Awareness Under General Anesthesia

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Abstract

Objective : To determine the occurrence and associated factors of awareness in the patients undergoing elective surgery under general anesthesia.

Methods : A prospective cohort study of 802 patients, scheduled for elective general and gynecological surgery under endotracheal anesthesia was performed at Siriraj Hospital. Balanced general endotracheal anesthesia was performed as routine practice. Standard monitoring and clinical observation for movement, tear, sweat, and eye-lid opening were obtained. They were interviewed during the first 12 hours after a surgical completion. If the patient was suspected to have awareness, then a second interview was performed on postoperative day 3.

Results : The ages of the study population were 16-84 years. There were 659 females and 143 males. Awareness was found in 5 patients (3 females, 2 males) as an occurrence of 0.62 per cent. The only positive clinical observation found was hand movement. The cause of awareness should be inadequate anesthesia. Apart from that, data gathered from interviews with the group who had no awareness (797 patients), the last thing they could remember before unconsciousness was auditory perception. Also hearing someone calling was the first thing upon awakening. Most of the patients did not dream during anesthesia. No serious psychological disorder occurred.

Conclusion : The occurrence of awareness was 0.62 per cent in the patients undergoing surgery under anesthesia. Inadequate anesthesia was the most likely cause of awareness. No post-operative sequelae of awareness occurred.

Key word : Awareness, General Anesthesia, General Surgery

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During general anesthesia, patients may have awareness that is generally quoted at slightly less than 1 per cent. Patient awareness can take many forms, but a simple working definition is the spontaneous recall of events occurring under general anesthesia. Alternatively, awareness may be classified as explicit and implicit memory. Anesthetic awareness refers to explicit memory of intraoperative events, which the patient can relate to after anesthesia. It may occur with or without sensation of pain, vivid recollection or vague dreams[1-3]. In contrast, implicit memory is subconscious processing of information by the brain. Recall of implicit memory may occur during dreaming, under hypnosis, or through psychological methods. Awareness under general anesthesia is divided into two categories, consciousness with pain and consciousness without pain. Awareness with painful sensation has a great effect on postoperative sequaelae ranging from mild anxiety to post-traumatic stress disorder (PTSD). Symptoms of PTSD include sleep disturbance, nightmares, hyperarousal, emotional numbing, preoccupation with death and social difficulties. Appropriate referral to a psychologist trained in treatment of PTSS is warranted[3,4]. Awareness without pain may result from the concomitant use of local anesthetics or opioids or volatile anesthetics.

Anesthesiologists often intentionally give light anesthesia when it is indicated by the patient's clinical situation. These conditions include hypovolemia (e.g., major trauma), cesarean section (to minimize neonatal depression), or cardiac surgery undergoing cardiopulmonary bypass. Awareness during anesthesia at Siriraj Hospital was reported as 5.6 per cent in patients undergoing cardiac operation[5]. However, there is no incidence report of awareness during anesthesia in Thai patients undergoing common surgical procedures under general anesthesia. Therefore this research pattern was designed to be a prospective cohort study of the incidence of awareness in Thai patients scheduled for general surgery under endotracheal anesthesia. Also the aim of this study included the factors to be implicated as causative events.

PATIENTS AND METHOD

The study protocol was approved by our ethical committee and was performed in a prospective collective interview. Written informed consent was obtained from each patient before the study. The inclusion criteria included elective surgery for gynecological, head and neck and abdominal operations with ages of 15 years or older. Exclusion criteria included ASA physical status >3, age <15 years, psychological disorders, cerebrovascular disease, cardiac surgery, emergency case, postoperative ventilator support >1 day, and patient refusal.

Patients interviews were performed by two of us who listened to the answers to questions at a period of 12-15 hours postoperatively. All patients received balanced general anesthesia with endotracheal intubation. A second interview was performed on the third postoperative day in any patient suspected of having an intraoperative awareness. Nine questions in Thai language were asked. They were modified from Brice DD, et al[6]. The questions included the following :

1. What was the last thing that you remembered before sleeping?
2. What was the first thing you remembered after you regained consciousness?
3. Did you dream during anesthesia?
4. Did you recall anything during anesthesia?
5. Did you feel anything during surgery?
6. Did you try to tell someone about your awakening?
7. Did you fear or worry before operation?
8. Have you ever been previously operated or under general anesthesia?
9. What was the worst feeling during general anesthesia?

In cases in which awareness occurred, the anesthetic record was reviewed and the anesthesiologist who anesthetized the patient was interviewed. The anesthetic machine was re-checked to confirm correct function. Anesthesiology staff visited the patient and reconfirmed awareness also expression of sympathy along with attempting to answer patient's questions.

RESULTS

Eight hundred and two patients were included in this study. The demographic data are shown in Table 1. The patients ranged in ages from 16 to 84 years with mean ± standard deviation of 47.25 ± 13.12 years. Information of anesthesia and surgery are presented in Table 2. Evidence of awareness

Table 1. Demographic data and occurrence of awareness.

Variable	Number of patient	Number of patient with awareness
Total patients	802	5
Gender :		
Female	659	3
Male	143	2
ASA physical status		
1	471	4
2	312	1
3	19	0
Type of surgery		
Gynecology	413	2
Abdomen	253	3
Thyroid / breast	136	0
Operative time (hour) :		
1	117	1
2	343	1
3	215	1
≥4	127	2

Table 2. Anesthetic agents used in study population.

Anesthetics	Number of patient
Premedication	
None	177
Diazepam	238
Midazolam	387
Induction agent	
Thiopental	798
Ketamine	4
Narcotics	
None	29
Morphine	351
Fentanyl	241
Pethidine	149
Nitrous oxide	
None	11
<50%	13
50-60%	138
61-70%	640
Volatile anesthetics	
None	1
Halothane	675
Isoflurane	124
Sevoflurane	2

under general anesthesia was found in five patients (0.62%). Three of them heard the voice of conversation during the operation, another two cases had awareness of pain. Three patients recalled that they were operated upon in the operating theater, especially the fifth case who could remember the operative events without pain throughout the surgical period. All of them had no significant postoperative sequaelae of intraoperative awareness. The detail of each case will be further discussed.

During the interviews of 797 patients who had no awareness, 20 per cent of the patients heard conversation before unconsciousness. Upon awakening, 45 per cent of the patients heard someone calling their names. Eighty-eight percent of patients did not dream during anesthesia and 72 per cent did not worry about the operation.

DISCUSSION

Five patients (0.62%) in this study had awareness during anesthesia. There were 3 females and 2 males. The previous studies in obstetric and cardiac operation showed awareness 0.2-1.5 per cent[6-11]. Therefore in high-dose narcotic anesthesia, it is impossible to guarantee that patients undergoing cardiac surgery will be completely unconsciousness. It was due to inadequate anesthesia during rewarming period of cardiopulmonary bypass[10,11]. General anesthesia in obstetric patients may produce neonatal suppression, therefore, doses and concentration of anesthetic are minimized[7,9]. Intraoperative awareness was frequently found 11-48 per cent in traumatic patients because of intentional administration of small doses of anesthetics during hypovolemia and hemodynamic instability[3,8]. Awareness was normally reduced upon the combination of volatile anesthetic with opioids in balanced anesthesia. However, all patients in this study were not considered to be in the high risk group of awareness, but we found it in 5 cases as follows :-

Case 1

Thai male, 58 year-old, 52 kg, has been diagnosed of carcinoma of colon, schedule for colectomy. Premedication was not administered. Endotrcheal anesthesia consisted of thiopental as an induction agent, succinylcholine as a muscle relaxant for intubation. Maintenance of anesthesia was halothane 0.5-0.75 per cent in oxygen, pancuronium 2 mg every 45 minutes, fentanyl 100 mcg and midazolam 2 mg throughout 3 hours of surgery. The patient moved his hands during operation. There were hypertension and tachycardia during anesthesia. Interview of the patient's experience showed an auditory perception,

sensation of paralysis and pain during abdominal stretching. Therefore his awareness should be caused by inadequate anesthesia.

Case 2

Thai female, 28 year-old, 56 kg, underwent hysterectomy and bilateral salphingectomy for ovarian tumor. General anesthesia was performed with thiopental, diazepam (2 mg), morphine (8 mg), nitrous oxide (50%), pancuronium (8 mg) and inconstant halothane inhalation due to massive bleeding and hemodynamic instability. The operative time was 5 hours. During postoperative interview it was found that she was periodically conscious, felt her abdomen stretched two times without pain. It is rather clear that the patient awakened during operation because of periodical suspension of anesthesia without any sedative medication caused by massive blood loss.

Case 3

Thai male of 48 year-old, 63 kg, scheduled to anterior resection of carcinoma of sigmoid colon. Midazolam (8 mg) was orally premedicated. Endotracheal anesthesia was induced with thiopental. Morphine (10 mg) and droperidol (5 mg) were given intravenously along with sublingual nifedipine to attenuate hypertension and tachycardia at the time of skin incision. Maintenance of anesthesia included nitrous oxide 50 per cent in oxygen, halothane 0.25-1.5 per cent, pancuronium 1-1.5 mg/45 minutes, fentanyl 100 mcg initially then 25-50 mcg/h. Consequently, blood pressure was higher than the beginning and heart rate was increased from 80 to 100-115 bpm throughout 6 hours operative time. The patient was interviewed on postoperative day 1. He heard doctor's conversation and had painful sensation of abdominal surgery. Upon a review of his past history, he drank 1 bottle of liquor every day for 30 years and stopped 3 months before surgery. Awareness of this patient was likely caused by inadequate depth of anesthesia, in spite of large doses of various anesthetics. Chronic alcoholism increases minimal alveolar concentration (MAC) of volatile anesthetics. Also the anesthetic requirements increase in chronic disease.

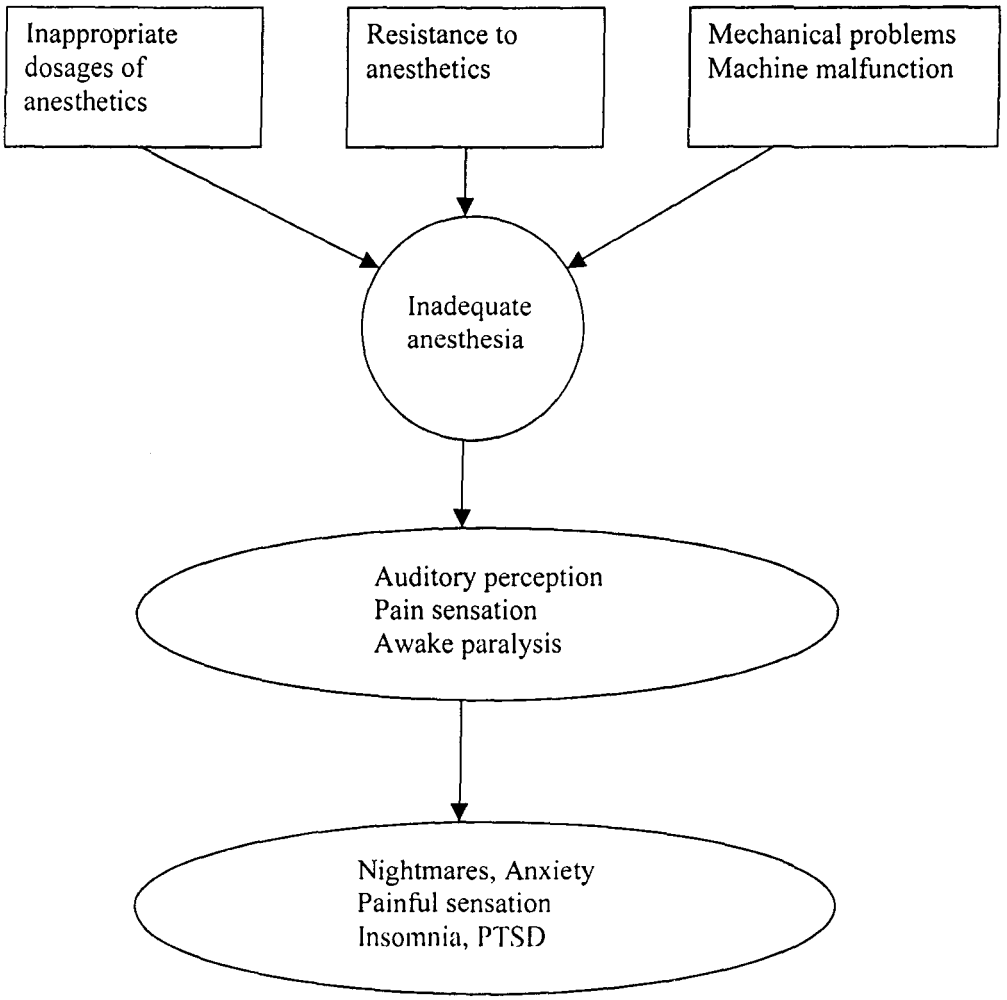
Case 4

Thai female, 77 year-old, 55 kg, has been diagnosed as having gall stones, undergoing cholecystectomy. There was no premedication. Induction of anesthesia consisted of thiopental. Anesthesia was maintained by pethidine (50 mg), nitrous oxide (50%) in oxygen, isoflurane (0.2-0.5%), and atracurium (40 mg) as muscle relaxant. Surgical time was only one hour. During the operative period, the blood pressure was increased from 110/62 mmHg to 130-160/70-80 mmHg, while the heart rate was 90-110 bpm. Postoperative interview showed that she heard some conversation in the operating room throughout the surgical period without pain. No problem of the anesthetic machine was found. The interviewer got more information from the patient that she was very anxious about the serious sickness of her husband as well as herself. She had a lot of stress and insomnia. Also she was afraid of death. Her awareness may be related to her mental distress since the preoperative period.

Case 5

Thai female of 42 years of age, 65 kg, underwent tuboplasty under general endotracheal anesthesia. She did not have any premedication. Anesthesia was induced with thiopental and morphine (6 mg). Maintenance of anesthesia consist of nitrous oxide 66 per cent in oxygen, halothane (0.25-0.5%), morphine (2 mg) and atracurium. Her blood pressure and heart rate were significantly higher than baseline values. From postoperative interview, it was found that the patient had awareness almost throughout the surgical period. She recalled surgical instruments touched her belly without pain sensation. The patient did not move her extremities during anesthesia. There was no doubt of halothane vaporizer used for this patient. Her past anesthesia history was reviewed. Twenty years ago, she had awareness without pain as same as this time during general anesthesia for appendectomy. She understood that this feeling had to happen when a patient was anesthetized. So that she was not worried about it. She did not want to tell either the surgeon or the anesthesiologist. The cause of this patient's awareness should be inadequate anesthesia, then it was considered to administer higher doses of anesthetic agents for her further general anesthesia.

Awareness under general anesthesia is a commonly feared experience, both by patients and the anesthesiologist. The postoperative interview allows the anesthesiologist to gather explicit information about anesthetic recall. Only few patients spontaneously complain of intraoperative awareness. So, the anesthesiologist should make a compassio-



PTSD = post-traumatic stress disorder.

Fig. 1. Causes and consequences of awareness under anesthesia.

nate inquire about the patients' subjective feelings during the operative period. Complaints involving recall if intraoperative conversation, pain, muscle relaxant or paralysis, surgical events, or intubation should be persued to determine their validity. Awareness may manifest months to years postoperatively as PTSD. Recall under anesthesia was found to be more likely in women and when anesthesia relying on opioids and muscle relaxant without volatile anesthetic was used[12]. The factors to be implicated as causative events of awareness under anesthesia include anesthetic technique (70%); e.g., accidental or purposefully light anesthesia, anesthesia equipment (20%); e.g., empty vaporizer or machine/ventilator malfunctions, and miscellaneous/unknown (10%)[13]. Besides poor tolerance of anesthesia and medication errors, certain patients have been shown to have an increased anesthetic requirement; younger age, smoking, hypernatremia, hyperthermia, chronic use of certain drugs (alcohol, opiates, or amphetamines) may increase anesthetic requirements for unconsciousness. Drugs that increase central nervous system catecholamines, such as cocaine, amphetamines, monoamine oxidase inhibitors and tricyclic

antidepressants, also increase MAC of volatile anesthetics[3,12]. The causes and the consequences of awareness under anesthesia are shown in Fig. 1.

In this study, the cause of awareness should be the inadequate/light anesthesia. There were inadequate doses of anesthetics (case 1, case 5), intentionally reduced doses of anesthetics due to hemodynamic instability (case 2), increased anesthetics requirements due to long-term use of alcohol (case 3) and psychological stress (case 4). The fifth patient was likely to need high doses of anesthetics for her unconsciousness. Anyhow, using an amnesic agent (midazolam) as a part of preoperative medication may minimize intraoperative recall. No patient who exhibited postoperative psychological symptoms or PTSD required referral for psychological counseling.

Prevention of awareness is an important consideration in the delivery of general anesthesia. The auditory pathway is the most metabolically active part of the conscious brain. Thus, hearing is the last sense suppressed by anesthesia[3,14]. This fact has significant implications. Because hearing plays an important role in implicit memory, intraoperative conversation, especially with painful sensation may be the greatest effect on postoperative well-being sequelae. Monitoring of auditory-evoked potentials can not provide a complete answer to how deeply anesthetized a patient is. Electroencephalogram Bispectral Index (BIS) monitoring is a newer technology to give an objective measure of the degree of hypnosis that the patient is under[3,12,15]. Kerssens C, et al. demonstrated that there was no explicit or implicit memory effect of familiar words presented during adequate propofol anesthesia at BIS levels between 40 and 60 in elective surgical patients[16]. Much research and many experiences have led to the recommendations for prevention of awareness under anesthesia[1,3,7,12]. Preoperative period, the anesthesiologist should perform a complete check of machine, vaporizer and equipment. Amnesic agents such as midazolam or scopolamine should be used as premedicants or adjuvants to anesthesia, especially in cases where awareness is likely to occur, such as in trauma, and cesarean section. Intraoperatively, muscle relaxant should be minimized or avoided unless necessary for surgical conditions. Volatile anesthetics should be administered in at least 0.4-0.6 MAC when combined with nitrous oxide and opiates or 0.8-1 MAC when used alone. BIS monitoring should be encouraged to refrain from disparaging remarks about patient's condition and habitus. Education of all provided as to the potential for awareness should help prevention of inappropriate remarks in the operating room.

When a case of awareness under anesthesia is identified, the anesthesiologist should take action immediately. The anesthesiologist should question the patient compassionately and acknowledge belief in the accounts. An honest and sincere explanation of what happened should be given. The possible reasons should be explained to the patient at the earliest postoperative time with sympathy and empathy. Then, maintenance of contact with the patient and follow-up are essential. We should refer the patient for psychological counseling or psychiatric care, particularly in patient who exhibit psychological symptoms[1,3,12].

In conclusion, the present study demonstrates that occurrence of intraoperative awareness under anesthesia is 0.6 percent of patients undergoing elective general surgery. The major cause may be inadequate anesthesia. We managed the patients by obtaining a detailed account of their experience, honest and sincere explanation with very sympathy, and reassurance that repetition during future anesthesia is not likely to occur. No patients developed significant psychological problem that need referral for psychological counseling.

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การรู้สึกตัวขณะได้รับยาสลบ

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วัตถุประสงค์ : เพื่อศึกษาอุบัติการณ์และปัจจัยที่ส่งเสริมการเกิดการรู้สึกตัวขณะได้รับยาสลบ ในผู้ป่วยที่มารับการผ่าตัดทั่วไป

วิธีการ : ทำการศึกษาผู้ป่วยที่มารับการผ่าตัดที่ไม่เร่งด่วนทางนรีเวช ช่องท้อง ธัยรอยด์และเต้านม ภายใต้การระงับความรู้สึกแบบดมยาสลบ อายุมากกว่า 15 ปี ณ.โรงพยาบาลศิริราช เป็นการศึกษาแบบ prospective cohort ผู้ป่วยทุกรายได้รับการดมยาสลบเทคนิคใส่ท่อช่วยหายใจและควบคุมการหายใจด้วยยาสลบที่ใช้ทั่วไปในโรงพยาบาลศิริราช ทำการบันทึกการขยับตัว แขน ขา น้ำตาไหล เหงื่อออก และ การลืมตา ขณะดมยาสลบ จะทำการสัมภาษณ์ผู้ป่วย 12 ชั่วโมงหลังเสร็จผ่าตัด และสัมภาษณ์ ในวันที่ 3 หลังผ่าตัด ถ้าผู้ป่วยมีการรู้สึกตัวระหว่างได้รับยาสลบ

ผลการศึกษา : จากการศึกษาผู้ป่วย 802 ราย มีผู้ป่วย 5 ราย รู้สึกตัวระหว่างได้รับยาดมสลบ คิดเป็นอุบัติการณ์ร้อยละ 0.62 จากการวิเคราะห์สาเหตุของการรู้สึกตัวนี้พบว่าเกิดจากการให้ยาสลบตื้น/สลบลึกไม่เพียงพอ เนื่องจากให้ยาขนาดน้อยไป ผู้ป่วยมีอารมณ์เครียดมากก่อนผ่าตัด ดื่มสุราเรื้อรัง และ ต้องการยาดมสลบขนาดสูง ทั้งนี้ไม่พบอาการทางคลินิกที่สอดคล้องกับการรู้สึกตัว ยกเว้นเพียง 1 รายขยับมือเล็กน้อย ในการสัมภาษณ์ผู้ป่วยอีก 797 คนที่ไม่รู้ตัวระหว่างผ่าตัด พบว่าสิ่งสุดท้ายที่จำได้ก่อนสลบคือ การได้ยินเสียงสนทนากัน และสิ่งแรกที่ตื่นจากยาสลบ คือได้ยินเสียงเรียกชื่อ ส่วนใหญ่จะไม่มีการฝันขณะสลบ และไม่มีสิ่งแทรกซ้อนสำคัญตามมาจากการรู้สึกตัวขณะสลบ

สรุป : การศึกษาครั้งนี้พบอุบัติการณ์ของการรู้สึกตัวขณะได้รับยาสลบร้อยละ 0.62 โดยมีสาเหตุสำคัญคือการได้รับยาสลบไม่เพียงพอ อย่างไรก็ตามไม่พบภาวะแทรกซ้อนที่รุนแรงจากการรู้สึกตัวขณะสลบ

คำสำคัญ : การรู้สึกตัวขณะสลบ, การดมยาสลบ, การผ่าตัดทั่วไป

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