Correspondence

Anaesthetists and care of the critically ill child 1

The recent editorial on anaesthetists and care of the critically ill child (Tomlinson. *Anaesthesia* 2003; **58**: 309–11) was both timely and sensible. After the 1990 NCEPOD report on deaths in children following surgery [1], there was an entirely appropriate movement to raise standards in the provision of anaesthesia for children. However, an excess of reforming zeal has led to the excellent becoming the enemy of the good. In pursuit of the highest standards, we have managed to scare some previously competent anaesthetists into perceived incompetence.

As the editorial points out, in an emergency involving the airway, any anaesthetist is better than none. In these circumstances, it is simply not acceptable to say 'I do not do children'. If one is the most competent anaesthetist available, one must do one's best. Indeed, the quoted guidance from the GMC makes this amply clear [2]. The corollary of this is that if things do not go well (short of actual negligence), support for the individual who did his/her best must be forthcoming from employers, colleagues, the medical defence organisations, and from the bodies who set the standards – the Royal College, the Association of Anaesthetists and the GMC itself. A clear statement to this effect would be both reassuring and helpful, and might do something to temper the growing reluctance of some anaesthetists to have anything to do with the care of this vulnerable group of patients.

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Anaesthetists and care of the critically ill child 2

I agree with the recent editorial (Tomlinson. *Anaesthesia* 2003; **58**: 309–11) that there are a number of potential ways to maintain skills and confidence regarding the resuscitation and early management of critically ill children in the district general hospital. In our region, South and West Wales, we have initiated a number of developments to facilitate this. District general hospital consultants have visited for a 'refresher' week to attend a mix of paediatric anaesthetic and intensive care sessions, including retrievals. Also, we have developed a 'Stabilisation of the Critically Ill Child Study Day' aimed at medical and nursing staff who have first contact with critically ill children. This is aimed at filling the obvious deficit between initial resuscitation, well covered by paediatric life-support courses, and the arrival of the paediatric intensive care retrieval team. This includes extensive coverage of advanced paediatric airway management, ventilatory strategy and cardiovascular support. This is part of a an extensive regional [1] outreach programme that includes basic life-support training and feedback sessions.

Lastly, exposure to paediatric intensive care in Specialist Registrar Training should be viewed as an effective tool to prepare for a district general consultant post, not just for those pursuing the speciality.

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Anaesthetists and care of the critically ill child 3

The recent editorial (Tomlinson. *Anaesthesia* 2003; **58**: 309–11) is well argued and puts into context the Royal College of Anaesthetist's flyer, which may have been poorly understood by

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some. However, I would like to make two additional points.

Whilst I applaud efforts to promote a team approach to the care of sick children, it is often the anaesthetist who does the bulk of the work. Colleagues in acute paediatrics and surgery must also keep their resuscitation skills current and, importantly, be willing to use these skills. As far as I am aware, the Royal College of Paediatrics and Child Health has not issued a similar flyer.

Units may wait many hours for retrieval teams to arrive, albeit with telephone advice in the interim. The vast majority of our general ICUs have not been specifically funded to perform the task of delivering level 2 care to children. Whilst we can reasonably expect on-call consultant anaesthetists to perform the initial resuscitation and airway management in children, the next 6 h of intensive care may be something they feel ill prepared to lead.

These issues need to be addressed if we are to make an impact on the quality of care of very sick children in the UK.

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Does the Internet provide safe information for pre-anaesthetic patients?

The importance of clear information for patients was emphasised in the recent article by Heidegger *et al.* [1]. Increasingly, people are using the Internet to further their knowledge of healthcare subjects. Unfortunately, the quality of this information is very variable and at times can be incomplete.

We decided to type the exact search phrase 'having an anaesthetic' into a search engine and review the first 10 sites. Waldman [2] reported on the dominance of the search engine 'Google', and hence this was used. A recent study by Eysenbach & Kohler [3] reported that people tend to look only at the first couple of websites from any search; thus, to obtain a brief snapshot of the information patients would access, this was the strategy used (Table 1).

Table 1 Website addresses.

Website	Address
Website A	http://www.brighton-healthcare.nhs.uk/PressPr/Trust%20Leaflets/anaesthetic.htm
Website B	http://www.ich.ucl.ac.uk/factsheets/operations/having_general_anaesthetic/
Website C	http://www.ich.ucl.ac.uk/factsheets/operations/having_general_anaesthetic/your_child_anaesth_lflt.pdf
Website D	http://www.royalmarsden.org/captchemo/child_guide/anaesthetic.asp
Website E	bulletin.ninemsn.com.au/bulletin/eddesk.nsf/All/4826751E0227B2D7CA256C0B00162E96
Website F	http://users.bigpond.net.au/kolivas/aip/pregnancy.html
Website G	http://users.bigpond.net.au/kolivas/aip/faq.html
Website H	http://www.mpssociety.ca/pubsform.php3
Website I	http://www.wcvh.com.au/services/surgery_anaes.htm
Website J	http://www.youranaesthetic.info/downloads/you_and_your_anaesthetic.pdf

A grid was produced, which made use of the American Medical Association Guidelines for medical and health information sites on the Internet [4], namely information about authors, reference sources, website ownership and currency. Additionally, six key questions about anaesthesia were asked, namely an explanation of an anaesthetic, the anaesthetist, the different kinds of anaesthetic available, the importance of pre-operative fasting, reasons for cancelling an anaesthetic and the main risks involved (Table 2). Items were scored on a three-star scale (from 0 to 3) with 0 representing no information, and 3 representing clear accurate information that provided a full explanation (Table 3).

Table 2 Questions.

(1) What is an anaesthetic?
(2) What is an anaesthetist?
(3) What kinds of anaesthetic can I have?
(4) Why should I fast before an anaesthetic?
(5) Why might my anaesthetic be cancelled?
(6) What are the risks?
(7) Evidence of who wrote the information.
(8) Reference base used.
(9) Information regarding who owns the website.
(10) Evidence of the currency of the information.

Five of the top 10 websites scored highly in most of the key areas. One of the top 10 websites could not be displayed, and one was a duplicate address. Interestingly, the fifth highest website concerned veterinary anaesthesia and offered the only adequate explanation for cancellation of anaesthetics. Of the first five listed by the

Table 3 The scale used to assess the Websites.

	Question									
Website	1	2	3	4	5	6	7	8	9	10
A	***	***	**	**	0	*	0	0	***	0
B										
C	***	**	***	***	0	*	0	0	***	***
D	*	0	0	0	0	0	0	0	***	0
E	0	0	*	0	0	0	0	0	***	***
F	***	**	***	0	0	***	***	0	***	**
G										
H	0	0	0	0	0	0	0	0	***	0
I	*	0	0	**	**	***	***	0	***	***
J	***	***	***	***	*	***	*	0	***	***

Website B could not be displayed.
Websites G and I are the same.

search engine, only two provided comprehensive information. The areas that were less thoroughly explained included the questions: what is an anaesthetist, why might my anaesthetic be cancelled and what are the main risks? Reassuringly, the top scoring website was produced by the Royal College of Anaesthetists and the Association of Anaesthetists, but this was the 10th address listed by Google.

To conclude, there is good information available on this subject, and the sites that scored poorly contained little information rather than dangerous or misleading facts.

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Towards needleless induction of anaesthesia

I found the correspondence regarding the necessity of premedication (Hames. *Anaesthesia* 2003; **58**: 297) especially interesting as it draws attention to one of two aspects of contemporary anaesthetic practice that are at variance with traditional practice before the advent of day surgery units (DSUs) and sevoflurane. The popularisation of DSUs has been accompanied by a change from the traditional practice of giving premedicant anaesthetic drugs intramuscularly, orally or rectally some hours before surgery, to the contemporary practices of either omitting premedication or administering an aliquot of benzodiazepine or opioid intravenously in the DSU or operating room shortly before induction of anaesthesia, whilst the introduction of sevoflurane has been accompanied by a resurgence of interest in inhalational induction of anaesthesia in adults [1].

The trend from traditional to contemporary practice regarding premedication appears to have developed as a result of better premedicants and the requirement for rapid patient turnover in DSUs, rather than according to standards of good practice rationalised by outcome studies. Further, despite the ready availability of sevoflurane, the wishes of adult patients regarding their preferred route of induction of anaesthesia (mask or needle) is not usually canvassed during the pre-operative visit, and the traditional intravenous route is still routinely used by most anaesthetists. In an attempt to rationalise both issues, I undertook an audit to assess the opinion of patients scheduled for ambulatory surgery as regards their desire to receive premedication, and their choice of route for induction of anaesthesia.

Having liaised with the Hospital's Research Ethics Committee, 168 consecutive adults presenting for all types of elective, ambulatory surgery under general anaesthesia administered by myself during a 4-month period were visited in the DSU prior to surgery. Each patient was asked whether they felt anxious about their surgery and whether they wished to receive sedation prior to surgery. Those requesting medication were asked whether they wished to receive the medication immediately or intravenously shortly before surgery. Patients requesting immediate medication were also asked whether they wished it to be administered by the oral, intramuscular or rectal route. Enquiry was then made whether they wished their anaesthetic to be commenced 'by a small needle on the back of the hand, in the usual manner' or 'by breathing a new anaesthetic gas – sevoflurane – via a fruit-scented mask, as is popular with children because it avoids the tiny needle'.

I questioned 190 patients (age range 16–89 years). Of these, 156 (82%) had undergone previous surgery for which anaesthesia had been induced by the intravenous route in 148 (95%) patients, by inhalation in six (4%) patients and by a non-recalled route in two (1%) patients. Of the 190 patients, 97 (51%) declined and 93 (49%) requested premedication, of whom two (1%) selected the intramuscular, 60 (65%) the oral, 0 (0%) the rectal and 31 (35%) the intravenous routes of administration. Intravenous (needle) induction was chosen by 49 (26%) and inhalational (mask) induction by 100 (53%) patients, the remaining 41 (22%) patients being equivocal ('I don't mind'), and asking that I 'do whatever is best'. Of the latter, 14 (34%) patients had an intravenous induction and the remaining 27 (66%) patients were induced using sevoflurane. Sevoflurane was successful and without incident, as the induction agent in the 127 patients to whom it was offered, and was administered via a scented mask from a circle absorber primed with sevoflurane 8% in equal parts of nitrous oxide and oxygen.

Elucidation of these data has interesting implications. The wish expressed by 49% of patients to have pre-operative anxiolytic medication suggests that the trends towards omission of premedication or administration of an aliquot of short-acting benzodiazepine or opioid in the pre-operative holding or anaesthetic room shortly before induction of anaesthesia may be under-treating pre-operative anxiety in almost half of patients presenting for ambulatory surgery. More interesting is the wish expressed by 52% of patients not to have premedication, which suggests that the current popular practice of inserting an intravenous cannula and

administering a subhypnotic dose of midazolam shortly before induction of anaesthesia may be considered unnecessarily invasive by approximately half of patients. Most surprising was the choice by 54% of patients to have anaesthesia induced by inhalation of sevoflurane via mask, with only 26% opting for the conventional intravenous route. This appears to contradict the concept popular amongst many anaesthetists that most patients have a mask phobia and suggests, to the contrary, that needle phobia is more prevalent amongst adults.

These data, though warranting analysis with respect to gender, age, ethnicity, nationality, previous exposure to anaesthesia/mask/needles, etc., which may influence patient choice as regarding premedication and route of induction of anaesthesia, suggests that such inquiry should be routine at the preoperative visit. By so doing, the appropriate prescription of premedication and avoidance of needles in conscious patients as part of a patient-centred philosophy [2] of 'needleless induction of anaesthesia' may contribute to allaying pre-operative anxiety and enhance patient satisfaction with their care. Although induction of anaesthesia by mask in the absence of an intravenous cannula is contrary to the view of anaesthetists familiar with the arrhythmogenic and vagal effects of halothane, the remarkably rapid action and stable cardio-respiratory profile of sevoflurane suggests that its use for induction of anaesthesia in adults, prior to insertion of an intravenous cannula, as is usual with children, is an acceptably safe technique.

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Major incident preparation

In light of increased concern of a terrorist-related major incident, as well as the ongoing risk of a domestic major incident in the catchment area, I audited the knowledge of the anaesthetists working in my local Trust on their knowledge and preparation for managing a major incident.

There were 33 responses, reflecting a 66% response to the audit questionnaire circulated to anaesthetists of all grades working within the two hospitals in the Trust. Consultants were responsible for 55% of responses. A significant number of responders (27%) did not know where the Major Incident Plan was kept, and 36% had never read the Major Incident Plan. Many (37%) did not have direct access at home to colleagues' telephone numbers. In the event of a major incident, most on-call staff would either contact A & E, operating theatres or begin clearing ICU beds, whilst most staff not on-call would either attend A & E, operating theatres or await telephone instructions. Excluding the brief lecture given in ATLS courses, only two anaesthetists (6%) had received formal training in major incident management. Six anaesthetists (18%) had previous experience of major incidents, and 54% had never been involved with any planning involving scenarios of major incidents.

A major incident, in medical terms, is an incident involving a number of casualties that can overwhelm the resources normally available to patients. As examples, a large number of admissions with minor problems from an accident or incident could swamp and overcrowd a hospital, whilst a smaller number of critically ill patients could overload even a regionally based ICU network. In light of this, most, if not all, NHS hospitals with an A & E department have a Major Incident Plan to help cope with the potentially overwhelming number of patients involved. Anaesthetists have a key role in the plan as they can be involved with resuscitation, definitive operating theatre care, provision of critical care in HDU/ICU, safe transfer of patients within and outside of the hospital, and may be part of the Mobile Medical Teams despatched to the major incident site. Thus it is essential that anaesthetists have a clear idea about their role and action in the event of a major incident being declared in their hospital.

This audit has highlighted deficiencies in the knowledge of our Trust's Major Incident Plan, and this has been remedied by heightening awareness of the Plan coupled with presentations by the A & E consultants. Home telephone numbers have been circulated to permanent members of staff to facilitate a cascade of telephoning other staff from home so that reliance is not placed on the hospital's switchboards. Staff are encouraged to undertake training such as the MIMMS course (Major Incident Medical Management and Support), and we will continue to ensure that the Anaesthetic Department is represented at any major incident planning sessions.

Major incidents can occur at any time. Is your Department prepared?

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Interrupted monitoring

We also have been interested in the significance of monitoring or the lack of it during transfers between the operating theatre and recovery area (Adekanye & Wali. *Anaesthesia* 2003; **58**: 190–1). The gap in continuous monitoring from anaesthetic room to theatre may have been closed by induction of anaesthesia in the operating theatre but in the postoperative phase, other than transfers to an intensive-care or high-dependency unit, it has so far been neglected.

We had an opportunity to note the continuity of monitoring on seven consecutive cases in a day surgical unit where an anaesthetic room is currently employed. All patients were fit, aged from 22 to 39 years and required general anaesthesia for minor gynaeco-

logical surgery by a consultant anaesthetist working normally. We were confident that neither the consultant (not myself), operating department practitioner nor recovery staff were aware of the observations being made. The time to re-apply a pulse oximeter and non-invasive blood pressure monitor was measured to the nearest 5 s, first when moving the patient from the anaesthetic room through a door to the adjacent operating theatre over a distance of less than 5 m and again when moving the same patient from the theatre to the recovery room through another door and around corners, a distance of approximately 18 m. It is not surprising there were some differences.

Except in one instance, the pulse oximeter was always applied first. The break in oximeter monitoring from the anaesthetic room to theatre averaged 31 s (range 15–60 s) compared with the much longer, again averaged, time of 105 s (65–200 s) to restore readings between theatre and recovery. The blood pressure cuff was re-applied after 55 s (25–90 s) when going into theatre but after surgery it took very much longer time – 125 s (60–250 s) before it was re-applied in recovery, including the occasion when replaced before the oximeter. The extreme times are the more interesting and arguably the more important. Thus, we found that monitoring was interrupted for a maximum time of 1 min for the pulse oximeter or 1 min 30 s for blood pressure for transfers between anaesthetic room and theatre. When transferring to recovery, the minimum times taken to re-apply the monitors were similar to these. However, in two patients, the delays were in excess of 2 min. In one of these cases, the pulse oximeter was not re-applied for over 3 min and the blood pressure cuff not replaced for more than 4 min.

Distances in the main operating theatres at this hospital are greater, through two doors, around as many as five corners and as far as 56 m to the furthest bed bays in recovery so that any delay before monitoring is re-established is likely to be that much longer. It could be said that routine surgery does not represent a high risk. Nevertheless, there is some risk and continuity of monitoring is nowadays considered important. Lightweight, portable pulse oximeters are available (e.g. Nellcor N-20 PA) and would be entirely suitable for postoperative use.

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Are five minutes enough?

The trainees in our department are again filling out diary cards this week. They have been told that they must adhere to set hours, which means that they must not arrive for work before 07:45 hours and must not leave later than 17:00 hours. Our lists commence at 08:30 and finish at 17:00 hours. If we are to be ready when the patient arrives in the anaesthetic room, we need to be there by about 08:15 hours to check the anaesthetic machines and draw up our anaesthetic agents. A quick calculation reveals that we have to pick up the list, get to the wards, see all our patients for the morning and get changed, all in just 30 min. As there are, on average, about three patients on each morning list, we clearly have barely 5 min for the pre-operative assessment and consenting of each patient.

To get an idea of how much time we are actually spending on pre-operative assessment/consent, we recently surveyed a group of 80 consultant anaesthetists working in the United Kingdom and asked them to record for each patient in a 1-week period how long they spent on the pre-operative visit. The results show that an average of 11 min are spent with each patient, the minimum being 2 min and the maximum 30 min. We similarly surveyed a group of 94 German and Austrian consultant anaesthetists who also kept a diary for a week detailing how long they spent on each pre-operative visit. The results revealed that our European counterparts are spending significantly longer on the pre-operative visit than ourselves. The average visit lasted 18 min, ranging from 7 min to 45 min.

In the light of the following statements taken from two recent Association of Anaesthetists' publications, is the amount of time we are spending on the pre-operative visit enough?

The aim in assessing patients before anaesthesia and surgery is to improve outcome. This is achieved by '… providing the opportunity for explanation and discussion … allaying fear and anxiety' [1]. The anaesthetist should explain the proposed anaesthetic procedure. There is often a choice of anaesthetic technique and the anaesthetist must ensure that the advantages and complications of each anaesthetic are explained to the patient [1]. All patients should be given the opportunity to ask questions and honest answers should be given [2]. Are we really to believe that a meaningful exchange between the anaesthetist and patient can be achieved during a pre-operative visit lasting only 5 min?

Once again our profession is caught between adhering to standards set by our own professional bodies, government guidance and patient expectations on the one hand, and the constraints of evermore cost-conscious NHS hospitals on the other. We wonder if further business planning by trusts and anaesthetic departments might enable the necessary time and resources to be directed to the pre-operative visit. In the meantime, I am sure that many of our trainees will still spend adequate time seeing their patients pre-operatively, albeit in their own time.

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Alveolar recruitment strategy improves arterial oxygenation after cardiopulmonary bypass

In a stimulating report (Claxton *et al.* *Anaesthesia* 2003; **58**: 111–16) the authors describe arterial oxygenation after cardiopulmonary bypass. They conclude that postbypass manual inflation followed by a stepwise increase in positive end-expiratory pressure (PEEP) (the recruitment strategy) resulted in better oxygenation indices (P_aO_2/F_iO_2) than postbypass application of no or low (5 cmH_2O) PEEP. Absolute values of the inspiratory fraction of oxygen (F_iO_2) in the postbypass period were not reported.

High F_iO_2 may result in alveolar instability and collapse if gas absorption from the alveoli outweighs their ventilation. Atelectatsis and decreased arterial oxygenation may result. After a vital capacity manoeuvre, re-collapse of re-opened alveoli may be partially prevented by the use of PEEP, but this effect also has been attributed to low oxygen concentrations [1]. It is thus not possible to deduce from Claxton *et al.*'s data whether better oxygenation in the recruitment group was an airway pressure or an oxygen concentration issue.

The application of tidal volumes up to 18 $ml.kg^{-1}$ in some, but not all, patients probably added an additional variable. Tidal volume amplitude determines the diameter of terminal airways in a model recently presented by Ron Anafi and colleagues [2, 3]. This model predicts that terminal airway have two stable states: open at high tidal volumes or nearly closed at low tidal volumes. It is thus possible that better oxygenation in the recruitment group was essentially due to tidal-volume-dependent opening of terminal airways and alveoli rather than to PEEP itself.

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A reply

I would like to thank Dr Kleinsasser for his comments on our alveolar recruitment study. He is indeed correct that there has been research done by Wagner *et al.* [1], suggesting that the use of very high-inspired oxygen concentrations can result in absorption atelectasis. He is also correct that we did not state in our original paper what the inspired oxygen concentration was in the postoperative period. I would like to thank him for pointing out this omission.

We did, however, use an inspired oxygen concentration of 40% for all groups of patients whilst they were still in the operating theatre, which in practice for all patients included the 30-min and 1-h time periods. It was at these time periods that we showed a significant improvement in oxygenation indices, and thus reached our conclusions that the recruitment strategy improved oxygenation up to this time period.

In the 2- and 6-h time periods, the patients were on the intensive care unit, and for ease of data collection and to allow for potentially higher oxygen requirements, we allowed any oxygen concentration to be used, and hence calculated the oxygenation index (P_aO_2/F_iO_2). In these time periods, I agree that the use of a higher oxygen concentration in the control groups could have allowed a better result in the treatment group; however, this was not the case as there was no statistically significant difference in the average oxygen concentration in the three groups at any time period, and we also failed to show any improvement in the treatment group at 2 and 6 h post bypass anyway.

Dr Kleinsasser's second comment regarding the possibility that better oxygenation in the recruitment group was essentially due to tidal-volume-dependent opening of terminal airways and alveoli rather than to PEEP itself is interesting and indeed further research into whether prolongation of any beneficial effect of high tidal volumes and then continuous PEEP to maintain alveolar splinting can be achieved would be worthwhile.

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Capnography through the lumen of a tracheal tube guide

It was interesting reading correspondence regarding the Portex Tracheal Tube Guide (Sellers. *Anaesthesia* 2003; **58**: 190). We have reported its use in cases of difficult intubation utilising its hollow lumen to ensure that the tip of the Tube Guide is in the trachea [1]. In spontaneously breathing patients, a 16FG intravenous cannula is inserted into the lumen of the introducer at its proximal end. The cannula is connected to the end-tidal CO_2 sampling line. By observing the end-tidal CO_2 waveform, one can ensure that the tip of the introducer is in the trachea. The tracheal tube can be slid over the introducer with continuous monitoring of capnography to ensure correct positioning of the tracheal tube. A 'clicking' sensation has been described as a sign of correct placement of the introducer [2]. We have used our technique on anaesthetised patients with success. The presence of the capnography waveform provides an objective sign for the correct placement of the tip of the introducer. We also reported its successful use in introducer-aided tracheal intubation through the laryngeal mask, where a Portex 15-mm swivel connecter with a bronchoscope cap angle piece is used

to ensure that the patient remains well oxygenated and receives anaesthetic vapour.

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New airway devices

I would like to highly commend Dr Cook for his most thoughtful, insightful and correct editorial on 'new airway devices' (Cook. *Anaesthesia* 2003; **58**: 107–10). I especially agree, in principle, with his three-stage study process for the introduction of new devices.

As Dr Cook pointed out, many supraglottic airways were marketed without proper premarketing evaluation; the public knows about these devices because the devices were marketed. However, there may be some companies that chose not to market a supraglottic airway because the device failed sufficiently to clear a testing process similar to that suggested by Dr Cook; the public does not know about these devices because they were not marketed.

One such company and device was Augustine Medical Inc.'s (AMI) GO_2 airway (I participated in the development and testing of the GO_2 airway almost from the beginning). The GO_2 airway was first developed in a few cadavers and two different mannequins. Next, the device was tested (with fibreoptic confirmation of position) in hundreds of awake topically anaesthetised volunteers and the control device for this phase of the testing was the laryngeal mask airway. Each time the design of the device was altered, the testing process was restarted (that is why hundreds of awake volunteers were studied). Next, the device was tested in thousands of patients under general anaesthesia by approximately a total of 50 users (in a Beta-site testing format). Each time the design of the device was altered the testing process was restarted (that is why 50 users studied thousands of patients). Ultimately, and to the great credit of AMI, the company decided the device did not perform well enough to avoid being considered just another 'me too' device trying to divide up the large supraglottic airway market. I write this letter to give credit where credit is due (to AMI) for following Dr Cook's advice; without this letter few would know about AMI's exemplary behaviour.

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The Proseal laryngeal mask

We recently had to administer anaesthesia for an emergency laparotomy to a 78-year-old man. His past medical history was extensive and included treated hypertension, severe chronic obstructive pulmonary disease (COPD), a Roux en Y gastrectomy for peptic ulcer disease and three different malignancies. The first two malignancies (a choroidal melanoma and acute myeloid leukaemia) had been successfully treated and were still in remission. The third malignancy, a squamous cell bronchial carcinoma, had been diagnosed 3 weeks previously following episodes of haemoptysis and subsequent biopsy on bronchoscopy. A CT scan of his thorax revealed a 25-mm spiculated soft tissue mass in the right upper lobe, encasing and compressing the right main bronchus. There was extension into the mediastinum causing bowing and narrowing of the trachea. He had commenced dexamethasone 4 mg twice daily and been referred for palliative radiotherapy of this malignancy. Three days before the laparotomy, he had been admitted under the care of the general physicians with black stools, dizziness and shortness of breath. A gastroscopy was performed and revealed an acute bleeding ulcer situated at the site of the Roux en Y anastomosis. Despite heater probe coagulation, the ulcer continued to bleed and emergency surgical intervention was deemed to be vital.

Anaesthesia for this patient presented a number of problems. His physiological reserve was already reduced due to severe COPD and the potentially vascular tumour in the trachea meant tracheal intubation would carry a significant risk. The tumour might bleed heavily or cause a physical barrier to passage of the tracheal tube. There was also the chance of complete airway obstruction secondary to loss of smooth muscle tone on induction of anaesthesia. After a frank discussion with the patient, it was decided to attempt anaesthesia under a thoracic epidural. We made a backup plan for conversion to a general anaesthetic. An epidural was inserted at approximately T_8 and tested with 5 ml lidocaine 1%. Following further epidural administration of 8 ml bupivacaine 0.5% and diamorphine 3 mg, a bilateral sensory block to pain was achieved between T_4 and L_2. He was given ketamine 30 mg and midazolam 2 mg and the laparotomy proceeded. After the peritoneum was incised, it became apparent that the epidural was not going to provide adequate analgesia and muscle relaxation. Therefore, propofol 130 mg and atracurium 30 mg were administered and a size 5 ProSeal laryngeal mask airway [1] (PLMA, Laryngeal Mask Airway Company, Henley on Thames, UK) was inserted. Its position was checked (as described by the manufacturer [2]) and a size 18 Ryles tube was passed down the drainage tube of the PLMA allowing the stomach contents to be aspirated. The rest of the laparotomy proceeded uneventfully. The PLMA was removed once the patient had reached a light plane of anaesthesia and he subsequently made a comfortable and otherwise satisfactory recovery to commence his radiotherapy as an outpatient.

Cases of irreversible tracheobronchial obstruction during anaesthesia of patients with mediastinal masses are numerous and well described [3, 4] and so a case such as this would, ideally,

be carried out in a centre equipped to perform emergency cardiopulmonary bypass [5]. A regional anaesthetic technique was considered as an alternative that might have avoided the unfavourable changes in respiratory physiology associated with intermittent positive pressure ventilation (IPPV) [6]. When the regional technique proved inadequate, a PLMA allowed the establishment of IPPV. A trade-off was therefore made between the risk of intubating the trachea of this patient and the risk of not providing him with the definitively secured airway.

The PLMA is similar to the classic laryngeal mask airway, but for this anaesthetic it had two additional, important advantages. Firstly, the drainage tube allows fluid in the oesophagus to bypass the pharynx and mouth. This has been demonstrated both in cadavers [7] and in a clinical setting [8]. Furthermore, the passage of a Ryles tube allowed us to keep the stomach empty until the protective airway reflexes returned. Secondly, the PLMA has a more effective seal, which is produced by the differently constructed cuff. This provides an improved airway to administer more effective IPPV [9] compared with the classic laryngeal mask.

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Assessing the difficult airway

It is easy to see how your correspondents (Ramachandran & Bhishma. *Anaesthesia* 2003; **58**: 392–3) were lulled into a false sense of security by personal familiarity with a previously straightforward airway and the stability of the patient's symptoms. Their letter illustrated how difficulties can arise despite the lack of warning signs.

In the assessment of a potentially difficult airway, all information is useful. We recently anaesthetised a patient for a bilateral neck dissection and laryngectomy who had been anaesthetised 2 weeks previously by a colleague. At that time, he did not have stridor and proved to be an easy intubation. At microlaryngoscopy, the surgeons saw and photographed a tumour sitting in the right piriform fossa. The picture was filed in the notes. The patient made an uneventful recovery from this procedure.

The laryngectomy was scheduled for a Monday morning. The patient had no new symptoms. On admission on the Sunday afternoon, the ENT senior house officer performed a nasendoscopy and was able to confirm that the appearances were the same as the picture taken 2 weeks previously. With this reassurance, we proceeded with an intravenous induction and secured the airway without problems.

We feel that nasendoscopy is easy to perform, and well tolerated by patients, and it provides a useful check of airway anatomy immediately before each procedure, particularly when images are kept in the notes. Perhaps if this investigation had been performed on the patient described in the letter, the difficulties would have been anticipated, and an awake fibreoptic intubation planned.

In addition, we would like to emphasise the importance of good liaison between the ENT surgeons and anaesthetists involved in the care of these difficult patients, particularly with respect to changing airway appearance over time.

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Bougie trauma – it is still possible

We read with interest the recent letter (Hodzovic *et al. Anaesthesia* 2003; **58**: 192–3) commenting on the paucity of reported cases of soft tissue trauma unambiguously caused by a multiple-use gum elastic bougie in the management of unexpected difficult intubation. As they correctly stated, so far only one such case has been reported [1]. In the same context, we want to report a critical incident involving a multiple-use gum elastic bougie that caused trauma to the airway. We believe it is a rare complication, especially when the insertion of the bougie and railroading of the tracheal tube has been successful at the first attempt.

A 60-year-old, ASA II woman presented for elective gynaecological surgery. She gave a history of bronchial asthma treated with bronchodilators as required. She had received no previous anaesthetics. On airway examination, she was assessed as Mallampati grade I. After routine monitoring was established, anaesthesia was induced with fentanyl 100 μg, propofol 180 mg and rocuronium 40 mg. Bag-mask ventila-

tion was commenced with isoflurane and oxygen 50% in nitrous oxide. At laryngoscopy, the patient was seen to have a Cormack and Lehane grade 2 view (partial view of the larynx). At the initial intubation attempt, a diagnosis of oesophageal intubation was made on the basis of lack of chest movements and no capnography trace. The tracheal tube was removed and ventilation with mask re-instituted. A second intubation was attempted using a multiple-use gum elastic bougie (Eschmann UK 15-Ch 60 cm). The bougie was advanced till the 'hold-up' sign was elicited (at 50 cm). No 'clicks' were felt as the bougie advanced. Insertion of the bougie seemed easy and an 8-mm cuffed, oral tracheal tube was railroaded successfully over it. After intubation, some fresh blood was noticed inside the tracheal tube. Correct placement was confirmed by capnography, equal chest movements and bilateral air entry into the lungs.

Soon after intubation, the oxygen saturation fell to 89%. Increased resistance to ventilation and high airway pressures were experienced. Subsequently, frank blood was suctioned out of the tracheal tube. On auscultation, there was generalised wheezing on the right side. Oxygen saturations remained low (89–90%) despite increase in F_{iO_2} to 1.0.

The operation was postponed and the patient transferred to the intensive care unit (ICU) for further management. In the ICU, a chest X-ray revealed extensive opacification of the right hemithorax with some loss of volume suggestive of extensive collapse despite the tracheal tube tip lying within the trachea (Fig. 1). Fibreoptic bronchoscopy was performed and several blood clots were removed from the right main bronchus. No obvious mucosal damage to the trachea was seen. Postbronchoscopy, the oxygen saturations improved to 98%. Repeat chest X-ray 1 h later showed the right lung to be well expanded (Fig. 2).

The patient was extubated a few hours later and subsequently discharged from the ICU. A CT scan of the chest 5 days later did not show any significant focal pulmonary lesion or evidence of chest malignancy. There was no air in the mediastinum. Surgery was performed 1 month later under spinal anaesthesia without any problems.

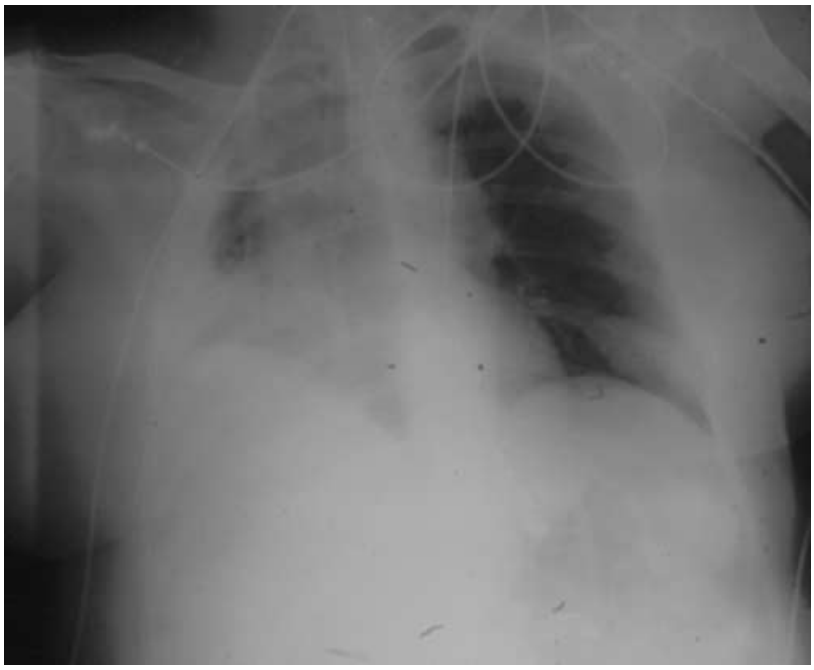

Figure 1 Chest X-ray revealing extensive opacification in the right hemithorax with some loss of volume suggestive of extensive collapse despite the tracheal tube tip lying within the trachea.

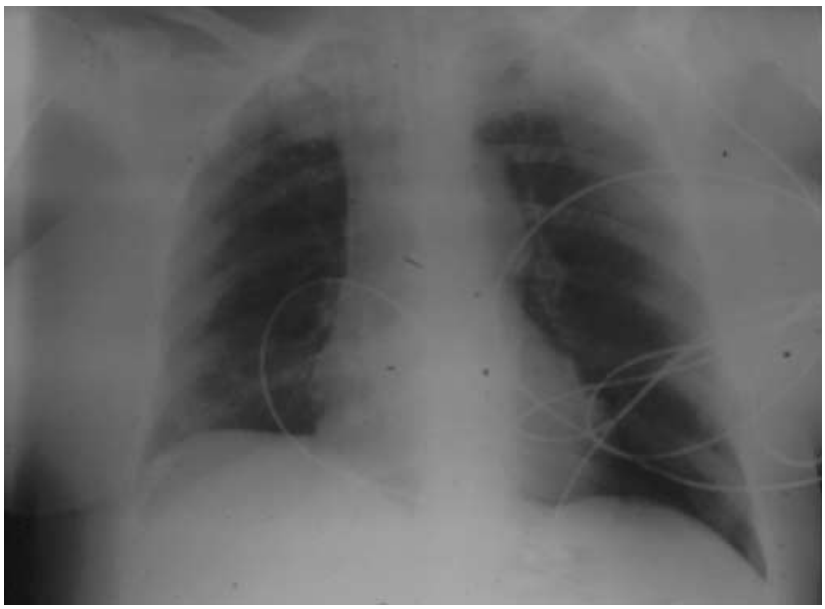

Figure 2 Repeat chest X-ray 1 h later (after bronchoscopic suctioning) shows well-expanded lungs.

In our case, the most obvious source of the blood into the bronchus was the trauma from the multiple-use gum elastic bougie.

The gum elastic bougie is useful in difficult intubation as long as the epiglottis is visible (i.e. grade 2, grade 3) at laryngoscopy [2]. It has been suggested that blind placement of the bougie can be confirmed by the 'click' and 'hold-up' signs [3]. In the United Kingdom, the multiple-use bougie is widely used by anaesthetists as the first choice method in the event of unexpected difficult intubation. Kadry and Popat reported pharyngeal wall perforation caused unambiguously by the bougie [1]. This occurred during the initial attempt of passing the multiple-use bougie. We feel that in our case it was quite unusual for a traumatic complication to happen as the insertion of the bougie and the railroading of the tracheal tube were very smooth and successful at the first attempt.

In the recent letter by Hodzovic *et al.*, the authors asked a worthwhile question: 'How many attempts (of multiple-use bougie in the management of difficult intubation) should be recommended?' We totally agree with the relationship between the number of attempts and traumatic complications in the use of bougies. But we also believe that it is worth considering the possibility of a traumatic complication even in an 'easy', first attempt, successful insertion of the gum elastic bougie.

In our patient, a grade 2 view was obtained on laryngoscopy. The 'hold-up' sign was elicited after passing the bougie. As some part of the cords was visible, could we have avoided the trauma by not eliciting the actual 'hold-up' by stopping once the bougie had just passed beyond the cords?

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Where is the narrowest segment in the upper airway?

Your correspondents (Whyte *et al. Anaesthesia* 2003; **58**: 196) stated that, as in children, the narrowest segment of the upper airway in adults is not the glottis, but at the cricoid cartilage, by referring to a paper of Koufman and colleagues [1]. In fact, this reference states that 'the subglottic cricoid is the smallest, fixed cross section in the upper airway'. Nevertheless, they only measured the diameter of the cricoid cartilage of cadavers [1], and compared it with the anteroposterior diameter of the glottis and trachea that were reported previously by different researchers. The anteroposterior distance is unlikely to be narrowest in the glottis, and thus it cannot be concluded whether the narrowest diameter of the glottis is greater or smaller than the narrowest length of the cricoid lumen.

As far as we know, there has been only one study that measured the length of both the glottis and the cricoid lumen [2]: Seymour & Prakash decided to measure the glottic and cricoid lumen in 134 cadavers because they sometimes had difficulties in advancing a double-lumen tube beyond the subglottis in adults. By inserting a cylindrical nylon sounds into the glottis and cricoid lumen, they measured the maximum effective size, and found that the diameter of the glottis was always either similar to, or greater than, the diameter of the cricoid lumen. Therefore, it was just last year (2002) when we finally obtained clear evidence rejecting the orthodox opinion that the narrowest segment in the upper airway is the glottis in adults.

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Haemophilus influenzae type B (HiB) is back

We would like to raise awareness of the increasing frequency of occurrence of the invasive *Haemophilus influenzae* type B (HiB) which can result in life-threatening epiglottitis. In October 1992, the HiB conjugate vaccine was introduced and the prevalence of HiB decreased from 23.8 per 100 000 cases in 1991 to 0.92 cases per 100 000 in 1996. In the last 4 years, its prevalence has started rising again nationwide to 1.88 per 100 000 in 2001 and 2.81 per 100 000 in 2002 [1, 2].

The HiB vaccination programme is based on three doses of conjugate vaccine at 2, 3 and 4 months of age without a further booster. In 1993, all children under 4 years were offered an additional single dose of vaccine (catch-up campaign). The current rise of invasive HiB disease in the UK could be caused by the waning effect of the 1993 catch-up campaign, higher carriage rates amongst older children or weaker immunisation effects related to the use of a combination vaccine against acellular pertussis, diphtheria, tetanus and HiB use in 2000–01.

We encountered a case of acute epiglottitis in a 6-year-old child, who after a 2-day upper respiratory infection developed stridor and respiratory distress. She was brought to the Emergency Department drowsy, unable to speak, using auxiliary respiratory muscles, with a temperature of 37.0 °C. The classic drooling of saliva was absent. She had been fully vaccinated as usual in the first year of life.

She was given two times 4 ml of 1 : 1000 epinephrine nebulised in 100% oxygen. The on-call consultant anaesthetist and ENT surgeon were called. A gas induction using sevoflurane 8% in

oxygen was performed. At laryngoscopy, a swollen bright red epiglottis was seen and the trachea was intubated with a size 4 uncuffed tracheal tube. The lungs were ventilated with normal compliance; however, there was no leak from around the tracheal tube.

The child was treated with intravenous cefotaxime and dexamethasone. After 36 h of sedation and ventilation in the intensive care unit, she was extubated and made a full recovery. HiB was isolated from her blood cultures.

For all those involved, this was the first case of HiB epiglottitis that we have seen. Given the above, it is possible that we will have to deal with this condition more often.

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Oral concretions – a potential hazard for the airway

I would like to present the case of a 23-year-old fit and healthy female patient for removal of an ingrown toenail as a day case. A full history was taken from this young traveller who denied any medical problems. Physical examination including airway assessment was unremarkable.

The patient was anaesthetised following a routine intravenous induction technique with propofol and fentanyl. The airway was maintained throughout the procedure by facemask allowing spontaneous ventilation. Oxygen and intermittent boluses of propofol were administered at the same time. Routine monitoring was used and recorded.

When the patient was anaesthetised, two large masses were found in her mouth, located almost symmetrically under the tongue on each side of the frenulum. These oral concretions were moving almost freely under the tongue

Figure 3

Figure 4

and were easily removed using a pair of forceps, avoiding potential aspiration into the upper airway (Figs 3 and 4).

The specimens were sent to the histopathology department and were diagnosed as salivary calculi. Macroscopically they were described as: 'two symmetrical, almost identical calcified masses. Each measures about 2.5 × 1.8 × 1 cm maximum, each has a clearly faceted surface about 1.5 × 0.7 cm on the medial aspect, and each narrows markedly anteriorly. The appearances would be consistent with two calculi which had developed in adjoining ducts, and which had, by apposition, developed these facets. Some debris was present with these calculi and this was processed.'

Microscopically: 'Sections from the soft tissue which came with the calculi shows only structureless debris and some vegetable matter. Special staining for fungal elements was negative.'

The pathologist further commented: 'The orifices of the ducts of the submandibular salivary glands open, via the sublingual papillae, through a small elevation on either side of the lower end of the frenulum of the tongue. Almost certainly, these twin calculi formed symmetrically in the terminal part of the two submandibular ducts.'

The patient's general practitioner was informed of the possibility of some predisposition to calculi formation in other parts of the body despite her apparently healthy condition.

This case illustrates an unusual but potentially lethal cause of unexpected upper airway obstruction. It also illustrates the importance of checking under the tongue (and the totality of the oral cavity) during a pre-operative upper airway assessment.

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Allergic reaction to hyaluronidase after a peribulbar injection

We read the letter concerning an allergic reaction to hyaluronidase for peribulbar anaesthesia with interest (Agarwal *et al*. *Anaesthesia* 2003; **58**: 493–4). Hyaluronidase has been used in peribulbar anaesthesia for many years and, indeed, it featured as part of a question in the 1953 final FFARCS paper [1]. However, its efficacy has never been fully established. Studies have produced widely conflicting results on the possible advantages of using hyaluronidase but these differences may be due partly to a number of confounding variables, including the choice of anaesthetic solution, injection site and techniques, as well as pH of the anaesthetic solution. We have recently evaluated the use of hyaluronidase for peribulbar anaesthesia, using the commonly used anaesthetic mixture of equal volumes of 2% lidocaine and 0.75% bupivacaine with no hyaluronidase, hyaluronidase 15 iu.ml^{-1} or hyaluronidase 150 iu.ml^{-1} added to the mixture. The rationale behind the study was to see, in view of its allergic potential, whether hyaluronidase really provided clear advantages in clinical anaesthesia. We found there was no statistically significant difference between the groups

in time taken to adequate anaesthesia and a small but statistically significant difference in ocular movement scores at 8 min in the group receiving the highest concentration of hyaluronidase [2]. In the light of these findings, we would recommend that the potential hazards of using hyaluronidase far outweigh any clinical advantages and its continued use for peribulbar anaesthesia must be questioned.

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Fresh frozen plasma for succinylcholine apnoea – time to reconsider?

A 44-year-old woman weighing 80 kg, with a history of mild asthma and reflux oesophagitis is presented for exploration of a parotid abscess. She had received one uneventful previous anaesthetic for varicose vein surgery. There was no history of familial adverse reaction to anaesthesia, although it only became apparent on closer questioning after the event that her parents were not her biological relations. Pre-operative haematological and biochemical parameters were in the normal range.

She was premedicated with oral nizatidine 150 mg and metoclopramide 10 mg. After pre-oxygenation and application of routine monitoring, anaesthesia was induced using a rapid sequence induction with thiopental 375 mg, fentanyl 100 μg and succinylcholine 100 mg to facilitate tracheal intubation. Anaesthesia was maintained with nitrous oxide, oxygen and isoflurane. Atracurium 30 mg was administered 5 min after induction. The procedure itself lasted approximately 20 min. An attempt was made to reverse the neuromuscular blockade with neostigmine 2.5 mg and glycopyrronium 0.5 mg but there was no return of respiratory effort. Peripheral nerve stimulation monitoring train-of-four activity showed two very feeble twitches. At this point, a second dose of neostigmine and glycopyrronium was administered. The pupils appeared to be somewhat constricted, and therefore naloxone 400 μg was given. There was, however, no spontaneous respiratory activity despite normothermia, normal serum electrolytes and permissive hypercapnoea. Ventilation was continued with isoflurane whilst a depolarising pattern of four equally depressed twitches with no fade or post-tetanic augmentation of contraction emerged, suggesting a prolonged succinylcholine blockade.

As an ITU bed was not available, the patient was kept sedated and ventilated in the recovery bay and the neuromuscular block was evaluated every 15 min. Approximately three and a half hours passed without any further improvement. At this juncture, we decided to administer two units of fresh frozen plasma (FFP). Within a few minutes of infusion of the second unit, there was a dramatic return of spontaneous respiratory activity. Eventually, sufficient muscle strength to sustain a head lift for 5 s returned, enabling successful extubation of the trachea. The patient was later transferred to the ward and monitored overnight. The remainder of the recovery period was uneventful.

The blood sample taken prior to the infusion of FFP showed reduced plasma cholinesterase levels and a phenotype $E1^a : E1^a$.

Atypical plasma cholinesterase activity occurs in 1 : 2800 patients. These patients may remain paralysed for many hours after routine doses of succinylcholine. Normal plasma cholinesterase activity shows a wide range in healthy adults and approximately 5% have levels in the low range [1]. This includes pregnant women, genotypically abnormal patients and those with systemic disease, e.g. liver disease, malignancy, etc. This patient had normal liver function tests and benign tumour pathology of her parotid gland. In this case, as atracurium had been given before any recovery from succinylcholine was apparent, there was some confusion as to the nature of the residual block at the end of the procedure. This prompted the administration of the second dose of neostigmine, leading to further uncertainties. It was only with the passage of time and careful monitoring of neuromuscular function that the depolarising nature of the block became apparent. We waited for a considerable length of time before infusing FFP as it transpired that spontaneous recovery could potentially take hours, necessitating prolonged ventilation in the recovery bay.

The use of blood products as a treatment of succinylcholine apnoea has been well documented [2, 3]. The plasma cholinesterase activity in bank blood falls to 85% within 2 days of donation, but remains at this level for at least 30 days. FFP, however, shows no decrease for 7 weeks and can provide a useful therapeutic and diagnostic manoeuvre [4]. The chance of a unit of FFP coming from a donor who also has a plasma cholinesterase deficiency is 0.03%. A freeze-dried cholinesterase concentrate is also available, but its cost and storage time preclude its routine use [3]. Despite its effectiveness, the use of FFP has not been widely advocated due to fear of disease transmission. However, in the UK, the chance of such transmission now is negligible and has to be balanced against the risks associated with continuing anaesthesia and morbidity such as infection associated with ventilation and invasive procedures. In addition, possible transfer out of the hospital for a suitable ITU bed is not without potential hazards and complications. According to the SHOT (Serious Hazards of Transfusion) cumulative data from October 1995 – September 2001 [5], there have been three cases of HIV, eight of hepatitis B and two of hepatitis C transmission in total. Over this period, 2500 000 units of blood and 400 000 units of FFP were transfused each year, thus representing a very small risk of transmission of infection.

Although prolonged respiratory insufficiency after succinylcholine administration is rare, the above case reiterates the need for monitoring neuromuscular function and highlights the risks associated with empirical use of muscle relaxants. This case also revisits the use of FFP to treat prolonged succinylcholine blockade. If used correctly, FFP may act as a useful diagnostic and therapeutic tool. Currently, there is an ever-increasing constraint on ITU beds necessitating out-of-hospital transfers. The risks of transmission of infection from FFP are miniscule, although it should not be forgotten that administration and cross-matching errors are all possible. However, these risks may be balanced against the risk of prolonged anaesthesia, ventilatory support and possibility of acquiring other hospital infections.

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Drug syringe labelling – does complacency come with age?

We were interested to read the review of 81 cases of awareness from the Australian Incident Monitoring Study (AIMS) (*Anaesthesia* 2002; **57**: 549–56), which showed that drug errors were the largest single cause of awareness during anaesthesia.

As part of a wider review of risk management in anaesthesia, we conducted an audit of drug syringe labelling in our department. Without prior warning, during a randomly selected operating list, one of us noted how many syringes in the anaesthetist's tray were labelled. This was only done once during that list and the purpose of the audit was not specified to the anaesthetist.

Over a 2-month period, 50 separate lists were audited. In total, 80 of 233 syringes were unlabelled (35%). However, if propofol syringes were excluded, the percentage was 24%. When the figures were broken down by grade of anaesthetist, an interesting trend emerged. Excluding propofol again, consultants did not label 33% of syringes, staff grades 16% and SHOs only 11%. This was despite SHOs using two more syringes per case on average than consultants.

It has been reported that 94% of surveyed College Tutors feel a standardised colour code should be introduced [1]. We currently use the Medilabel colour-coded labels, so there was no shortage of available labels. However, the labels still have to be placed on the syringe! There is undoubtedly an element of complacency that creeps in as experience grows. We all tend to use particular size syringes for different drugs but this is hardly failsafe. Unfortunately, no one is immune from drug administration errors and consultants are no different. Few can lay their hand on their heart and say it has never happened to them. We believe syringe labelling should be encouraged and practised by all as part of general risk management.

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Locking the K away

In an attempt to prevent accidental or inadvertent intravenous administration of concentrated potassium solutions [1], it has become the policy of our Trust to store such solutions under 'lock and key' in all clinical areas. Administration involves a process similar to that used for controlled medicines; the signatures of two authorised members of staff are required in a dedicated register. Drugs other than potassium, which have equal potential to cause harm, are not subject to such stringent measures. Our worry is that by effectively singling potassium out, a proportion of ward-based medical and nursing staff perceive that any intravenous administration of potassium is inherently risky and best avoided. We believe such stigmatisation may have contributed to the events described below.

A previously fit and well 77-year-old male with a history of prior abdominal surgery was admitted as an emergency complaining of constipation, abdominal pain and distension. A diagnosis of bowel obstruction was made and he underwent uneventful laparotomy the following day when a sigmoid volvulus was decompressed. His postoperative course was prolonged and he was managed on a general surgical ward for 2 weeks on intravenous fluids. He remained nil by mouth as he was unable to tolerate oral administration due to a persisting ileus. During this time, he received 28 l of crystalloid/colloid but only 8 g of potassium.

He was admitted to our critical care facility obtunded, in respiratory failure and in atrial fibrillation. Ultimately, he required a short period of invasive ventilation. Arterial blood gases after intubation and ventilation revealed a severe metabolic alkalosis with pH of 7.6 and standard bicarbonate of 36 $mmol.l^{-1}$. Whilst intubated over the course of the next 4 days, he required the administration of over 90 g of potassium, which was associated with a return of pH and standard bicarbonate to within normal ranges.

We believe what follows is a reasonable interpretation of events. Severe potassium depletion, in combination with acid loss via nasogastric drainage, caused the patient to develop a metabolic alkalosis. The patient progressively retained carbon dioxide, which is the predictable and physiologically dangerous respiratory compensation to such metabolic derangement. Subsequent reduced ventilation led to narcotic levels of carbon dioxide and this in combination with sputum retention eventually resulted in respiratory failure with a documented P_aCO_2 of 11.5 kPa immediately prior to intubation.

A previous audit conducted at our hospital revealed that less than 12% of surgical preregistration and senior house officers knew either what basal potassium requirements were, or were able to detail accurately the potassium content of intravenous solutions used in general ward areas.

We are concerned that a combination of inadequate basic science knowledge together with the perception that potassium is so dangerous that it requires to be locked away may lead to further identical incidents. We are taking active measures within our Trust to address these educational issues and are seeking advice from the Trust Risk Management Team regarding future policy for potassium storage and administration.

The aetiology of drug errors is multifactorial [2], and we believe we have identified a philosophical dilemma of risk management that is not unique to our example. An effective but drastic policy of storing potassium under lock and key may well be preventing a rare but potentially fatal incident (accidental intravenous injection of concentrated potassium solution). However, the same policy may in fact be increasing the likelihood of producing a more common (but usually less severe) adverse event (exacerbating hypokalaemia in surgical patients).

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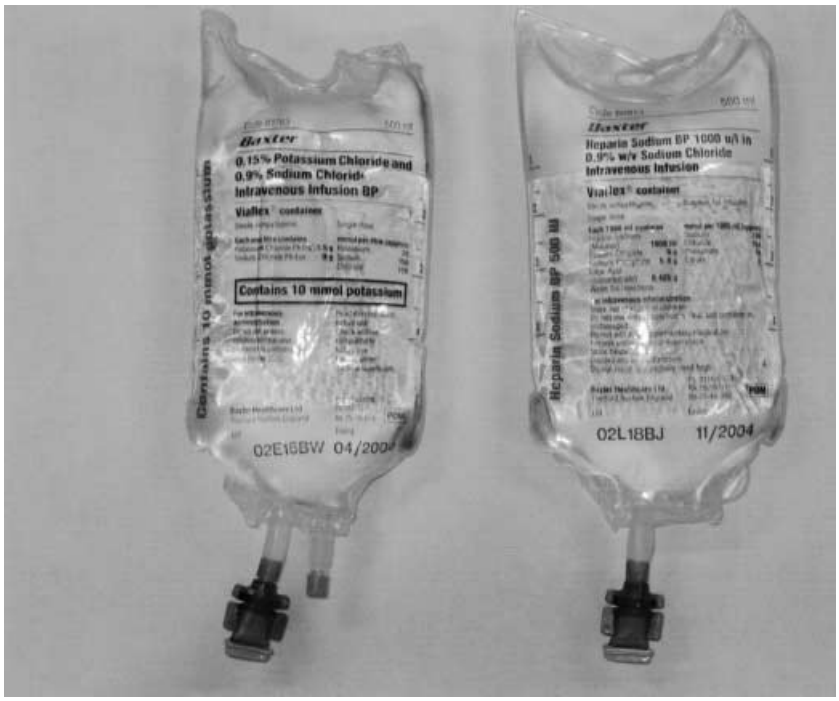

Figure 5

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Adverse events following NPSA guidelines

The National Patient Safety Agency (NPSA) has recently issued a protocol for the safe administration of potassium-containing solutions [1]. As a result, our hospital has now moved to using premixed bags of potassium in a variety of crystalloid fluids as supplied by Baxter. We have recently had two incidents that have arisen as a result of this new policy.

On two occasions, premixed bags of potassium in 0.9% sodium chloride were used in error in place of heparin in 0.9% sodium chloride as flushing solution for arterial lines in the operating theatre. Both of these were connected to patients' arterial cannulae following pressurisation. Fortunately, both errors were discovered and neither patient came to any harm.

Both bags of fluid look very similar (Fig. 5) and can easily be confused. We have now instituted a more rigorous checking procedure for such fluids and we are now isolating potassium-containing fluids from other fluids. However, the manufacturers of potassium-containing fluids need urgently to improve the labelling of such bags so as to avoid any confusion.

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An unusual complication of metoclopramide injection

Metoclopramide is well known for its extrapyramidal side-effects. However, we wish to report a case of an acute dystonic reaction to metoclopramide with the unusual consequence of

joint disruption requiring surgical intervention.

A 44-year-old woman having taken an overdose of nitrazepam and lofepramine along with alcohol required overnight airway management on the intensive care unit. She was monitored until she was judged fit to be discharged to a general ward the following day. Routine haematology, electrolytes and chest X-ray were all normal. When able to communicate, she revealed a past history of depression and epilepsy, although she had not had a seizure for over 3 years and was no longer taking anticonvulsant medication.

On the evening prior to her planned discharge date, she complained to the ward staff of mild nausea and was administered an intramuscular injection of metoclopramide 10 mg which had been prescribed on the 'as required' section of her prescription chart. Forty-five minutes later, the ward staff found her unresponsive on her bed and summoned the cardiac arrest team. On their arrival, she was maintaining her own airway with good respiratory effort and was cardiovascularly stable. She appeared unconscious with posturing similar to the classically described tetanic opisthotonus – she was rigid with an extended arched neck, flexor posturing of her arms and stiff legs. Oxygen was administered via a facemask and intravenous access was established. Procyclidine, to a total of 10 mg, was given intravenously, which produced a rapid regression of the rigidity and improvement in her level of consciousness. Blood gas analysis and electrolytes were entirely normal. She had no recollection of what had happened but complained of a severely painful left foot, which appeared clinically deformed, inverted and acutely painful to palpation. Subsequent X-ray examination of her left foot along with orthopaedic advice revealed dislocation of the midfoot joints. This required manipulation under general anaesthesia, which was achieved uneventfully. She was discharged the next day and kept under orthopaedic review, requiring crutches and a below knee plaster for 6 weeks.

Although the literature is full of reports of the adverse effects of metoclopramide, including tetanus-like dystonic reactions [1], we have been unable to find reference to an acute dystonic reaction producing joint disruption as occurred in this case. We would like to add this case to the long list of reports of adverse events following metoclopramide administration. Whilst metoclopramide is rarely used these days by anaesthetists as a first line anti-emetic, it remains popular amongst ward-based junior doctors. Our attention and theirs' should be focused on this case, where the clinically unnecessary use of a drug known to have unpleasant side-effects culminated in severe consequences. Perhaps it falls to us anaesthetists, as relative experts in applied pharmacology and frequent users of anti-emetic medication, to promote their safe and appropriate use throughout the hospitals in which we work.

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Intranasal fentanyl for postoperative analgesia after elective Caesarean section

There are many methods for providing postoperative analgesia, but each have certain disadvantages. Patient-controlled analgesia (PCA) requires intravenous access; epidural insertion may be difficult or contraindicated; intramuscular injections are painful, relatively inconvenient to administer, and have a risk of infection and nerve damage. We tested fentanyl administered as patient-controlled intranasal analgesia (PCINA). In this study, we used a nasal pump by Go Medical from Anaesthetic Medical Systems Ltd. The pump is a spray bottle with flow-control tubing that, after activating a spray, takes 3 min for the reservoir to refill. This serves as a lockout mechanism and prevents continuous and over-administration of fentanyl. The volume of the bolus is 0.18 ml.

Striebel *et al.* [1, 2] used a 27-μg fentanyl dose for non-obstetric surgical procedures but side-effects included mild respiratory depression. We opted for a 4.5-μg dose. The efficacy of nasal fentanyl is comparable to intravenous administration, because opioids are well absorbed from the nasal mucosa, it avoids first-pass metabolism and results in a high bioavailability (71%) [1, 2].

Following Research Ethics Committee approval, we compared analgesia for pain relief for 8 h after elective Caesarean section under a standard spinal anaesthetic. We administered fentanyl via PCINA (a maximum of 90 μg of fentanyl per hour) to 10 patients (Group I), and intramuscular morphine 10 mg on a 4-hourly PRN basis to 11 patients (Group II). Physiological parameters were measured at 30-min intervals, including sedation, pulse oximetry, heart rate, blood pressure, respiratory rate and time for three-segment regression of the spinal block. Rescue analgesia of 2–2.5 mg intravenous morphine was provided to patients in both groups. Pain relief was assessed every 30 min using a 10-cm visual analogue scale (VAS). All patients recorded pain scores by 4 h.

In Group I, there was a mean of four fentanyl dosages per 30-min interval. The lowest number of dosages was 17 (76.5 μg) and the highest was 71 (319.5 μg) during the 8 h. Two patients had nine dosages in 30-min intervals, i.e. the highest possible number of intranasal sprays allowed by the lockout time; neither required rescue analgesia. In Group II, most patients received one intramuscular morphine dose during the 8 h. Two patients received two intramuscular doses. One patient did not request any analgesia. The mean of the highest VAS scores was 4.5 for Group I and 5.1 for Group II.

Rescue analgesia was given as 2–2.5 mg intravenous morphine PRN every 15 min if VAS scores were greater than 5, or if the patient was too distressed by pain. This occurred in six patients: one in Group I (6 mg) and five in Group II (6–20 mg).

No side-effects were reported from any Group I patients. One patient from Group II reported mild to moderate pruritus.

Mean analgesic plasma concentration of fentanyl ranges from 0.6 to 3 $ng.ml^{-1}$ following intravenous administration [3]. Blood samples from patients in Group I were taken at 0, 5, 15, 30, 60 and 120 min after the first administration of intranasal fentanyl. However, no fentanyl was detected in any of the serum samples.

We found no clinically relevant intergroup difference in the measured sedation scores, oxygen saturation, heart rate, systolic blood pressure and respiratory rate (unpaired *t*-test with two-sample equal variance test), VAS scores, or amount of rescue analgesia (Fisher's exact test, $p = 0.149$). However, for this small sample of patients, the power of this study was only 0.23.

In conclusion, we think that our results are encouraging. The ease of intranasal administration, the safety of a controlled dose and the high patient acceptability of this method of pain relief deserve more attention. The lack of clinical significance between the two groups' VAS scores suggests that PCINA may be as effective as intramuscular morphine, or may be superior in terms of the number of patients requiring rescue analgesia. The high patient satisfaction with the intranasal pain relief was also remarkable. However, the PCINA patients had a much more frequent rate of analgesic administration at their disposal. This may contribute to a placebo effect. Further work needs to be done with this novel but, as yet, less established tool of providing analgesia to determine optimum dose without increasing side-effects.

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Cerebral hypoperfusion with systemic hypotension during common carotid ligation

We experienced a case of cerebral hypoperfusion during systemic hypotension, which was detected by continuous monitoring of regional cerebral oxygen saturation (rC_sO_2) by near-infrared spectroscopy in a patient whose collateral circulation through the Circle of Willis had been determined by a pre-operative balloon occlusion test.

A 71-year-old woman with cancer of the oropharynx was admitted to our hospital. She had a history of varicose veins in the lower extremities. Prior to the scheduled operation, irradiation to her tumour and chemotherapy were performed effectively. Three months later the patient underwent tumour resection, radical neck dissection, reconstruction using a forearm musclocutaneous flap and tracheostomy. During the postoperative period, the patient suffered from a refractory wound infection and graft thrombosis. Ten days after the last operation, when the dressing was being changed, blood was found to be oozing from both the neck and the oral cavity. A cerebral angiogram was performed in order to determine the most appropriate therapeutic strategy. The patency of the Circle of Willis was confirmed by cerebral angiography, and left common carotid artery (CCA) occlusion for 20 min induced no neurological symptoms. Systolic blood pressure (SBP) was maintained between 110 and 120 mmHg throughout the test. Just after conclusion of the test, the patient suffered sudden and acute massive bleeding from a branch of the left CCA. She developed hypovolaemic shock (SBP 50–60 mmHg). A continuous infusion of dopamine (5 $\mu g.kg^{-1}.min^{-1}$) was started to maintain her blood pressure and the patient was immediately scheduled to undergo ligation of the left CCA to control the bleeding. Anaesthesia was maintained with fentanyl, sevoflurane and nitrous oxide. During the operation, when the SBP decreased below 90 mmHg (mean blood pressure 75–80 mmHg), the value of rC_sO_2 of the left side decreased 10% more than that of the right side. Throughout the operation, we tried to maintain SBP at more than 90 mmHg. The operation time was 10 h 12 min and that of anaesthesia was 11 h 47min. The patient was extubated in the operating room and was discharged without any sequelae.

Carotid artery ligation is sometimes performed to control bleeding from the head and neck [1]. The most serious complication of this procedure is cerebral hypoperfusion with neurological deficit [2]. In normal human subjects, the Circle of Willis is the most important collateral channel for circulation in the brain. This system has many variations and 28% of patients have an inadequate Circle of Willis as a channel for collateral circulation [3]. Therefore, it is important to confirm the function of this system.

Cerebral angiography with unilateral carotid artery balloon occlusion is a popular method of testing the function of the circle of Willis [4]. In our patient, the test suggested normal collateral circulatory function, yet during the CCA ligation, transcranial cerebral oximeter (INVOS 3100 A) indicated a decrease in rC_sO_2 during systolic hypotension suggesting cerebral hypoperfusion from an insufficient collateral circulation. When severe systemic hypotension is present, cerebral blood flow decreases and cerebral hypoperfusion may occur even if the Circle of Willis is intact. A decrease in rC_sO_2 correlates well with cerebral blood flow [5].

Our case illustrates the potential risk of cerebral hypoperfusion caused by systemic hypotension even if no neurological symptoms have developed during the pre-operative balloon occlusion test. The continuous monitoring of rC_sO_2 is useful to detect early cerebral hypoperfusion and to prevent neurological sequelae during carotid artery operation.

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Extravasation and tissue necrosis secondary to central line infusions

Extravasation injuries caused by peripheral intravenous drug administration are well described but extravasation injuries from central venous lines are rare [1, 2]. We wish to report an extravasation injury from a central venous cannula that caused significant patient morbidity.

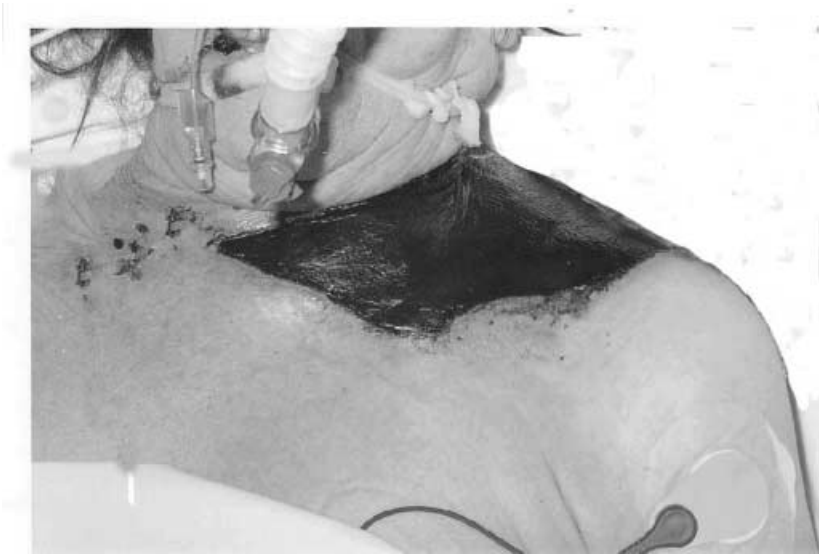

Figure 6 Necrotic tissue on the patient's left shoulder.

A 78-year-old woman was admitted to our ICU following a laparotomy in another hospital for perforated bowel. Management at the referring hospital included insertion of a central venous catheter with Swan sheath sited in her left internal jugular vein, but no note was made of catheter type or insertion depth. Review of the chest X-ray showed a multilumen catheter with the tip situated in the brachiocephalic vein. Postoperatively, the patient required epinephrine in doses up to 0.38 $\mu g.kg^{-1}.min^{-1}$ (1.5 $mg.h^{-1}$) for 4 days.

On the fifth day postoperatively, the patient's left supraclavicular region was oedematous and the skin was discoloured, so the central line was removed. However, the skin in the supraclavicular region subsequently became necrotic, involving approximately 2% of the total body surface area (Fig. 6) and requiring surgical debridement. A pectoralis major muscle flap and split skin graft was required to cover the defect. The patient subsequently made a full recovery and has not required any further surgery.

We assume that the tissue necrosis was caused by drug extravasation [3, 4] because either the proximal port was initially not intravascular or subsequent migration rendered the lumen extravascular. In a prospective study of 1303 central venous cannulations, there was no mention of a single incident of extravasation, suggesting that this type of complication is rare [5].

Walker *et al.* made several suggestions for the prevention of extravasation injuries from central cannulation, including regular aspiration of the proximal lumen, infusing only isotonic crystalloids down the proximal lumen, or to produce a catheter with its lumen situated more distal [1]. Monitoring the vascular pressure via the proximal lumen would give an early warning of extravascular migration of the catheter [2]; however, proximal lumen intravascular pressure measurements are significantly different from distal port sites, and may be less accurate [6].

It must be remembered that initial correct positioning of the central catheter with free aspiration of blood from all lumens with secure skin fixation and checking the position with a chest X-ray is vitally important to prevent the potentially serious complication of extravasation.

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Anaesthetic management of quinsy in a patient with Shwachman–Diamond Syndrome

A 21-year-old female patient (40 kg, 128 cm tall) presented with a paratonsillar abscess, which required surgical drainage. The patient had Shwachman–Diamond Syndrome (SDS), diagnosed at 4 months of age, a rare congenital disorder characterised by bone marrow dysfunction, exocrine pancreatic insufficiency and short stature.

The patient displayed severe trismus. Computerised tomography had confirmed the diagnosis of a left paratonsillar abscess. Intravenous antibiotics had been ineffective.

Pancreatic insufficiency had resulted in relative malnutrition and poor skeletal growth. She was pancytopaenic (haemoglobin 8.1 $g.dl^{-1}$, white cell count $1.7 \times 10^9.l^{-1}$ and platelet count of only $11 \times 10^9.l^{-1}$). Pre-operatively, she was given 2 units of blood, 2 units of platelets to cover nasal fibreoptic intubation and intravenous vitamin K on the advice of the haematologist. Previous general anaesthetics had been uneventful.

After placement of standard monitoring (ECG, non-invasive blood pressure and pulse oximetry), an 18G intravenous cannula was inserted in the dorsum of the left hand and intravenous midazolam 3 mg was administered. The nasal mucosa was sprayed with 3 ml of lidocaine 4%. A further 2 ml of lidocaine 4% was applied topically to the oropharyngeal mucosa. Oxygen 10 $l.min^{-1}$ was administered via a variable performance facemask attached to a reservoir bag. Fibreoptic laryngoscopy via the right nostril easily visualised the vocal cords. A cuffed 5-mm Mallinckrodt tracheal tube was correctly positioned under direct vision. Capnography and auscultation confirmed correct tracheal tube placement after removal of the fibrescope. General anaesthesia was then induced with 8% sevoflurane in 100% oxygen and maintained with 2–3% sevoflurane in a 50 : 50 mixture of oxygen and nitrous oxide, with the patient breathing spontaneously. Fentanyl 50 μg was given to supplement general anaesthesia. Extubation, with the patient semi-erect, was uneventful, as was her subsequent recovery.

SDS was first reported in 1964 [1]. Only 200 cases have been reported since. Shwachman, Diamond, Osaki and Knaw reported this syndrome in a group of five children attending a cystic fibrosis clinic at Harvard Medical School. SDS is inherited as an autosomal recessive. It mainly involves pancreas, bone marrow and skeleton, but the liver, kidneys, teeth and immune system may also be affected [2].

Neutropaenia is the most common haematological abnormality, occurring in 88–100% of patients. In most cases, neutropaenia occurs intermittently, the neutrophils having defects in mobility, migration and chemotaxis. Patients are prone to recurrent bacterial infections of the upper respiratory tract, otitis media, pneumonia, osteomyelitis, bacteraemia and skin infections [3, 4]. Severe upper respiratory infections can cause airway obstruction. Almost one half of patients with SDS have pancytopaenia; however, some (24–88%) may have variable degrees of thrombocytopaenia and up to 80% have anaemia, which is usually mild and normochromic–normocytic [2, 3, 5].

Varying severity of pancreatic dysfunction due to acinar maldevelopment is a hallmark of SDS. This can lead to malnutrition and fat-soluble vitamin deficiencies. Its severity is not consistent with either haematological or skeletal abnormalities and usually improves with advancing age.

Skeletal abnormalities are reported to occur in more than 75% of patients with SDS. These include rib cage abnormalities, femoral head dystosis, kyphoscoliosis, genu and cubitus valgus, syndactyly and clinodactyly [2, 3]. Patients with SDS appear emaciated and frail with a tendency to easy bruising [3] and require sympathetic handling and positioning in the operating theatre.

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Trauma in pregnancy: anaesthetic management of the pregnant trauma victim with unstable cervical spine

Trauma in pregnancy is currently a leading cause of non-obstetric maternal death, and maternal death is the most common cause of fetal death. Cervical spine injury, respiratory failure and haemorrhagic shock are the most frequent causes of maternal death in pregnant trauma victims [1]. We present a case of a parturient who presented for an emergency posterior cervical fusion following unstable traumatic cervical spine fractures. The pregnancy was known to be present pre-operatively.

A 40-year-old, previously healthy female was admitted to the Emergency Department with unstable, motor-vehicle-related, cervical spine fractures (C_1 and C_2) and multiple rib fractures with left-sided pneumothorax for an emergency posterior cervical spinal fusion under general anaesthesia. The patient was haemodynamically stable. Her neurological examination revealed a Glasgow Come Scale (GCS) of 15, free range of motion in all four extremities and 5/5 motor strength. An obstetric ultrasound revealed a single fetus in breech presentation with estimated gestational age of 15 weeks without any gross abnormalities. Fetal heart rate (FHR) was 140 beat.min^{-1} and reactive.

Airway control with awake fibreoptic tracheal intubation was deemed necessary and therefore pharmacological prophylaxis against aspiration was accomplished in a standard manner with intravenous administration of a histamine 2 receptor antagonist and metoclopramide combined with oral non-particulate antacid. Topical anaesthesia of the upper airway mucosa via a mask nebuliser containing lidocaine 4% for about 15–20 min was conducted. The patient was taken to the operating room and pre-oxygenation was accomplished with 3–5 min of normal tidal volume ventilation with 100% oxygen. Small amounts of midazolam to a total dose of 2 mg were titrated to effect to facilitate the patient's co-operation. Awake tracheal intubation was accomplished in a semisitting position with gentle insertion of the 7-mm internal diameter tracheal tube over the fibreoptic bronchoscope. The patient was asked to assume the prone position on the operating room table and, following repeat neurological examination documenting her ability to move all four extremities, general anaesthesia was induced in a standard manner. Every effort was made to avoid any direct pressure to her abdomen and gravid uterus. Sensory evoked potentials were monitored throughout surgery and no changes in either amplitude or latency were reported. Anaesthesia was maintained with isoflurane, fentanyl, propofol and vecuronium. Following uneventful surgery, the patient was transported to the intensive care unit (ICU) and extubated. FHR was 140 beat.min^{-1} and reactive. The postoperative hospital course was uneventful and she accomplished full recovery.

The difficulty in airway management in trauma victims increases from no pregnancy present pre-operatively to pregnancy present pre-operatively. The difficulty in airway management in pregnant trauma victims increases from elective, to urgent, to emergency situations. The anatomic and physiological changes of pregnancy (mucosal oedema, increased oxygen consumption, decreased functional residual capacity) increase the difficulty of airway management, while decreasing the time available and the margin of safety.

It is essential to titrate analgesic and sedative drugs carefully to maintain continual meaningful verbal communication between the anaesthetist and patient (i.e. respond to commands in a clear, crisp and unambiguous manner, and remain rational and alert). Respiratory depression and aspiration of stomach contents during the application of a local anaesthetic agent is much less likely to occur if the patient remains awake and alert. In addition, a rational, alert mother minimises the risk of neonatal depression. Midazolam is the benzodiazepine recommended for these purposes; however, it is highly unionised and very lipophilic, and its fetal/maternal ratio is 0.76 at 15–20 min after maternal administration. However, unlike other benzodiazepines, the ratio falls rapidly. No adverse fetal effects have been reported.

The literature documenting obstetric and anaesthetic management of pregnant trauma victims is limited [2, 3]. We are not aware of any reports documenting emergent anaesthetic management (including awake fibreoptic intubation) of the pregnant trauma victim presenting with unstable traumatic cervical spine fractures for emergent surgery.

In summary, this case clearly demonstrates that timely and aggressive surgical and anaesthetic management (including the airway management) of the pregnant trauma victims may be life saving for both the mother and her fetus.

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Myocardial ischaemia complicating an elective Caesarean section

The recent Confidential Enquiry into Maternal Deaths in the UK [1] illustrated possible problems associated with oxytocin used to maintain a tonic uterus after delivery of an infant by Caesarean section. We describe a patient who suffered myocardial ischaemia during Caesarean section, temporally related to the administration of a bolus dose of oxytocin.

A healthy 31-year-old, non-smoking tennis coach required an elective Caesarean section, for which she had

straightforward spinal anaesthesia. After delivery of the baby and subsequent administration of intravenous synthetic oxytocin 5 i.u., she developed clinical symptoms and ECG changes of myocardial ischaemia. Myocardial damage was confirmed with a troponin T level of 0.19 $\mu g.l^{-1}$, 12 h after the onset of symptoms. A subsequent angiogram demonstrated normal coronary arteries and a diagnosis of acute coronary syndrome was made. Thereafter, the patient made an unremarkable recovery.

It is not uncommon for patients undergoing Caesarean section to experience symptoms of chest discomfort, dyspnoea, nausea and vomiting, which are often attributed to surgical stimulation. Patients suffering from myocardial ischaemia can also complain of very similar symptoms, making it difficult to differentiate between these two causes at the time of surgery.

Myocardial infarction during pregnancy is unusual, with an incidence in the region of 1 in 10 000 [2]. Hence, transient symptoms of chest pain are attributed to causes other than myocardial ischaemia, particularly as patients presenting for Caesarean section tend to be young, healthy and have minimal risk factors for coronary vascular disease. In this case, it is not clear what precipitated the myocardial ischaemia. Neither anaemia nor severe haemorrhage were present, nor was there any apparent cardiac disease or excessive use of vasoactive drugs such as ephedrine.

Significant venous air emboli and amniotic fluid emboli entering the circulation can cause myocardial ischaemia with potentially catastrophic consequences. This does not seem likely in our patient, as she remained haemodynamically stable and well oxygenated throughout.

The ischaemic episode was temporally related to the administration of oxytocin. This drug has been previously implicated in causing myocardial ischaemia [3] for which two mechanisms are postulated. Coronary artery vasospasm has been demonstrated by intracoronary administration of oxytocin in an isolated dog's heart [4]. This mechanism is supported by a report of peripheral arterial spasm associated with the use of synthetic oxytocin [5]. Alternatively, intravenous oxytocin produces vasodilatation of vascular smooth muscle resulting in a reduction in both systolic and diastolic blood pressures. The diastolic hypotension reduces coronary perfusion. This in combination with the physiological anaemia of pregnancy may impair myocardial oxygen supply sufficiently to induce myocardial ischaemia. No decrease in blood pressure was recorded, but even if it did occur between the 3-min recordings, it would still be difficult to explain how such a transient effect could lead to myocardial ischaemia in a healthy patient.

It seems likely that several factors were involved, as the normal physiological response to oxytocin (or indeed the anxiety associated with childbirth) does not result in such dramatic symptoms.

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Peripartum anaesthetic management of a parturient with spinal cord injury and autonomic hyperreflexia

I report a case of a parturient with spinal cord injury (SCI) who presented in early preterm labour with uterine-contractions-induced acute onset autonomic hyperreflexia and received combined spinal epidural analgesia (CSEA) for labour and an uneventful Caesarean section.

A 17-year-old, 164-cm, 60-kg, gravida 1, para 0 female with SCI was admitted to the labour and delivery (L & D) suite at 36 weeks' gestation in preterm labour with regular uterine contractions, facial flushing, piloerection, headache and hypertension. She did not report any pain associated with her contractions. Her past medical history was significant for motor-vehicle-related cervical (C_{6-7}) spinal cord transsection at 28 weeks' gestation. Anterior cervical fusions were performed under general anaesthesia in the immediate post-trauma period. At the time of the insult, the fetus suffered parenchymal brain injury and subsequently developed post-traumatic growth restriction.

The patient had no known drug allergies. Her admission blood pressure was 145/90 mmHg, heart rate 60 $beat.min^{-1}$ and respiratory rate 19 $breath.min^{-1}$. Fetal heart rate was 140 $beat.min^{-1}$ and reactive. The diagnosis of eclampsia was ruled out by routine laboratory studies (liver and kidney function tests). The working diagnosis of acute onset autonomic hyperreflexia was established and administration of labour analgesia was indicated.

A CSEA with levobupivacane 2.5 mg combined with fentanyl 5 μg was promptly administered via a needle through needle technique (18-G Touhy-Schliff epidural needle, and a 27-G Pencan spinal needle) at the L_{3-4} vertebral interspace. A 20-G multi-orifice epidural catheter was inserted 4 cm into the epidural space. Aspiration from the epidural catheter was negative for blood and CSF. The decrease in the patient's blood pressure was recorded in approximately 4–5 min after the

induction of labour analgesia. Over the next 5 min, her headache and other early symptoms of autonomic hyperreflexia subsided. Labour epidural analgesia consisted of a continuous infusion of levobupivacaine 0.0625% with fentanyl 2 $\mu g.ml^{-1}$ at a rate of 8 $ml.h^{-1}$.

Six hours after the induction of CSEA, emergency Caesarean section was required for fetal distress. Surgical anaesthesia was established with incremental doses of chloroprocaine 3% to a total of 15 ml (450 mg) and fentanyl 50 μg administered through an epidural catheter. An uneventful Caesarean delivery of a female fetus weighing 2050 g, who had Apgar scores of 6 and 8, after 1 and 5 min, respectively, was accomplished. No postoperative complications were reported.

Each year more than 2000 women of childbearing age in the United States alone sustain a SCI [1]. As a result of increased survival rates in women with SCI, the number of parturients with SCI is increasing [2]. Vaginal delivery is preferred. Any parturient with SCI whose level of transsection is at T_6 or higher is at risk for acute autonomic hyperreflexia as a result of uterine contractions. Autonomic hyperreflexia in patients with SCI may be mistaken for pre-eclampsia at presentation [3]; consequently, routine laboratory studies (liver and kidney function tests) may be the key differential between the two disorders. Effective management includes prompt administration of labour analgesia. Because of rapid onset of labour analgesia, CSEA seems particularly suitable for these patients. Occurrence of preterm labour is not uncommon in parturients with SCI [4]. Early diagnosis is hampered by the inability of most quadriplegics to sense uterine contractions in the usual way. The incidence of pregnancy complications in parturients with SCI is increased, particularly when SCI occurs in pregnancy.

The literature documenting peripartum anaesthetic management of pregnant patients with SCI is limited [1–5]. I am not aware of any reports documenting emergent administration of CSEA for parturients with SCI presenting in preterm labour with uterine-contractions-induced acute onset autonomic hyperreflexia. This case clearly demonstrates that expeditious induction of labour analgesia may prevent or ameliorate peripartum complications (including autonomic hyperreflexia) in labouring parturients with SCI.

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Pushing water down the femoral shaft

The orthopaedic surgeons in our hospital are keen on using chlorhexidine irrigation when treating wounds. Nowadays, they even use it by means of a Pulse Lavage system, which I have discovered can produce pressures in excess of 400 mmHg if the outlet is restricted. I do not know how well based their routine is in respect of the antimicrobic effect of this rather diluted, 0.02%, chlorhexidine, but neither the anaesthetists nor the surgeons in our hospital have considered it to be much of a problem. By accident, in relation to some testing we wished to carry out, I discovered to my surprise that these solutions are in water, not in 0.9% saline. No one in our department, or in the orthopaedic department, was aware of this. We had all assumed, which one should never do, that it has been in saline.

For fear of effects along the lines of the TUR syndrome, albeit of lesser degree, I do not feel happy when any significant amount of fluid is used as irrigation in any body cavity unless it is iso-osmotic. The solution in question has an osmotic pressure of zero. The raw surfaces down the femoral shaft after reaming and before cementing a prosthesis do not seem to me to be the ideal cavities to irrigate under considerable pressure with zero osmotic water. However, as this has been going on for a long time without any obvious side-effects to our patients, our surgeons are not happy abandoning their practice on theoretic grounds only. We will, in future, see if we can find signs of increased haemolysis after total hip replacements where a significant amount of this chlorhexidine water has been in use, but have as yet not done so.

This potential problem has surfaced now because we want to expand our use of the cell-saver techniques in orthopaedic surgery, and this irrigation solution would of course totally destroy every salvaged red cell. However, we have done some *in vitro* tests in our haematology laboratory using chlorhexidine 0.02% in 0.9% saline, and this solution does not seem to have any effect on the red cells, apart from a small increase in clotting time. Indeed, the little literature I have found suggests that chlorhexidine itself is quite inert to red cells and the vascular bed, and if it were to be used in a cell saver, more than 90% would be washed out before being retransfused to the patient, so one would not expect to see any significant toxic effect.

I would very much appreciate comments from my colleagues in the UK and elsewhere on this practice:

- Is it only in Cornwall that we have not realised that the available chlorhexidine irrigation solutions are in water rather than saline?
- Do the surgeons in your area use this irrigation technique?
- If not, would you be happy if your surgeon was to suggest power irrigation of raw wound/bone surfaces with zero osmotic water?

- If indeed there is a good case for chlorhexidine irrigation, should we not push the industry to produce it in saline?
- Is there a suitable substitute for this irrigation solution that we could offer to our surgeons?

I invite you to contact me with your answers to these questions and indeed any comments.

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History of anaesthesia

John Zorab, in his recent letter (Zorab. *Anaesthesia* 2002; **57**: 1242), gives but a brief explanation of Lethe. Were this necessary for our learned readership, it would be helpful if it were more informative. Hades (Dis) was one of the three sons of Cronos (Saturn) and Rhea (Ops), youngest brother of Zeus (Jupiter) and Poseidon (Neptune). In the division of the world between the three brothers, he took the lower world, which became known as Hades through association. The name Hades was feared and rarely spoken, the Classical equivalent of Voldemort [1].

Lethe was the daughter of Eris (Discordia). Through the nether world ran a river named after her, but this river was in the Elysian Fields, where the souls of the blessed existed. They would drink of the water of Lethe prior to returning to the normal world as reincarnated souls so that they would have no memory of the lower world. The spirits of the guilty and evil-doers passed into the judgement hall of Hades, where their torment for eternity was decided prior to their entering Tartarus and joining the company of well-known sufferers such as Tityus, Ixion, Tantalus and Sisyphus. I am sure further explanation is unnecessary to our learned readership.

Finally, I think that it is most unlikely that Adam is suffering from a postanaesthetic headache, as he is still 'in a deep sleep' undergoing the procedure of uxorectomy, and would one really suggest that the Almighty is not able to provide a perfect anaesthetic without sequelae?

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James Matthews Duncan

There is an earlier account of Matthews Duncan's experiments with chloroform than the one cited by your correspondent (McKenzie. *Anaesthesia* 2003; **58**: 488–9). This was communicated by him to Sir Robert Christison, entered in Christison's journal on July 25, 1870, and transcribed into his biography by his sons [1, 2]. It reads as follows:

'On asking Dr Matthews Duncan to repeat a remarkable statement he made to me a few months ago, relative to his concern with the discovery of the anaesthetic virtues of chloroform, he gave it me thus. One day when Sir James Simpson and he were in Dr Gregory's laboratory at the College, he (Dr Duncan) got possession of every liquid in the laboratory which he imagined ''would breathe''. Four or five bottles were thus carried off, and chloroform was one. At this time, the correspondence with Mr Waldie about anaesthetics, and the suggestion by that gentleman to try chloroform, had not been heard of by Dr Duncan. One forenoon Dr Duncan made trial of the chloroform. He had previously experimented on himself with various substances, but found none suitable. On trying chloroform, he was convinced that the article sought for was found. The same or next evening the trial was repeated by Dr Keith, Sir James, and himself. This was the trial which is now a matter of history; but the previous trial has never been noticed. Dr Duncan was at that time assistant to Sir J. Simpson in his scientific work, and undertook this special inquiry under his general guidance.'

A footnote adds the information, received from Matthews Duncan, that around 1885 nitrous oxide and ether were much more used in London than either chloroform or methylene, whereas in Edinburgh chloroform still held first place.

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The Palm-LM (laryngeal airway) simulator

Laryngeal mask airway insertion is a core skill for anaesthetists and those involved in resuscitation. Commercially available airway manikins are not ideal for teaching laryngeal mask insertion.

We have therefore developed our own hand-held simulator whilst teaching anaesthetic trainees and candidates on life-support courses. The use of one's own palm to teach and practise laryngeal mask insertion is free and effective. The Palm-LM simulator can be used to mimic the hard palate, soft palate and posterior pharyngeal wall as the lubricated laryngeal mask slides along them during insertion (Figs 7 and 8) and permits demonstration of

Figure 7

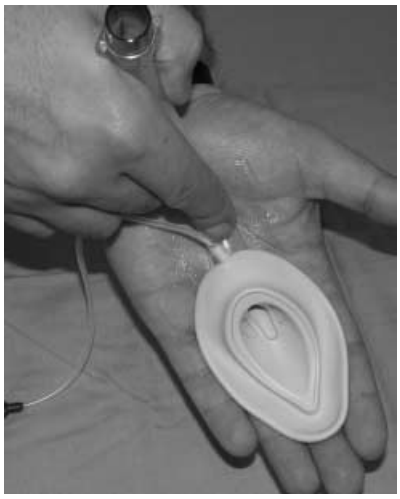

Figure 8

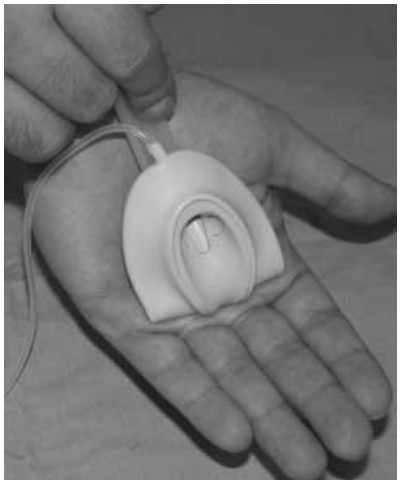

Figure 9

Figure 10

the correct method of placement with a realistic feel. It can also be used to show how the laryngeal mask folds back against the posterior pharyngeal wall when a suboptimal insertion technique is employed, and why rotating the device when this occurs is sometimes effective (Figs 9 and 10).

The Palm-LM simulator fits easily in the operator's pocket when not in use and comes in a variety of sizes for practising insertion of different sizes of laryngeal mask. It is highly portable and easy to clean and we highly recommend it. We have decided not to patent our device in the broader interest of medical education.

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Web addresses

I can sympathise with your correspondent (McHugh. *Anaesthesia* 2003; **58**: 401) and the problems he encountered when trying to access the Difficult Airway Society website (http://www.das.com.uk) and found he was visiting the Duxford Aviation Society (http://www.das.org.uk). I have had similar problems trying to the access the website of the World Federation of Societies of Anaesthesiologists (WFSA). http://www.wfsa.org will take you to the website of the Wilhelm Furtwangler Society of America, dedicated to the memory of the distinguished former conductor (1886–1954) of the Berlin Philharmonic, whilst http://www.wfsa.org.uk is the website of the Welsh Federation of Sea Anglers.

If you want to know more about the Welsh Football Supporters Association, a group that probably needs all the support it can muster, for some reason you will have to visit http://www.soft.net.uk but if you are interested in the World Federation of Societies of Anaesthesiologist you will find it at http://www.anaesthesiologists.org.

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History of anaesthesia

Charles John Samuel Thompson (1862–1943) was Henry S. Wellcome's in-house historian and, in the Lecture Memoranda entitled 'Anaesthetics Antient and Modern' that he prepared for the Annual Meeting of the British Medical Association in Exeter in 1907 and to which I referred in a previous letter [1], he wrote:

'It is probable that primitive man employed digital compression of the carotid arteries to produce anaesthesia, as the aboriginal inhabitants of some countries do today. According to Caspar Hoffman, this method was practised by the ancient Assyrians before performing the operation of circumcision. Curiously enough the literal translation of the Greek and Russian terms for the carotid is ''artery of sleep''. The ancient Egyptians are believed to have used Indian Hemp and the juice of the poppy to cause a patient to become drowsy before a surgical operation. Pliny relates that they applied to painful wounds a species of rock brought from Memphis, powdered, and moistened with sour wine, which is the first record we have of local anaesthesia with carbonic acid gas. The ''sorrow-easing drug'' which, as we are told in the fourth book of the Odyssey, was given by Helen to Ulysses and his comrades, probably consisted of poppy juice and Indian hemp. It is indeed actually stated that she learned the composition from Polydamnia, the wife of Thone, in Egypt. It is possible also that the ''wine of the condemned'' mentioned by the prophet Amos [2], may have been a preparation of these drugs. There are several passages in the Talmud, which point to the fact that the practice of easing the pain of torture and death by stupefying the sufferers was a very ancient one. Thus it is stated: ''If a man

is led forth to death, he is given a cup of spiced wine to drink, whereby his soul is wrapped in night''; and again, ''Give a stupefying drink to him that loseth his life, and wine to those that carry bitterness in their heart. In connexion with crucifixion, which was a common punishment for malefactors among the Jews before the Christian era, with the sanction of the Sanhedrin, the women were wont to ease the terrible death agony of the sufferers by giving them something in the nature of a ''wine of the condemned'' upon a sponge. It is probable that the ''wine mingled with myrrh'' which, according to St Mark [3], was offered to Christ before nailing Him upon the Cross, was indeed a narcotic draught, given with the object of lessening His sensibility to the agony.'

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