

# MEASURING THE DEPTH OF ANESTHESIA

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## What is Anaesthesia?

We all practice anaesthesia but as yet, we have no specific method by which the state of anaesthesia can be assessed. Awareness under anaesthesia remains an area of concern to patients, anaesthetists and those responsible for providing insurance against medical malpractice.

## Incidence of Awareness

The incidence of awareness during anaesthesia is difficult to quantify but has probably decreased in real terms over the past 20 years. However, reports range from 0.8 to 8 cases per 1000 anaesthetics with the most recent assessment of almost 12,000 cases reporting the incidence as 2 per 1000 anaesthetics.

## Definition of Awareness

Awareness during anaesthesia may not be identifiable from cardiovascular data but may cause major psychological trauma during and after surgery. It may not be even simple to detect that patients were aware during general anaesthesia from postoperative questioning of the patient.

## Assessment Techniques

A variety of techniques have been studied as objective measures of anaesthetic depth. These range from observations of heart rate and blood pressure to analyses of the electrical activity of the brain. Most anaesthetists will control administration of anaesthetic agents by clinical signs although it has been recognized for years that autonomic effects do not always provide an accurate assessment. Many attempts have been made to devise an instrument to monitor the level of anaesthesia. The bispectral index (BIS) is one technique which has been developed over recent years and assessed in several trials as a measure of the level of hypnosis. Another technique which has been studied widely is the auditory evoked potential (AEP) which measures the response of the brain to auditory stimulation.

The principal difficulty in assessing any technique to measure anaesthetic depth is that there is no accepted gold standard available to define the state of anaesthesia. If we define the state of consciousness as retaining the ability to respond to verbal command, then it is recognised that patients may be conscious during anaesthesia but have no recall. Patients have been reported to respond to verbal command when receiving anaesthesia during surgery but to have no recollection of this afterwards. A recent study reported that only 12% of patients who recovered conscious in the operating room after the end of anaesthesia had recall of this, while 25% of patients believed that they had recovered in the ward. This illustrates the difficulty of detecting when patients were truly anaesthetised. It is probably extremely fortunate for our speciality that anaesthetic agents provide such a profound degree of amnesia.

## When do we have Anaesthesia?

If we define anaesthesia as a loss of response to command then we can assess any system to monitor the level of anaesthesia by taking subjects from consciousness to loss of consciousness and back. Clearly, this approach can only be used when the subjects are either not undergoing surgery or else have a completely satisfactory local analgesia block in place.

## Anaesthesia During Surgery

Anaesthetists would agree generally that patient movement during surgery represents an inadequate level of anaesthesia. However, there is no report of any patient having experienced awareness in MAC studies which are designed deliberately to have 50% of patients move. One possible standard is that any monitor of anaesthetic depth should allow the anaesthetist to deliver good quality anaesthesia in a non-paralysed patient. This requires:

adequate cardiovascular and respiratory stability

ideally no, or at least only minimal, patient movement

no awareness or recall of events during the procedure  
similar signal values for different types of anaesthetic agents at equipotent doses  
signal values at recovery from anaesthesia similar to those obtained before induction  
appropriate change during surgical stimulation  
unaffected by alterations in the cardiovascular system or by cardioactive drugs  
marked difference in the signal between consciousness and unconsciousness

#### Hypnosis and Analgesia

Studies have demonstrated the interdependence of hypnosis, analgesia and stimulation and have shown clearly that there is no single concentration of an anaesthetic agent which results in satisfactory anaesthesia for all patients. Indeed, within individual patients, the requirements for anaesthetic will vary considerably depending on the degree of surgical stimulation and the quality of analgesia provided at any point in time.

#### Conclusions

The frequency of awareness in patients undergoing surgery has decreased and we can expect progress in the developments of systems to provide guidance about the state of anaesthesia. The advantages of being able to monitor anaesthesia accurately and reliably should prevent patients experiencing the trauma of surgery while awake but paralysed. In addition, it is possible to titrate anaesthetic agents to achieve the precise level required for any level of surgical stimulation in an individual patient. It is clear, however, that a prime requirement is for anaesthetists to define the elusive state of anaesthesia which has transformed the practice of surgery over the past century and to lay down conditions which these new monitoring devices must meet.