

Accidental awareness while under general anaesthesia

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Summary

Accidental awareness during general anaesthesia may cause many intraoperative discomforts and bring further moderate to severe long-term symptoms including flashbacks, nightmares, hyperarousal or post-traumatic stress disorder. The incidence of awareness varied from 0.017% to 4% among studies. The relatively reliable incidence of intraoperative awareness with postoperative recall is 0.02%. The reason causing awareness was unclear. Insufficient anaesthetic dosing was thought as the principal cause. Even awareness was not comprehensively understood, some endeavors have been raised to prevent or reduce it, including *i*) Reducing the insufficient anaesthetic dosing induced by negligence; *ii*) Providing close clinical observation and clinical parameters from the monitor such as bispectral index or electroencephalogram, as well as isolated forearm technique and passive brain-computer interface may bring some effects sometimes. Because current studies still have some flaws, further trials with new detecting approach, superior methodology and underlying aetiology are needed to unfasten the possible factors causing awareness.

Keywords: Accidental awareness, general anaesthesia

Unintended or accidental awareness during general anaesthesia (AAGA) was regarded as a failure in the general anaesthesia process. It was difficult to define awareness or AAGA accurately since consciousness and anaesthesia were also difficult to define. Unintentional or accidental consciousness during general anaesthesia (GA), without emphasizing recall, has been referred to as awareness earlier, while AAGA, defined as explicit recall of GA and could be spontaneously reported by the patient or detected by direct questioning or promoting, has been mentioned more (1,2). Although AAGA was relatively uncommon, it brought negative experiences including but not limited to intraoperative hearing voices or equipment noises, sensation of paralysis or pain, awareness of tracheal intubation and inability to breathe, etc. Furthermore, moderate to severe symptoms including flashbacks or nightmares, avoidance of situations relating

to the experience, hyperarousal and post-traumatic stress disorder (PTSD) may suffer in 79% of patients who experienced AAGA long-term (3). However, no studies have provided any strong evidence that awareness without recall has important negative consequences to date (2).

The incidence of awareness is difficult to be accurately determined. The identification of awareness in most researches based on explicit postoperative recall ranges, spontaneous patient reports or structured postoperative interviews, such as the Brice Questionnaire (6-12). The relatively reliable incidence of intraoperative awareness with postoperative recall is 0.02%, while the incidence without explicit recall may be much higher (3,7,13,14) (Table 1). Variation among studies in the proportion of patients with a possible awareness event may be up to 200-fold (4% vs. 0.017%) (Table 1). It was unclear whether the differences in incidence resulted from disparities in patient population, sample size, time of investigation, anaesthetic technique, study design, clinical severity, method of identification or definition of awareness. It was found that different definition of awareness, for instance, explicit recall

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Table 1. The incidence of accidental awareness during general anaesthesia (2000-2017) (4,5)

Study and year	Sample size, N	Incidence	Method of identification	Study design	Explicit postoperative recalls or not
Sandin <i>et al</i> , 2000	11,785	18 (0.15%)	Modified Brice questionnaire: PACU, 1–3 days and 7–14 days postoperatively	Observational prospective case study	Explicit recalls
Myles <i>et al</i> , 2000	11,811	12 (0.11%)	Question and answer survey within 24 h of surgery	Observational prospective case study	Explicit recalls
Myles <i>et al</i> , 2004 (11)	Total: 2,463 BIS: 1,225 Routine care: 1,238	Total: 13 (0.52%) BIS: 2 (0.16%) Routine care: 11 (0.89%)	Modified Brice questionnaire: 2–6 h, 24–36 h, and 30 days postoperatively	Randomised controlled trial	Explicit recalls
Andrade <i>et al</i> , 2011	Total: 5,731 BIS: 2,861 ETAC: 2,852	Total: 9 (0.15%) BIS: 7 (0.24%) ETAC: 2 (0.07%)	Modified Brice questionnaire: 72 h and 30 days postoperatively	Randomised controlled trial	Explicit recalls
Andrade <i>et al</i> , 2011	Total: 18,832 BIS: 9,460 ETAC: 9,376	Total: 20(0.11%) BIS: 8 (0.08%) ETAC: 11 (0.12%)	Brice questionnaire: 28-30 days postoperatively	Randomised controlled trial	Explicit recalls
Pandit <i>et al</i> , 2014	2,766,600	471 (0.017%)	Spontaneous complaints/reports of awareness	Cross-sectional observational study	Explicit recalls
Andrade <i>et al</i> , 2008	184	2 (1.1%)	IFT and postoperative structured interview	Observational prospective case study	No cases of explicit postoperative recall
Sanders <i>et al</i> , 2017	260	12 (4%)	IFT followed by modified Brice questionnaire	Observational prospective case study	No cases of explicit postoperative recall
Total	2,817,666	557 (0.020%)			

IFT, isolated forearm technique; BIS, bispectral index; ETAC, end-tidal anaesthetic gas concentration.

was regard as necessary or not may differentiate the results mostly (15,16). However, what was certain was that with upwards of millions admissions leading to surgical intervention annually, patients suffered from the accidental awareness could be an enormous number of cases.

What incentives awareness was not clear totally. Insufficient anaesthetic dosing, sometimes caused by administration equipment failure or the negligence of an anesthetist, was thought as the pivotal cause of awareness. However, some occult factors might cause consciousness and memory despite clinicians may consider adequate anaesthesia. It is unclear whether the reduced potency of anaesthetic was induced by a genetic contribution (17-20).

Even awareness was not comprehensively understood, some endeavors to prevent awareness have been advocated. Reducing the insufficient anaesthetic dosing induced by negligence should be the first step. Anaesthesia equipment before each use, especially vaporiser, circuit and drug-infusion pump, must be checked carefully. Drug error should be avoided by double-checking and labelling all drug syringes. Clinical parameters from the monitor or clinical signs being directly observed might work sometimes. The isolated forearm technique (IFT) was thought as the

current gold standard for connected consciousness monitoring and was used to remind the anesthetist (21). Electroencephalogram derived bispectral index (BIS) or electroencephalogram (EEG) was once proved to be critical in preventing intraoperative awareness with explicit recall compared with clinical signs in most clinical researches (8-10,12). However, a study has shown that the BIS protocol was less useful in preventing awareness than end-tidal anesthetic-agent concentration (9). Moreover, innovative techniques, such as passive brain-computer interface (BCI) based on an intention of movement may provide a foundation that would allow to detect awareness (22).

Although substantial progress has been made in understanding awareness about the incidence, consequences, and prevention, lack of gold standard of the definition, detection and prevention still prevent us from minimizing it. Thus, further trials about AAGA, especially with new detecting approach, superior methodology, underlying aetiology and novel results compared with the existing literature are still precious in the future.

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(Received August 16, Accepted August 30, 2019)