

Evidence-based perioperative medicine (EBPOM): a summary of the 8th EBPOM conference 2009

The 8th evidence-based perioperative medicine (EBPOM) conference was held in London on 2–3 July 2009. The meeting was co-chaired by Dr Mark Hamilton, Consultant in Anaesthesia and Intensive Care Medicine at St George's Hospital, London, and Professor Monty Mythen, Smiths Medical Professor of Anaesthesia and Critical Care, and Director of the Centre for Anaesthesia, University College London.

As the field of perioperative medicine continues to grow nationally and internationally, there is increasing recognition that significant improvements in patient care can be achieved through the integrated application of evidence. EBPOM 2009 encompassed five days of lectures and workshops on improving perioperative care and incorporating the 2nd national cardiopulmonary exercise testing (CPET) meeting as well as the two-day 8th EBPOM conference. The conference enabled delegates and speakers to debate and share their knowledge and experience, and outlined improvements in surgical outcome and the application of technology and enhanced pathways to further improve the quality of surgical care.

Regional anaesthesia (NAP3) — as safe as houses?

Dr Tim Cook, Consultant Anaesthetist, Royal United Hospital, Bath, and Lead, Royal College of Anaesthetists' 3rd National Audit Project (NAP3)

Dr Cook presented findings from the Royal College of Anaesthetists' 3rd National Audit Project (NAP3) on major complications of central neuraxial block (CNB; Cook et al, 2009). This two-phase project sought to determine the number of CNBs (epidurals, spinals, caudals and combined spinal epidurals (CSEs)) performed each year in the UK, and the prevalence and incidence of serious complications of CNB procedures.

The census phase produced a denominator of over 707000 CNBs. Out of 84 major complications reported, 52 met the inclusion criteria: data analysed 'pessimistically' and 'optimistically' yielded

30 and 14 permanent injuries, respectively. The incidence of permanent injury caused by CNB (per 100000 cases) was 'pessimistically' 4.2 (95% confidence interval 2.9–6.1) and 'optimistically' 2.0 (1.1–3.3). The data are reassuring and suggest that CNB has a low incidence of major complications, many of which resolve within 6 months.

In the 30 patients with permanent harm (judged 'pessimistically'), 60% occurred after epidural block, 23% after spinal anaesthesia and 13% after CSE; more than 80% of these patients had a CNB placed for perioperative analgesia. Two-thirds of initially disabling injuries resolved fully. However, vertebral canal haematoma (in elderly patients), vertebral canal abscess and spinal cord ischaemia (in elderly patients) were the main causes of permanent neurological harm after perioperative CNB. Delays in identification, review and diagnosis of inappropriately weak legs after CNB led to avoidable harm.

Cook TM, Counsell D, Wildsmith JAW (2009) Major complications of central neuraxial block: report on the 3rd National Audit Project of the Royal College of Anaesthetists. *Br J Anaesth* 102: 179–90

The GALA trial — general vs local anaesthesia for carotid surgery

Dr Andrew Bodenham, Director of Intensive Care and Consultant in Anaesthesia, Leeds General Infirmary

GALA is a multicentre, randomised trial assessing the relative risks of stroke, cardiac events and death following carotid endarterectomy under either general or local anaesthesia (GALA Trial Collaborative Group, 2008). In total, 3526 patients with symptomatic or asymptomatic carotid stenosis from 95 centres in 24 countries were randomly assigned to surgery under general ($n=1753$) or local ($n=1773$) anaesthesia. The primary outcome was the proportion of patients with stroke, myocardial infarction or death between randomisation and 30 days after surgery.

A primary outcome occurred in 84 (4.8%) patients assigned to surgery under general anaesthesia and in 80 (4.5%) patients in the local anaesthesia

group; three events per 1000 treated were prevented with local anaesthesia. The two groups did not significantly differ for quality of life, length of hospital stay or primary outcome.

Thus there was no clear difference in outcomes between general and local anaesthesia for carotid surgery. The anaesthetist and surgeon, in consultation with the patient, should decide which anaesthetic technique to use on an individual basis.

GALA Trial Collaborative Group (2008) General anaesthesia vs local anaesthesia for carotid surgery (GALA): a multicentre, randomised, controlled trial. *Lancet* 372: 2132–42

New oral anticoagulants — implications for regional anaesthesia

Professor Samuel J Machin, Professor of Haematology, University College London

Heparin was the first anticoagulant drug used in the 1930s; since then many anticoagulant drugs have been developed, although some are no longer in use. The presentation focused on the new oral anti-thrombotic agents: dabigatran etexilate, an oral, direct thrombin inhibitor licensed in the UK in April 2008; and rivaroxaban, an oral, direct factor Xa inhibitor licensed in the UK in October 2008.

Dabigatran etexilate is effective within only 30 minutes–2 hours. Rivaroxaban inhibits Factor Xa and reduces thrombin generation, with significant efficacy for reducing venous thromboembolism.

There is a risk of spinal bleeding associated with indwelling catheters used in neuraxial anaesthesia, thus their use should be carefully managed in patients receiving anticoagulants (ie avoid preoperative anticoagulation before regional anaesthesia and observe for 3 days after catheter removal for neurological impairment). Under regional anaesthesia dabigatran is used in 67% of knee and 48% of hip replacement operations, and rivaroxaban is used in 60% of all replacements; both have no reported incidence of spinal haematoma to date. Dabigatran is not recommended with postoperative indwelling epidural catheters.

Anaphylaxis — guidelines and emerging evidence

Dr David Hepner, Associate Director, Weiner Center for Preoperative Evaluation, Brigham and Women's Hospital, Boston, and Assistant Professor of Anaesthesia, Harvard Medical School, USA

During an anaesthetic, patients are exposed to multiple medications, which can cause mild to severe anaphylaxis, a clinical syndrome involving multiple organ systems (Hepner and Castells, 2003).

The first step in the treatment of an anaphylactic reaction consists of the withdrawal of the likely causative drug and the interruption of the release of preformed mediators from mast cells and basophils, with prevention of more mediator release. An immediate assessment of the airway, breathing and circulation, and early administration of epinephrine is essential to avoid airway compromise and cardiovascular collapse.

Other treatment strategies include airway support with 100% oxygen, intravenous crystalloid replacement (2–4 litres) to compensate for the peripheral vasodilatation, and glucocorticoids to decrease airway swelling. Norepinephrine, metaraminol and glucagon (for patients receiving β -blockers) are potent vasopressors in anaphylaxis refractory to epinephrine. Emerging trends include treatment with arginine vasopressin as an alternative when cardiovascular collapse does not respond to epinephrine.

Hepner DL, Castells MC (2003) Anaphylaxis during the perioperative period. *Anaesth Analg* 97: 1381–95

Preoperative management of patients with neurologic disease

Dr Angela Bader, Associate Professor of Anaesthesia, Harvard Medical School, Director, Weiner Center for Preoperative Evaluation, Brigham and Women's Hospital, Boston, USA

The literature is limited on the provision of anaesthetic care to patients with neurologic disorders, such as multiple sclerosis (MS) and cerebrovascular disease (CBD). Patients with MS should be informed that there is no clear link between any anaesthetic and an increase in relapse rate; choice is based on overall medical issues and type of surgery.

However, care should be taken as increased temperature, infection, the postpartum state and postoperative, pain-induced stress are associated with relapse.

Preoperative evaluation of patients with a history of CBD involves risk-factor stratification to assess the risk of cerebral reinfarction; despite medical advances, the overall risk of perioperative strokes has not decreased. The incidence of perioperative stroke depends on the type and complexity of the surgical procedure. Over 80% of perioperative strokes occur postoperatively, and one-third are caused by embolism from atrial fibrillation. The risk of stroke without known carotid disease is about 0.5%; Evans and Wijdicks (2001) reported a perioperative stroke risk of 3.6% in patients with known carotid stenosis. Thus prophylactic carotid endarterectomy should be recommended only if the associated risk is <3.6%.

Evans BA, Wijdicks EFM (2001) High-grade carotid stenosis detected before general surgery: is endarterectomy indicated? *Neurology* 57: 1328–30

Reducing preoperative myocardial injury; guidelines and pharmacology

Professor Don Poldermans, Professor of Medicine and Head of Perioperative Cardiac Care, Erasmus Medical Center, Rotterdam, The Netherlands

Pharmacological risk reduction is one of the most important elements of perioperative management. Randomised, controlled trials investigating the effects of β -blockers in the perioperative period have shown divergent results; the initiation time and dose of β -blocker therapy, dose adjustments for heart rate control and the patient's underlying cardiac risk are important factors that may relate to the effectiveness of treatment (Poldermans et al, 2008).

Care should be taken not to overtreat the patient; start with a low-dose β -blocker at least 1 month before surgery (eg bisoprolol 2.5 mg daily), carefully titrate up as necessary (avoiding hypotension and bradycardia) and continue with a maintenance dose after surgery. Do not withdraw long-term β -blockers before surgery. People metabolise metoprolol differently and some may require a higher perioperative dose.

The Dutch Echographic Cardiac Risk Evaluation Applying Stress Echo III trial showed that statins can improve postoperative

outcome. Perioperative fluvastatin reduces the incidence of myocardial ischaemia, reduces inflammatory markers and shows a clear, long-term effect in intermediate-risk patients. Perioperative treatment with a β -blocker and a statin (bisoprolol or fluvastatin) improves long-term outcome in non-vascular surgery patients.

Poldermans D, Hoeks SE, Feringa HH (2008) Preoperative risk assessment and risk reduction before surgery. *J Am Coll Cardiol* 51: 1913–24

Research presentations

A panel of experts judged short presentations and their submitted abstracts. The prize was awarded to Dr Ben Messer for 'A completed cycle of audit into postoperative nausea and vomiting' (PONV); the authors Hilary Turner, Jennifer Saul Benjamin, Ben Messer and WJ Wight from the Royal Victoria Infirmary, Newcastle-upon-Tyne, highlighted that education of staff can improve the prescription of anti-emetics and reduce the rates of PONV.

Evidence-based myths of anaesthesia!

Dr Neil Soni, Consultant in Intensive Care and Anaesthesia, Chelsea and Westminster Hospital, London

A medical myth may be a fundamental belief that remains a core value for a clinician, but the implementation of which may vary according to current opinion or practice. In perioperative medicine the theory behind most new innovations is sound, but the evidence to show benefit may be lacking.

There are conflicting opinions about awake or asleep epidurals; although many patients are awake for their epidurals, most would prefer medication when asleep. There are also differing views on whether regional is better than general anaesthesia.

Every aspect of procedures has heterogeneity, even within the same hospital and between patients, surgeons and anaesthetists. Despite differences, simple strategies do make an impact; smoking cessation 6–8 weeks preoperatively reduces major complications, wound infections and cardiovascular symptoms, and decreases the hospital stay by 2 days (Møller et al, 2002).

Møller AM, Villebro N, Perderson T et al (2002) Effect of preoperative smoking intervention on postoperative complications. *Lancet* 359: 114–17

Optimising perioperative outcomes: risk assessment, patient preferences and performance measures

Professor Lee Fleisher, Robert Dunning Dripps Professor and Chair of Anaesthesiology and Critical Care Medicine, University of Pennsylvania School of Medicine, USA

The application of evidence to clinical practice requires risk assessment to determine factors that contribute to a patient's mortality and morbidity; with improvements in anaesthesia outcomes over the past 50 years, the focus is also on improving non-fatal perioperative outcomes, such as perioperative myocardial infarction and pulmonary dysfunction. However, does knowing risk translate into improved outcome? As consequences of actions are uncertain (each patient is an individual) and include both favourable and unfavourable effects, a decision must be made based on a risk:benefit analysis.

Risk indices can identify independent predictors of adverse events in order to define who needs further evaluation and to target interventions (Fleisher, 2001); they can also be used to better inform the patient. It is essential to determine patient preferences; 'standard gamble' (eg to assess location of care for outpatient *vs* inpatient surgery) and 'willingness to pay' (eg to assess the value of interventions for PONV) have been used for anaesthesia outcomes with success.

Measuring compliance with best practices based upon strong evidence in the perioperative setting include antibiotic timing and redosing, continuation of a preoperative β -blocker and PONV treatment, with the supposition that measuring best 'processes' will result in better outcomes.

Fleisher LA (2001) Risk indices: what is their value to the clinician and patient? *Anaesthesiol* 94: 191–3

Perioperative databases — can they improve perioperative care?

Professor Scott Beattie, R. Fraser Elliot Chair in Cardiac Anaesthesia, Departments of Anaesthesia, University Health Network and the University of Toronto, Canada

Professor Beattie believes that databases can provide sensitive and accurate data on which to formulate care and public policy, and defines three key points: that research results using information from a database will require scrutiny; that alternative sources

of data (the randomised, controlled trial) yields higher quality information; and that 'high-quality' information improves care.

Although randomised, controlled trials are considered the 'gold standard' for clinically important information they are expensive, time consuming and may overestimate the benefits of therapy; high-quality, non-randomised trials increase knowledge by more efficient use of resources, increased size and statistical power and better measures of safety. The Strobe initiative (STrengthening the Reporting of OBServational studies in Epidemiology) is an international collaboration of epidemiologists, methodologists, statisticians, researchers and journal editors involved in the conduct and dissemination of observational studies (www.strobe-statement.org). Propensity analysis reduces bias between treatment groups by adjusting for measured confounders, as advocated in the Strobe statement.

Large, validated databases provide information that considers the total population and the treatment escalations based on disease severity.

Data collection and quality improvement for perioperative care

Professor Kathy Rowan is Director, Intensive Care National Audit and Research Centre, London

The Intensive Care National Audit and Research Centre (ICNARC) aims to facilitate improvements in the organisation and practise of critical care through a broad programme of audit and research. Professor Rowan's ideal would be that every person having surgery would have data collected preoperatively, intraoperatively and postoperatively, with a view to assessing and improving perioperative care.

The American College of Surgeons' National Surgical Quality Programme (ACS NSQIP) has shown impressive results, reviewing 135 variables and following up patients to 30 days in terms of mortality and morbidity, although it is expensive to run. Could there be a NHS NSQIP equivalent, building on existing knowledge (methodological research in risk adjustment/outcome measurement, specific audits and data linkage) and learning from experience elsewhere (eg Case Mix Programme), ensuring not to duplicate generic data collection?

The Case Mix Programme is a national, comparative audit of patient outcome from intensive care; over 80% of adult, general critical care units participate. Data are validated and analysed by the ICNARC; these analyses form the electronic Data Analysis Report, which shows how each unit compares with others and helps the unit understand more about the care it delivers. It aims to assist each unit in decision-making, resource allocation and local performance management (see www.icnarc.org). Perhaps this experience could be useful when considering an NHS NSQIP equivalent?

The inaugural Ernest Henry Starling lecture: a personal view on 50 years of high-risk surgery

Professor David Bennett, Professor of Intensive Care Medicine, St George's Hospital, London

Ernest Henry Starling (1866–1927) was a physiologist whose major contributions included: the 'Starling equation', describing fluid shifts in the body (1896); the discovery of peristalsis (with Bayliss in 1899); the discovery of secretin, the first hormone (with Bayliss in 1902) and the introduction of the concept of hormones (1905); and the discovery that the distal convoluted tubule of the kidney reabsorbs water and various electrolytes.

Professor Bennett presented his view on 50 years of high-risk surgery. Shoemaker et al (1988) identified a group of high-risk surgical patients using simple clinical criteria and demonstrated that only variables related to blood volume and flow had significant prognostic value. He showed that early optimisation of cardiac output in a wide range of high-risk surgical patients produced highly significant reductions in both morbidity and mortality; thus oxygen delivery of 600 ml/min/m² became the goal, and the concept of goal-directed therapy was born. Subsequent studies in perioperative optimisation used fluid challenges to achieve maximal stroke volume and could demonstrate significant reductions in morbidity and mortality.

Some of the risk of postoperative morbidity and mortality may be genetically determined, but impaired cardiac function is probably the most important, with impairment of the microcirculation. High-risk patients can be identified using biomarkers and simple clinical criteria,

and perhaps by CPET. Developing postoperative complications dramatically reduces long-term survival. Increasing cardiac output in the perioperative period results in significant reduction in mortality and morbidity, which is sustained for several years.

Current investigations include the optimisation of perioperative cardiovascular management to improve surgical outcome (OPTIMISE) trial, set up across 12 centres; the closure date is April 2012.

Shoemaker WC, Appel PL, Kram HB, Waxman K, Lee TS (1988) Prospective trial of supranormal values of survivors as therapeutic goals in high-risk surgical patients. *Chest* 94: 1176–86

Regional anaesthesia, oxygen delivery and elective hips: breaking new ground?

Professor Giorgio Della Rocca, Director, Department of Anaesthesia and Intensive Care, Azienda Ospedaliero-Universitaria, University of Udine, Italy

Hip arthroplasty is one of the most commonly performed major surgical procedures. It is often performed in elderly patients, and the mortality rate varies between 0.2–10% (Pearse et al (2006) classified high-risk as having a ≥5% mortality rate). As haemodynamic optimisation has been shown to reduce complications, mortality and length of stay in other high-risk populations (eg abdominal and cardiac surgery), Professor Della Rocca and Dr Cecconi (Department of Anaesthesia, St George's Hospital, London) investigated whether haemodynamic optimisation could reduce mortality and morbidity in patients undergoing hip arthroplasty.

Forty patients (with mild systemic disease) undergoing elective hip arthroplasty under spinal anaesthesia were studied: 20 were randomised to a haemodynamic protocol (targeting stroke volume maximisation plus oxygen delivery of 600 ml/m²); 20 were randomised to standard management. Patients receiving goal-directed therapy received more crystalloids, colloids and blood intraoperatively, and had fewer postoperative complications at 7 days.

Pearse RM, Harrison DA, James P et al (2006) Identification and characterisation of the high-risk surgical population in the UK. *Critical Care* 10: R81

Biomarkers and the assessment of preoperative risk in major surgery

Professor Brian Cuthbertson, Professor of Critical Care, Health Services Research Unit, University of Aberdeen

Approximately 20–30 000 patients die each year around the time of surgery, most from cardiovascular causes. Clinicians are not good at predicting risk as existing risk prediction scores are unreliable.

Professor Cuthbertson et al (2005) studied the use of B-type natriuretic peptide (BNP) in predicting the level of peri- and postoperative support required after coronary artery bypass grafting (CABG); they found that BNP was a sensitive and specific predictor of morbidity and mortality after elective high-risk surgery. Further studies have shown it to be a useful predictor of risk in elective non-cardiac surgery and may predict left ventricular function in sepsis.

As a marker of renal disease, estimated glomerular filtration rate (eGFR) is a powerful predictor of morbidity and mortality after CABG (Hillis et al, 2006); perhaps eGFR should be integrated into existing clinical prediction models for morbidity and mortality after cardiac surgery.

Croal et al (2006) found that troponin I levels (TnI) increase after cardiac surgery, and concluded that cardiac TnI levels measured 24 hours after cardiac surgery predict short-, medium- and long-term mortality.

Croal BL, Hillis GS, Gibson PH et al (2006) Relationship between postoperative cardiac troponin I levels and outcome of cardiac surgery. *Circulation* 114: 1468–75

Cuthbertson BH, McKeown A, Croal BL et al (2005) Utility of B-natriuretic peptide in predicting the level of peri- and postoperative cardiovascular support required after coronary artery bypass grafting. *Crit Care Med* 33: 437–42

Hillis GS, Croal BL, Buchan KG et al (2006) Renal function and outcome from coronary artery bypass grafting. *Circulation* 113: 1056–62

Restructuring surgical care — more or less!

Mr Peter Holt, Clinical Lecturer in Outcomes and Vascular Surgery, St George's Vascular Institute, London

Healthcare specialisation in surgical practice and regionalisation of complex services would include the provision of trauma services and vascular surgical services in England. With an increasing emphasis on the public reporting of health outcomes,

elective outcomes may be used to determine quality. As there is increasing evidence that centralisation improves measured outcomes for cardiac and vascular surgery, abdominal aortic aneurysm (AAA) repair and carotid endarterectomy (CEA) can be used as models for other complex surgical services.

Service attributes selected by patients attending AAA screening included car parking, minimally invasive surgery and outcomes. A volume–outcome relationship was found to exist for arterial surgery; thus outcomes data can be used to model services. Elective deaths may be prevented through a regionalised model of care. Travel times appeared acceptable to patients; >90% of patients said they would travel for over an hour to access improved healthcare services.

New developments in obstetric anaesthesia

Dr Roshan Fernando, Consultant Anaesthetist, University College Hospital, London

Although ephedrine has historically been used for the treatment of hypotension induced by spinal anaesthesia, it has a slow onset of action, is difficult to titrate and can cause fetal acidosis. A better alternative is phenylephrine, which is a rapidly acting, potent vasoconstrictor with a short duration of action and causes less fetal acidosis; reflex bradycardia can occur, but this rarely needs anticholinergic treatment. A combination of a crystalloid coload technique with a phenylephrine infusion has been shown to virtually eliminate spinal-induced hypotension and reduce fetal acidosis and maternal nausea (Ngan Kee et al, 2005).

Studies have reported a variable effect of epidural fentanyl on breastfeeding; rapid placental transfer and drug accumulation in fetal tissues may correlate with early and continuing breastfeeding problems.

Epidural labour analgesia has been linked to increasing intrapartum temperature. Maternal pyrexia is correlated with neonatal brain injury, although this is an abnormal response that occurs immediately after drug administration in a minority of women. A combined spinal epidural gives good flexibility and improves cardiovascular stability with a lower dose of spinal bupivacaine (5–7 mg).

Ngan Kee WD, Khaw KS, Ng FF (2005) Prevention of hypotension during spinal anaesthesia for Caesarian delivery. *Anaesthesiol* 103: 744–50

Cardiothoracic anaesthesia: new developments and current thinking

Dr J-P van Besouw, Chairman, Association of Cardiothoracic Anaesthetists, St George's Healthcare NHS Trust, London

New developments within percutaneous cardiac procedures include the trialling of bioabsorbable drug-eluting stents; Ormison et al (2008) showed a 100% success rate for the implantation of the bioabsorbable everolimus-eluting stent, with comparable adverse effects with other stenting procedures. Other procedures include transcatheter aortic valve replacement; this should be performed by a multidisciplinary team, generally for severe, symptomatic aortic stenosis and often with preoperative antiplatelet therapy.

Developments within the topic of transfusion strategy in cardiac surgery include the cessation of use of aprotinin as it can cause the development of renal dysfunction and increases mortality risk. As acute anaemia can affect outcome, pre-optimisation is important (transfusion effect). Transfusion of red blood cells older than 14 days is associated with a significantly increased risk of postoperative complications as well as reduced survival.

Advances in cardiopulmonary bypass surgery include the development of the mini-cardiopulmonary bypass (MICPB) system. Ranucci and Isgro (2007) concluded that patients receiving a MICPB had a shorter stay, had lower peak postoperative serum creatinine and bilirubin levels and suffered less postoperative blood loss. More studies are needed to confirm these results.

Ormison JA, Serruys PW, Regar E et al (2008) A bioabsorbable, everolimus-eluting coronary stent system for patients with single *de-novo* coronary artery lesions (ABSORB): a prospective open-label trial. *Lancet* 371: 899–907

Ranucci M, Isgro G (2007) Minimally invasive cardiopulmonary bypass: does it really change outcome? *Critical Care* 11: R45

'Tricks and traps' in developing a better preoperative service

Dr Ross Kerridge, Anaesthetist and Director of the Perioperative Service, John Hunter Hospital, Newcastle, Australia

Preoperative systems are changing worldwide, with a shift towards organised, structured processes for patient assessment and preparation by a centralised, hospital-based, multidisciplinary team.

To achieve an effective preoperative service, it is important to identify 'tricks' to success and to avoid pitfalls or 'traps'. A 'trick' to achieving change is to identify a clear vision, to conceptualise it with appropriate terminology, to justify resource allocation, to share why change is necessary and to make the value of each step clear. Clinicians need to develop better classifications of perioperative morbidity and mortality and to facilitate research to avoid the 'trap' of the lack of standardisation of terminology in current clinical information systems.

A centralised preoperative service can deliver a common, approachable reference point for staff dealing with basic issues and can deliver improved practice for less clearcut issues such as blood transfusion. Effective triage is a crucial part to enable the delivery of efficient and appropriate care when needed. An improved service depends on the professional care team working together in supporting patient care; to audit this service, 'key performance indicators' must be produced regularly.

Clinicians often fall into the 'trap' of presenting new clinical problems, but a 'trick' may be to provide a realistic, confident vision for the development of future perioperative care systems that address the multidimensional challenges of modern health care.

Perioperative CV monitoring: new methods, new promise?

Dr Andrew Rhodes, Clinical Director of Critical Care, St George's Hospital, London

Haemodynamic monitoring in the perioperative period involves fluid management to predict which patients need fluid and to control a fluid challenge, and vasoactive agents to monitor oxygen delivery. It is essential to administer the correct amount of fluid to patients to improve long-term survival, especially in high-risk patients. Thus sophisticated monitoring equipment is needed to enable correct fluid titration.

Marik et al (2008) reported that central venous pressure is not a good predictor of fluid responsiveness and should not be used for decision-making regarding fluid management. Dr Rhodes uses a more sophisticated system, the LiDCO™plus monitoring system, which measures cardiac output and calibrates PulseCO™ to provide

a real-time and continuous assessment of a patient's haemodynamic status.

The affect of increases in intrathoracic pressure on cardiac output can be plotted to show how a patient is responding to a fluid challenge; the type of fluid given is not of importance if given fast enough. Pearse et al (2005) found that sufficiently early goal-directed therapy after major surgery reduces postoperative complications and duration of hospital stay.

Thus fundamentals of haemodynamic monitoring comprise correct measurement (understanding the technology), correct interpretation (understanding the physiology) and correct application (understanding the medicine).

Marik PE, Baram M, Vahid B (2008) Does central venous pressure predict fluid responsiveness? *Chest* 134: 172–8

Pearse R, Dawson D, Fawcett J et al (2005) Early goal-directed therapy after major surgery reduces complications and duration of hospital stay. *Critical Care* 9: R687–93

Airway management — can it ever be truly evidence based?

Dr Ian Calder, Consultant Anaesthetist, The National Hospital and The Royal Free Hospital, London

When there is no real evidence, practice relies on 'common sense', which may not be questioned ('herd behaviour') and may be laid down as dogma. It is hard to identify difficult airways as it is a low prevalence problem. It is better to think about true and false positives and the likelihood ratio between them, rather than sensitivity and specificity issues (the pre-test probability multiplied by the likelihood ratio equals the post-test probability).

Muscle relaxants can be used with good effect to facilitate face mask ventilation (FMV) (Szabo et al, 2008), make intubation easier (Combes et al, 2007) and facilitate intubation if FMV fails (Calder et al, 2007).

It is essential to ensure all reasoning and practice is evidence-based and to avoid hubris, where we think we know all the answers.

Calder I, Yentis SM, Kheterpal S, Tremper KK (2007) Impossible mask ventilation. *Anaesthesiol* 107: 171–2

Combes X et al (2007) Comparison of two induction regimens using or not using muscle relaxant: impact on postoperative upper airway discomfort. *Br J Anaesth* 99: 276–81

Szabo TA et al (2008) Neuromuscular blockade facilitates mask ventilation. *Anaesthesiol* 109: A184

Perioperative fluid balance: current thinking and answers

Professor Monty G Mythen, *Smiths Medical Professor of Anaesthesia and Critical Care, and Director of the Centre for Anaesthesia, University College London*

Albumin is expensive and may cause harm, especially in trauma resulting in bleeding; the Saline versus Albumin Fluid Evaluation (SAFE) Study (2007) found that patients with traumatic brain injury resuscitated with albumin had a higher mortality rate than those resuscitated with saline.

The *British Consensus Guidelines on Intravenous Fluid Therapy for Adult Surgical Patients* (Powell-Tuck et al, 2009) outlines recommendations for preoperative treatment with intravenous fluid and inotropes, to achieve predetermined goals.

Concern about hyperchloraemic acidosis has focused attention on the type of fluid administered. Lactated Ringer's solution is superior to normal saline, with fewer adverse effects. The Danish Study Group on Perioperative Fluid Therapy (2003) compared colloid (HES) with crystalloid (normal saline) regimens; the colloid 'restricted' fluid regimen reduced complications and mortality.

Individualised, goal-directed therapy with optimisation of stroke volume reduces complications and hospital stay.

Danish Study Group on Perioperative Fluid Therapy (2003) Effects of intravenous fluid restriction on postoperative complications: comparison of two perioperative fluid regimens. *Ann Surg* 238: 641–8

Powell-Tuck J, Gosling P, Lobo DN et al (2009) *British Consensus Guidelines on Intravenous Fluid Therapy for Adult Surgical Patients*. www.ebpom.org

SAFE Study Investigators (2007) Saline or albumin for fluid resuscitation in patients with traumatic brain injury. *N Engl J Med* 357: 874–84

Surgical complications: a life sentence?

Dr Mark Hamilton, *Consultant and Honorary Senior Lecturer, Anaesthesia and Intensive Care Medicine, St George's Hospital and Medical School, London*

The economic burden of surgery is considerable, with an additional cost of treating surgical complications. The definition and collection of data for perioperative complications are not well-defined and are probably more common than reported, with more than 50% of complications being preventable by better practice.

Khuri et al (2005) used data from 105951 patients who underwent eight types of operation to determine the effect of complications on mortality; the occurrence of a perioperative complication reduced median patient survival by 69%, and a 30-day postoperative complication was more important than preoperative patient risk and intraoperative factors in determining long-term survival after major surgery.

Surgical mortality varies between hospitals and countries. Predictors of postoperative morbidity include age, ASA score, duration and type of surgery, estimated blood loss and arterial pH. Myocardial injury increases hospital stay and places a huge burden on healthcare budgets. Troponin is an independent predictor of intermediate and long-term outcomes.

Goal-directed therapy can be used to reduce perioperative complications and improve surgical outcome. Evidence-based therapies include correct timing and dose of antibiotics, temperature control, thromboprophylaxis and goal-directed haemodynamic and fluid management.

Khuri SF, Henderson WG, DePalma RG et al (2005) Determinants of long-term survival after major surgery and the adverse effect of postoperative complications. *Ann Surg* 242: 326–43

Enhanced surgical recovery

Mr Alastair Windsor, *Consultant Surgeon and Honorary Senior Lecturer, University College London Hospitals*

The main principle of an enhanced surgical recovery programme is to reduce morbidity, thus reducing length of stay in hospital and related cost without a change in discharge criteria. Changing traditional surgical care involves preoperative patient education by an enhanced recovery nurse. Changes in surgical technique include postoperative removal of nasogastric tubes to reduce complications, although these can be reinserted as needed.

Enhanced surgical recovery includes programmed postoperative care for each patient. Reducing surgical 'stress' can be achieved by goal-directed fluid management, afferent neural blockade, pharmacological intervention and nutrition. A preoperative carbohydrate load attenuates muscle depletion and shortens hospital stay. Appropriate postoperative analgesia takes a multimodal approach, minimising PONV.

Gouvas et al (2009) compared an enhanced recovery programme (fast track) with standard care in colorectal surgery. The fast-track protocol reduced primary and total hospital stay with lower morbidity.

Areas of development include preoperative assessment of risk (CPET is important), the postanesthesia care unit, surgical innovation (eg the DaVinci surgical system and 'single port' surgery) and 'better' surgery (specialisation to become skilled in specific operations, eg restorative proctocolectomy).

Gouvas N, Tan E, Windsor A et al (2009) Fast-track vs standard care in colorectal surgery: a meta-analysis update. *Int J Colorectal Dis* 24: 1119–31 (in press)

Beta-blockers and surgery

Dr Paul Older, *Senior Lecturer, University of Melbourne, and Honorary Consultant, Department of Anaesthesia, Western Hospital, Melbourne, Australia*

There are conflicting views on perioperative β -blockade; β -blockade is used extensively in cardiovascular (CV) clinical practice but has the propensity to impair ventricular function (oxygen delivery). This effect on the CV system is rarely investigated perioperatively, for example by CPET. Although myocardial ischaemia is investigated preoperatively, Dr Older believes that postoperative morbidity and mortality are a function of myocardial dysfunction, which can also be detected preoperatively by CPET; thus the problems produced by β -blockade are easily clarified by CPET.

Although propranolol was used in the 1960s, it was not until the 1990s that β -blockers were widely used perioperatively. The POISE study (Devereaux et al, 2008) determined the effects of extended-release metoprolol in patients undergoing non-cardiac surgery; although the β -blocker regimen showed a reduction in CV events, there was an accompanying increase in death, stroke, hypotension and bradycardia. Thus β -blocker therapy should not be initiated perioperatively as routine therapy to reduce cardiac events. CPET will help evaluate ventricular function in patients who are on β -blocker therapy.

Devereaux PJ, Yang H, Yusuf S et al (2008) Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial). *Lancet* 371: 1839–47