# Awareness during Anesthesia:where are we now?

***Susilo Chandra***
*Department of Anesthesiology and Intensive Care*
*Cipto Mangunkusumo Hospital*
*Faculty of Medicine Universitas Indonesia*
*Jakarta – Indoneia*

One of the more common concerns expressed by patients who are about to undergo anesthesia is that they will remember intraoperative events. For some, this concern will likely be heightened with the Nov. 30, 2007, release of the movie Awake, about a young patient who experiences intraoperative awareness during cardiac surgery. Many anesthesiologists are already reporting an increase in the number of patients raising questions about intraoperative awareness, and surgeons and primary care physicians may also soon be faced with such enquiries.

Intraoperative awareness is the unexpected and explicit recall by patients of events that occurred during anesthesia. As many as 1 or 2 in every 1000 patients who receive general anesthesia experience this outcome, and the incidence may be even higher among children. Most patients who remember intra- operative events do not experience pain; rather, they have vague auditory recall or a sense of dreaming and are not distressed by the experience.

Awareness generally occurs where there is an imbalance between the depth of anaesthesia and the stimulus to which a patient is exposed. In surgery performed under local or regional anaesthesia this may deliberate, although there should not be awareness of the anaesthetised region.
“Explicit awareness” – this refers to the conscious recollection of events, either spontaneously or as a result of direct questioning.
“Implicit awareness” – implicit memories exist without conscious recall but they can alter patients’ behaviours after the event.

One of the difficulties in identifying the true incidence of awareness is the ability to detect it accurately and specifically. Some patients may dream around the time of surgery and although this is common (3 to 6%), it does not constitute awareness yet may cause diagnostic uncertainty. Patients may also recall sounds or conversations as well as the presence of airway devices still in situ as they regain consciousness. These may also be falsely interpreted as awareness.

On the other hand, true awareness may actually be quite difficult to detect. Whilst some patients are able to report awareness immediately post surgery, others may not realise they were aware until days or even weeks after the event. An acknowledged and well established method of detecting awareness involves the use of a structured Brice interview which asks the following questions:

1. What was the last thing you remembered happening before you went to sleep?
2. What was the first thing you remembered happening on waking?
3. Did you dream or have any other experiences whilst you were sleep?
4. What was the worst thing about your operation?
5. What was the next worst thing?

The causes of intra-operative awareness are, not surprisingly, multi-factorial. They can be placed into the following groups.

*Problems with patient dose requirement variability*

Pharmacogenetics can alter people's dose requirements. Both animal experiments and human genome analysis have shown polymorphisms in neurotransmitters and their receptors. Our delivery of inhaled anaesthetic agents is analysed in terms of minimum alveolar concentration (MAC). MAC is defined as the minimum alveolar concentration of vapour in the lungs, at one atmosphere, required to prevent a motor response to a standardised surgical stimulus in 50% of patients. It is one of the measures that we often use to help determine depth of anaesthesia and useful because it allows us a real-time measurement of effect site concentration (assuming the end-tidal measurement equates to the brain value).

There are a few problems with the use of MAC to help with preventing awareness. The value is a median one and therefore 50% of patients may still move in response to the surgical stimulus. In addition, MAC is refers to the concentration required to prevent a motor response – predominantly a spinal reflex. It does not refer to a patient's level of arousal and therefore the likelihood of them being aware; patients lose consciousness at levels well below 1 MAC.

Many factors alter MAC. It is decreased at the extremes of age, decreasing gradually above the age of 1, at a rate of approximately 10% per decade of life. It is also decreased by hypothermia, hypocapnia, hypothyroidism and pregnancy, as well as by other sedatives, analgesics and regional anaesthesia. Conversely, it is increased by the hyperthermia, hyperthyroidism, anxiety and the chronic use of certain drugs (sedatives, recreational drugs and enzyme inducing agents such as nicotine and alcohol).

*Problems tolerating side-effects of anaesthetic agents*

It is well known that general anaesthesia may cause cardiovascular depression by decreasing systemic vascular resistance as well as by direct myocardial depression. As a result, there are certain types of surgery during which anaesthetic doses may be deliberately reduced in the interests of safety, in order to maintain blood pressure. These typically include cardiac surgery, emergency or trauma surgery and Caesarean section. In the latter, there are also concerns about the effects of general anaesthetic agents upon the unborn, and often compromised, child.

*Problems detecting the clinical signs of awareness, or light anaesthesia*

In the absence of specific depth of anaesthesia monitoring, cardiovascular parameters are usually relied upon to gauge adequacy of anaesthesia. It is assumed that light anaesthesia will manifest itself by causing hypertension and tachycardia as well as other signs of sympathetic nervous system stimulation, such as lacrimation, papillary dilatation and sweating.

Many of these are pharmacological. Anti-cholinergic medications may dry secretions such and reduce sweating or lacrimation as well as causing mydriasis. Opioids can cause meiosis. Many anti-hypertensive and anti-anginal medications may reduce a

patient’s ability to mount a tachycardic and hypertensive response to stress (e.g. β-blockers, calcium channel antagonists, ACE-inhibitors). The presence of an epidural can also lead to relative hypotension as can hypovolaemia from any number of causes.

*Equipment and drug delivery mechanisms*

Breathing system malfunctions and disconnections have been associated with awareness. Vaporizers may malfunction in a num- ber of ways, each having the potential to deliver an inadequate dose of anaesthetic. These include: an empty vaporizer, miscalib- ration, impurities in the volatile agent (reducing its saturated vapour pressure) and disconnection from the anaesthetic machine. Blockage of an i.v. infusion pump or catheter, disconnection from the cannula or extravascular location of the cannula may risk awareness during TIVA.

Awareness was approximately twice as likely during TIVA as during volatile anaesthesia, but this ‘headline figure’ hides important detail. TIVA in the operating theatre was usually administered by target controlled infusion (TCI), but this was rare outside theatres. In-theatre failure to deliver the intended dose of propofol (disconnection, tissued drip, etc) was an important cause of awareness. Many awareness cases during TIVA involved use of non-TCI techniques (e.g. manual infusions, fixed rate infusions, intermittent boluses). High risk situations were conversion of a volatile anaesthetic to TIVA and transfer of paralysed patients outside theatres; inadequate dosing using non-TCI regimens was common. Three quarters of cases were considered preventable.

Many of these problems would be rapidly detected by default alarms (minute ventilation / airway pressure, “pump not infusing”, “on hold” or occlusion alarms) but many would not. Many monitoring devices do not alarm for low end-tidal anaesthetic concentrations unless specifically set to do so and an infusion pump can happily deliver anaesthetic agents to the floor the wrong way past a three- way tap junction.

*Managing awareness*

Pre-operative:

A thorough history and examination can identify potential risk factors for awareness. Specific patient factors may include a history of awareness, substance abuse (opioids, benzodiazepines), chronic pain with long term opioid use, limited cardiovascular reserve and a history of difficult intubation or anticipated difficult intubation.

Having identified risk factors it may be appropriate to discuss this with the patient and it may be prudent to pre-medicate with benzodiazepines.

Intra-operative:

Benzodiazepines can be used at induction of anaesthesia to help reduce the incidence of awareness, particularly if difficulty is anticipated at intubation. Titrating anaesthesia to blood pressure and heart rate may increase the risk of awareness. If anaesthetic agents are causing vasodilatation it should ideally be treated with a vasopressor or an inotrope rather than continually reducing the anaesthetic concentration.

It may also be worth considering using depth of anaesthesia monitoring when available.

Despite precautions and good technique, some cases of awareness will still occur. It is therefore important that anaesthetists' records can stand up to scrutiny in a court of law. In particular, it should be clear when drugs were administered and in what dose.

Post-operative:

If a patient complains of awareness, it is important to visit them and identify exactly what has happened. It may be necessary to differentiate between dreams or recall of events on emergence and genuine awareness. Denying the patient's version of events may contribute to a worse psychological outcome for them so it is important to apologise for their experience and express some sympathy. It should go without saying that detailed written records of these processes are vital.

*Depth of anesthesia monitoring*

Specific depth of anaesthesia (DOA) monitorsare rarely used during general anaesthesia inUK practice (processed EEG in 2.8% of general anaesthetics and isolated forearm techniquein 0.03%). Although DOA monitoring was over-represented in the awareness cases (4.3%), it appears to be used in a 'targeted fashion': in the Activity Survey DOA monitoring was used in ~1% ofcases of volatile without NMB and in ~23% of cases with TIVA and NMB. Only one report of AAGA in association with DOA monitoring was followed by adverse psychological sequelae. The overall findings are supportive of the use of DOA monitoring during TIVA with NMB (including cases where TIVA is used for transfer). End-tidal anaesthetic gas monitoring is an alternative to DOA monitoring, but in ~75% of reports to NAP5 it would likely have been impractical or ineffective at preventing awareness.

Further Reading :

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