesthetic department implemented a bundle of interventions aimed at improving paracetamol safety. Firstly, we restricted access by removing all paracetamol bottles from anaesthetic room drug cupboards and relocated them to a central store in the recovery area. To administer paracetamol i.v., anaesthetists are now required to consider, check, calculate, and chart this process of deliberation on an i.v. paracetamol request form (Fig. 1). This request form must be filled in only when the patient is in theatre and anaesthetised. The anaesthetist must first check the patient's medication administration record and surgical safety checklist for evidence of recent administration to ensure adequate dosing interval.

The form then prompts the anaesthetist to consider not just the child's weight but also the age when calculating the required dose. This reduces dose calculation errors, as the weight-based dose changes once a child crosses the threshold of being >44 weeks post-menstrual age. The form subsequently forces the anaesthetist to write down the volume of paracetamol they will actually administer, which reduces confusion between milligrams and millilitres, thereby minimising the 10-fold drug administration errors often seen with i.v. paracetamol. Finally, the form is completed by the selection of an appropriate-sized paracetamol ampoule/bottle that is needed to prevent inadvertent overdosage errors.

Upon completion, the form is handed over to an operating department practitioner (ODP) who retrieves the paracetamol from the central store. This process opens up opportunity for communication and for a second person to check the intended dose and its timing. Our paracetamol stock has been rearranged into three drawers labelled 'baby', 'child', and 'adult' containing 10, 50, and 100 ml bottles, respectively. This allows the ODP one more chance to check that the amount of paracetamol being retrieved is indeed appropriate for the size of the patient.

This added step requires anaesthetists to buy into the idea and comply with fully filling in the forms before drug administration. Our ODP colleagues also need to be diligent in checking them before handing any paracetamol over to their anaesthetists. It is thereby key to perform regular local audits to ensure best practice (e.g. forms are not completed in advance of patients being in theatre or before checking the drug administration chart, paracetamol is not collected without a form). After implementation, close monitoring of further paracetamol-related incidents will help determine its effectiveness in risk reduction. However, given that such incidents do not occur in large numbers in a single institution, perhaps the most effective way to assess if this simple intervention works would be to launch a national initiative and collect more data from multiple institutions.

There is a paucity of strong evidence for techniques to ensure safe drug administration during anaesthesia. At present, there is no evidence that a paracetamol prescription