

Deeper anaesthesia and poor outcomes- the jury is still out

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The ideal anaesthetic depth is where the risk of operative recall or 'awareness' is as low as possible, regardless of what is happening surgically, and where blood pressure and heart rate are kept optimal for the individual patient. Emergence from an appropriate level of anaesthesia should be prompt and uncomplicated, without side effects. The norm in current times has been for deeper anaesthesia, facilitated by modern short acting drugs.

Historically, the depth of anaesthesia was assessed using clinical observation of the patient and their haemodynamic responses. Technology advances have resulted in the development of a number of methods for monitoring the depth of anaesthesia including bispectral index (BIS).¹ This is a numerical scale based on electrical activity in the brain where complex EEG signals are converted to a single number using algorithms; the precise detail of this signal processing remain commercial secrets.^{1,2} Despite technology to filter electromyographic signals, BIS can be affected by the use of muscle relaxants. Indeed, in volunteer anaesthetists, onset of paralysis resulted in decreased BIS in the complete absence of any anaesthesia.³ Likewise some neuromuscular paralysis reversal agents increase BIS.⁴ Some studies report that BIS is no better than end tidal anaesthetic concentration monitoring,^{5,6} but despite this it is widely used. BIS decreases as anaesthesia deepens and a value of 40-60 is typical during maintenance of anaesthesia.

The relationship with mortality and depth of anaesthesia, as monitored by BIS, is a confusing picture. Meta-analysis of observational studies confirms excess late mortality when BIS is low,^{7,8} and there have been no definitive randomised controlled trials. The combination of low blood pressure with low BIS but low minimum alveolar concentration

of volatile anaesthetics (deeper anaesthesia despite low anaesthetic concentration) was also linked to excess early deaths.⁹

The need for an adequately powered randomised controlled trial to define the impact of anaesthetic depth on outcome is clear. In this issue the results of a randomised controlled trial of 'light' and 'deep' anaesthesia defined as target BIS values of 50 and 35 respectively is reported. The authors are to be congratulated for completing this important study which aimed to determine whether deeper anaesthesia, as defined by low BIS, is associated with increased mortality 1 year after surgery, in elderly patients who were at relatively high risk for complications. It was concluded that survival was not different between the BIS 35 (deeper anaesthesia) and BIS 50 (lighter anaesthesia) groups.

There are some limitations of the study, which have been recognised by the authors. The most important is that the target BIS levels were not achieved in the main intention-to-treat analysis (all patients who were randomised). In the patients in whom the actual BIS target was achieved (the per protocol group), there was also no difference in survival between the two BIS groups. However the numbers of patients to whom this applied was much lower than the sample size calculation. As it turned out, the trial was underpowered since the mortality rate (on which the trial had been powered) was actually lower than expected. The trial design was pragmatic and aimed to be generalisable. However, it should be noted that the patient population was restricted to patients aged >60, of ASA grade 3 or 4, and receiving volatile anaesthesia.

The results of this study do not concur with previous observational studies where deeper anaesthesia was associated with poorer long term survival.^{7,8} The authors conclude here that lighter anaesthesia was not associated with lower one-year mortality than deeper anaesthesia. However, since the lack of a difference between the two groups of patients does not mean that there actually was no difference, deeper anaesthesia could yet be linked to poorer outcome. Readers of the article should not therefore assume that deeper anaesthesia is safe in this specific group of patients. There are a few possible reasons for this – deeper anaesthesia is associated with lower blood pressures which may compromise organ blood flow. Although blood pressure was controlled in the study by Short et al, the use of vasoconstrictors to increase blood pressure may also be associated with reduced vital organ blood flow. Reduction in flow to organs such as the myocardium and kidney may result in organ failure which would then potentially result in excess mortality.

Therefore the uncertainty remains, and the jury is still out. [696 words]

Author contributions

Both authors conducted independent literature searches. HFG wrote the manuscript and NRW reviewed and revised it. Both authors approved the final version.

Declaration of interests

HFG is a Director and Trustee of the British Journal of Anaesthesia. NRW has no interests to declare.

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