EDITORIAL

Safety with Anaesthesia - The Paradigm of Continuous Improvement

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Since the advent of general anaesthesia over 150 years ago it has been recognised that the price of human safety while unconscious is eternal vigilance by the caregiver, the ability to handle life threatening problems and a systematic analysis of error. John Snow, a pioneer of anaesthesia and clinical epidemiology, placed reliance on observation of the respiratory pattern and the pulse and such clinical monitoring was the mainstay of safe anaesthetic practice for over a century.[1]

From the 1980s the availability of newer potent, short acting intravenous analgesics and sedatives has enabled techniques of analgesia and sedation to be extended beyond use in the operating room to areas which include pulmonary endoscopy, gastroenterology, cardiac catheterisation, lithotripsy, radiology, nuclear medicine, oncology, dentistry, obstetrics, critical care areas and transport. The increase in facilities and proper training of anaesthesiologists and other caregivers needed in these areas to ensure safety has been paralleled by the affordability and availability of monitoring technology in the 1990s. Pulse oximeters, automated blood pressure monitors, continuous ECG, inspired gas concentrations and end-tidal respiratory capnographs are now routinely used for patient monitoring in all Government and most private hospitals.

The need to achieve and maintain safe standards of care for the anaesthetised patient was recognised by the adoption of standards of monitoring by industrialised countries in the 1980s and this trend has continued elsewhere. In Malaysia the "Recommendations for standards of monitoring during anaesthesia and recovery"[2] was the first consensus publication on good clinical practice by a professional body and has been adopted in Ministry of Health hospitals in areas where anaesthetics are administered. The recommendations cover the issues of the anaesthesiologist, the anaesthetic machine, general and regional anaesthesia for the patient, the period until full recovery from anaesthesia is achieved, and the areas outside the operating room where anaesthesia or sedation may be administered.[2,3] Although the recommendations are targeted for anaesthetic practice, similar principles would apply to sedation and analgesia administered by non-anaesthesiologists.

Safety requires the continuous presence of a trained and experienced anaesthesiologist throughout an anaesthetic. Skilled assistance for the anaesthesiologist must be constantly available. The anaesthetic machine must be correctly functioning and prechecked for its attendant safety features and alarm systems to prevent hypoxia-related injury during its use. The patient's oxygenation, circulation and ventilation must be monitored by clinical method, supplemented by a quantifiable measure from equipment, e.g. arterial blood pressure, tissue oxygen saturation. A large number of hypoxia related incidents occur during the recovery phase after the discontinuation of anaesthesia before the patient has fully regained consciousness.[4] Prevention of these incidents requires provision of a post anaesthetic recovery area that is adequately equipped and permanently staffed with trained personnel, and awareness that the risk exists in all semi- or unconscious patients. Safety is enhanced by adherence to protocols that emphasise communication of vital information between operating room and recovery personnel and between recovery and ward personnel. As part of a good protocol, medical personnel must be contactable and available to provide assistance immediately when the need arises. The anaesthesiologist is obliged to review the condition of the patient before discharging the patient from recovery.

More recently, monitoring systems that aim to detect critical deficits in organ perfusion or oxygenation have advanced from research tools into clinical practice. Examples include the detection of intrapartum fetal oxygen saturation by fetal oximetry, of spinal cord dysfunction by evoked potential monitoring, of tissue oxygenation by gastric intramucosal CO_2 tonometry, of cerebral metabolism by jugular venous sampling and magnetic resonance spectroscopy. Clinical studies have indicated that intraoperative transesophageal echocardiography is a more sensitive and early indicator of segmental wall motion abnormalities due to myocardial ischemia than the abnormal changes detected with an ECG or pulmonary artery catheter.[5,6] At present the capital cost of acquiring such monitoring technology, training users and providing maintenance limits their routine practice in the local setting.

In spite of these advances and of the trend towards lower incidences of serious complications, anaesthetic accidents still occur resulting in death or serious injury. The majority are due not to equipment failure nor adverse drug reactions but occur through human error, lack of vigilance due to inattention, distraction, fatigue, inexperience, inadequate supervision and failure of communication, producing a concatenation of active failures and latent failures.[7] Often the anaesthesiologist performs the final link in the chain of disaster as "the one who attends the scene of the accident".[8] These problems have been identified by processes such as the national perioperative mortality review from the Ministry of Health which have provided periodic recommendations to improve anaesthetic safety.[9] A different approach, known as critical incident monitoring, is described by Choy, et al. in this issue of the journal.10 They confirm the results of an earlier study that the majority of incidents resulted from failure to recognise and treat airway obstruction and hypoventilation which resulted in hypoxia.

It seems reasonable to suggest the use of anaesthesia simulators to train and test doctors in difficult situations and stop mistakes before they occur. The methodology is to provide an environment which mimics anaesthesia or resuscitation events and permits a doctor to effect and learn skills management at the same time. Computer generated software interactions, including virtual simulations, are relatively low cost, have the potential for limitless visual permutations and enhance eye-brain coordination but lack realism because the responses to the clinical problems are applied through keyboard skills.[11] At the other end of the scale "speaking" mannikins display real-time physiological changes coupled to intravenous equipment, monitors, anaesthesia machines and ventilators.[12] The scenario is directed by an instructor speaking to the anaesthesiologist through the mannikin and the simulations and responses are largely realistic, except that the surgeon is absent. The anaesthesiologist's performance during the training session is videotaped. A crucial part of simulator methodology is the debriefing session which follows in which the videotape is commented on by the anaesthesiologist and instructor in private.[13] The conclusions are focused via positive feedback and encouragement designed to increase confidence in handling a future event. The person likely to make errors can be identified and stressful situations for that individual can be managed by appropriate counterstress techniques. Error prevention by simulator experience may be the most important goal in anaesthesiology training and bring it in line with training standards in the aviation and nuclear industry. Future technological developments in anaesthesia may allow a closer symbiosis of the roles of humans and machines to counter each other's weaknesses. The investment on a mannikin simulator is substantial in comparison with the budget of an anaesthesiology department but the potential dividend is inestimable when human life is preserved.

References

1. Snow J. On Chloroform and other anaesthetics. London: Churchill, 1858.

2. Inbasegaran K, Tan PSK, Das S. Recommendations for Standards of Monitoring during Anaesthesia and Recovery. Malaysian Society of Anaesthesiologists, 1993.

3. Inbasegaran K, Das S, Chang HL, et al. Recommendations for safety standards and monitoring during anaesthesia and recovery. Malaysian Society of Anaesthesiologists, 1997.

4. Endler GC, Bhatia RK. Care of obstetric patients during the immediate postanaesthesia period. J Clin Anaesth, 1991; 3: 117-24.

5. Smith JS, Cahalan MK, Benefiel DJ, et al. Intraoperative detection of myocardial ischemia in high-risk patients: Electrocardiography versus two-dimensional transesophageal echocardiography. Circulation 1985; 72: 1015-21.

6. Leung JM, O'Kelley BF, Mangano DT. Relationship of regional wall motion abnormalities to hemodynamic indices of myocardial supply and demand in-patients undergoing CABG surgery. Anaesthesiology 1990; 73: 802-14.

7. Reason J. Human Error. Cambridge University Press. 1990

8. Allnutt MF. Human factors in accidents. Br J Anaesth 1987; 59: 856-64.

9. Perioperative mortality review 1994-1996. Ministry of Health Malaysia, 1998.

10. Choy YC, Lee CY, Inbasegaran K. Anaesthesia incident monitoring study in Hospital Kuala Lumpur - the Second Report. Med J Malaysia. 1999; 54: 4-10.

11. Schwid HA, O'Donnell D. The Anaesthesia Simulator-Recorder: a device to train and evaluate anaesthesiologists' responses to critical incidents. Anaesthesiology 1990; 72: 191-7.

12. Holzman RS, Cooper JB, Gaba DM, et al. Anaesthesia crisis resource management: real-life simulation training in operating room crises. J Clin Anaesth 1995; 7(8): 675-687.

13. Rogers PL. Developing a curriculum for medical students in critical care medicine. New Horizons 1998; 6: 248-54.