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Awareness and Recall during General Anesthesia

Facts and Feelings

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Background: Experiences of awareness and recall during general anesthesia can be most distressing for patients. To obtain relevant information, the authors systematically interviewed patients in whom awareness during surgery had occurred, and questioned them about their experiences.

Methods: Twenty-six patients, referred by colleagues, described the facts and feelings they had experienced during the period of awareness, and whether these had had any consequences. Available anesthetic records were independently judged by three experienced anesthesiologists for relevant parameters.

Results: Auditory perception and the sensation of paralysis were most frequently mentioned, followed by the sensation of pain. Patients' feelings were mostly related to anxiety, panic, powerlessness, and helplessness. Eighteen patients (70%) experienced unpleasant aftereffects, including sleep disturbances, dreams and nightmares, and flashbacks and anxiety during the day. Only nine patients (35%) had informed their anesthesiologists about what had taken place. Twelve anesthetic records were assessed. In three, the occurrence of awareness had been indicated, while, in a fourth, it was noted that an amnesic drug had been given at a moment of increased blood pressure. Experienced anesthesiologists were unable to reliably distinguish awareness cases from matched controls when judging the records.

Conclusions: Details recalled from the period of awareness correspond with data from the literature. The anesthesiolo-

gist's role in discussing, and dealing with, traumatic experiences related to anesthesia may be of great importance. The hand-written anesthetic record is of limited value in retrospectively explaining why awareness and recall have occurred. (Key words: Anesthesia, general. Anesthesia-related posttraumatic stress-response. Anesthetic record. Awareness. Postoperative care. Psychologic sequelae. Quality of anesthesia. Recall.)

INFORMATION on what patients recall of events during general anesthesia is based mostly on case reports. Since an early account of awareness resulting from insufficient anesthesia,¹ many case reports have appeared in the literature. A large variety of anesthetic techniques have been involved. In early reports, anesthesia consisted of a mixture of nitrous oxide in oxygen, in combination with a neuromuscular relaxant, with²⁻⁴ or without^{5,6} supplementary opioids. More recently, cases have been described in which volatile anesthetics, such as halothane,⁷⁻⁹ or intravenous anesthetics, such as ketamine,¹⁰ high-dose fentanyl,¹¹⁻¹³ and propofol,¹⁴ were used. Descriptions of personal experiences^{15,16} illustrate clearly how distressing awareness and recall can be. Most of these case reports relate the patient's actual experience, rather than aftereffects of awareness. Such consequences of awareness and recall have been described only on the basis of small series of patients.¹⁷⁻²⁰

Thus far, the experiences of a more extensive series of patients have only been reported by Evans.²¹ He questioned 27 patients with recall after 28 general anesthetics, having selected his patients by advertising in four British newspapers. Although Evans received many responses, it is possible that his sample was biased by a disproportionate number of "complainers." To prevent such a selection bias, we opted for a different method of patient selection. The purpose of the current study was to find out whether any common patterns could be distinguished in patients experiencing awareness and recall. We were not only interested in the details patients recalled from the period of awareness, but also whether this experience had had any conse-

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quences. Furthermore, we wanted to know whether these experiences of awareness could, in retrospect, be explained by data from the anesthetic records.

Materials and Methods

We wrote to all colleagues at the anesthesiology department of a large university hospital, requesting that they refer all patients with experiences of awareness and recall, regardless of when the experience had occurred or where the anesthesia had taken place. After explaining the purpose of the study to the referred patients, we first offered them the opportunity to talk freely about their experiences. Next, they were interviewed in a semistructured way. The topics discussed were based on a list of questions described in table 1. All interviews were conducted by the first author, and most were audiotaped.

We also attempted to trace the anesthetic records, and studied those we found for special details related to the awareness period. Special attention was paid to blood pressure and heart rate. These were considered high if their respective values were >30 mmHg, or >30 beats/min, greater than baseline (in accordance with Evans' PRST scale²²).

To study the possibility that awareness cases can be detected by inspection of the anesthetic records, we selected from the hospital files for each awareness case two similar cases in which no awareness had been reported. These were chosen so as to match the cases on the following: year of surgery (within a range of 5 yr), age (within a range of 10 yr), gender, ASA physical status, type and duration of surgery, anesthetic technique, duration of anesthesia, premedication, and tracheal intubation. When complete matching was impossible, priorities were given to type/duration of anesthesia and type/duration of surgery. The anesthetic records of cases and matched controls were then photocopied, with relevant information (*e.g.*, anesthesiologist's name; special remarks noted on the record that could reveal the occurrence of awareness, such as "patient is awake") omitted. Three experienced anesthesiologists (years of experience as a qualified anesthesiologist: 10, 17, and 26, respectively) then rated all anesthetic records, in random order, for the possibility that awareness and recall might have taken place, on a five-point rating scale, with 1 = "very unlikely" and 5 = "very likely." The raters were only informed that the records contained "some" cases in which awareness and recall had occurred. In a second stage, the same

Table 1. Interview Questions

1. What did you notice: sounds, tactile sensations, visual perception, pain, paralysis?
2. Did you feel something in your mouth or throat?
3. What went through your mind?
4. Did you believe you were dreaming?
5. How long did it last?
6. Did you try to alert anyone?
7. How was your preoperative mental state?
8. Have there been any consequences?
9. Did you inform the anesthesiologist/hospital staff?
10. Have you changed your opinion about anesthesia?

raters assessed all records once more, in groups of three (one case, two matched controls, in random order) with the instruction to identify the case in each set of three records, *i.e.*, a forced-choice situation. Lastly, in a third stage, detailed information was given of what each patient with awareness had reported, and the raters were again asked to identify the case in each group of three records, in a similar fashion.

In comparing subgroups of patients, we used Fisher's exact test (two-sided)²³ for statistical analysis. Differences were considered significant if *P* values were below 0.05. To assess the ability of each rater to classify the patients in the correct groups, Cohen's kappa was used as an agreement measure.

Results

During a 20-month period, 31 patients were referred. After an extensive inquiry, three patients were excluded from the survey because their experiences could not be accepted as awareness-cases during general anesthesia: two recalled events from the postoperative period, and one had only received intravenous midazolam without an anesthesiologist in attendance. Two other patients were excluded because of incomplete data. One of these (a 47-yr-old man) had awakened during a combined epidural-general anesthesia, and had responded to verbal instructions. He left the hospital before he could be interviewed, and we were unable to contact him thereafter. The second patient (a 20-yr-old man) could also not be interviewed more extensively. Although he had originally stated, on awakening, that he had "heard everything," he denied this a few hours later.

The remaining 26 patients (8 men and 18 women) were interviewed in depth. Details about patients and

Table 2. Awareness Cases and Details from the Anesthetic Records (n = 12) in Descending Order of Time Interval between Awareness and Interview

Patient No.	Time Interval*	Patient Detail†	Operation	Premedication‡	Anesthesia§	Special Details in Anesthetic Record¶	Experiences and Feelings during the Awareness Period	Sequelae**
1	7 yr	Female 37 yr ? ASA 2	Cesarean section (emergency)	None	Methohexital 60 + 40 mg N ₂ O/O ₂ ; F ₁₀₀ 50% droperidol 3.75 mg fentanyl 75 + 200 µg succinylcholine 75 mg curare 20 mg 55 min	HR↑	Heard people talking, experienced pain, felt someone pulling her abdomen, could not move, found impossible to breathe, anxiety and panic, fell asleep after the baby was born, thought the anesthetic did not work well, thought they were not taking care of her and thought: I am leaving (am dying)	Mental distress for several months
2	22 mo	Female 29 yr 43 kg/1.61 m ASA 2	Colostomy M. Crohn (elective)	Diazepam 10 mg 230 min calm	Methohexital 50 mg droperidol 5 mg N ₂ O/O ₂ : F ₁₀₀ 38% fentanyl 500 µg vecuronium 4 + 1 mg 120 min	No abnormalities HR + BP in normal range	Heard the surgeon discussing the position of the legs and the place of the incision, could not move, could not open her eyes, anxiety and panic, tried to warn but found this impossible	None (had originally forgotten the episode, memories came back after talk with fellow patient)
3	19 mo	Male 23 yr 84 kg/1.85 m ASA 1	Acetabular fracture (emergency)	Diazepam 10 mg 120 min calm	Propofol 170 mg propofol Σ 2,500 mg O ₂ /air: F ₁₀₀ 38% epidural bupivacaine†† sufentanil 60 µg vecuronium 14 mg 270 min	No abnormalities HR + BP in normal range	Awakened by pain, noticed the position of the leg that was operated on, could see green colors and instruments, heard buzzing sound, happened too quickly to warn anyone, thought "I am supposed to sleep, something has to be done because of the pain"	None
4	14 mo	Female 58 yr 68 kg/1.69 m ASA 2	Colostomy sigmoid carcinoma (elective)	None	Propofol 150 mg droperidol 5 mg propofol Σ 1,050 mg O ₂ /air F ₁₀₀ 48% fentanyl 500 µg vecuronium 12 mg 150 min	BP↑ lorazepam 4 mg at moment of extubation tremely increased blood pressure	Could see surgeon, heard voice of surgeon, experienced pain at the operation site, could not move, tried to scream, but no sound was audible, anxiety and powerlessness, was thinking of coma	Anxiety, bothered her for several months, ↑ fear of anesthesia
5	11 mo	Female 54 yr 61 kg/1.64 m ASA 3	Reoperation hemorrhage after renal transplantation (emergency)	None	Thiopental 125 mg isoflurane O ₂ /air; F ₁₀₀ 43% fentanyl 750 µg atracurium 30 mg 50 min	"awareness" BP↑ + BP↓ HR↑	Could see people and surroundings, heard people talking and moving about, could not move, could not speak, tried to warn but found this impossible, anxiety and panic, believed to be in coma	↑ fear of anesthesia, bothered her for several months, still thinks about it, denied aftereffects at interview

AWARENESS AND RECALL

6	9 mo	Male 26 yr 73 kg/1.82 m ASA 3	Priapism, hemodialysis (emergency)	Lorazepam 2 mg 15 min nervous	Methohexital 120 mg isoflurane N ₂ O/O ₂ ; F _{IO₂} 37% fentanyl 300 µg atracurium 30 mg 60 min	HR↑	Did not fall asleep at induction but felt paralysis, heard people talking, could see surroundings and people, could not move at all, tried to warm but found this impossible, anxiety, felt alone and unguarded	↑ fear of anesthesia, took him several months to get over it
7	3 mo	Female 33 yr 73 kg/1.68 m ASA 1	Laparoscopy + curettage (elective)	Diazepam 10 mg 90 min very nervous	Propofol 150 mg propofol ≥ 820 mg O ₂ /air; F _{IO₂} 34% sufentanil 50 µg vecuronium 10 mg 50 min	HR↑	Noticed the curettage, heard noise, metal clattering, and voices, recognized voice of gynecologist, could not move, could not open eyes, tried to warm but found this impossible, felt anxiety and powerlessness	↑ fear of anesthesia
8	2 mo	Female 34 yr 72 kg/1.68 m ASA 2	Ileostomy, M. Crohn (elective)	Lorazepam 2 mg 60 min calm	Propofol 150 mg propofol ≥ 1,560 mg O ₂ /air; F _{IO₂} 40% sufentanil 120 µg atracurium 70 mg 210 min	No abnormalities HR + BP in normal range	Heard much noise, clattering of instruments, and voices, heard someone shouting in amazement about what was found during surgery, could see light and lamps, wanted to know what was going on but found it impossible to ask	None. Fearful and in panic immediately after operation, thinks about episode during the days but denies any sequelae
9	6 days	Female 36 yr 83 kg/1.60 m ASA 3	Cesarean section (elective)	None	Methohexital 130 mg N ₂ O/O ₂ ; F _{IO₂} 50% after childbirth: O ₂ /air; F _{IO₂} 44% propofol ≥ 470 mg fentanyl 400 µg vecuronium 8 + 1 mg (+ priming 0.1 mg) 80 min	HR↑	Heard much noise and voices, felt the mask pressed on her face, could not move, tried to warm but was unable to do so, no pain but was afraid this would come, felt anxiety and panic, felt like suffocating, thought she was dying	Sleep disturbances, nightmares, flashbacks, ↑ fear of anesthesia, need for psychotherapeutic help
10	3 days	Male 34 yr 73 kg/1.73 m ASA 1	Staple removal knee (day surgery)	None	Propofol 140 mg isoflurane F _{IO₂} 20% sufentanil 40 µg vecuronium 6 mg 45 min	"awareness" BP↑ HR↑	Heard discussion about missing x-rays, noticed that new x-rays were taken, felt the tube in his throat, heard talking about himself as being awake, felt paralyzed, tried to warm but found this impossible, felt anxiety and powerlessness, was afraid the operation would start	None
11	3 h + 9 days	Female 28 yr 58 kg/1.71 m ASA 1	Maxillary corticotomy (day surgery)	None	Propofol 120 mg propofol ≥ 1,150 mg O ₂ /air; F _{IO₂} 50% fentanyl 250 µg vecuronium 5 mg 75 min	"awareness" HR + BP in normal range	Was awake at various moments, felt the nasal intubation, heard surgeon speaking to nurse about instruments, felt the drill, could not move, tried to warm but was unable to do so, felt anxiety and helplessness, feared pain	None, was agitated in immediate postoperative phase, denied any sequelae at second interview

Table 2. Continued

Patient No.	Time Interval*	Patient Detail†	Operation	Premedication‡	Anesthesia§	Special Details in Anesthetic Record¶	Experiences and Feelings during the Awareness Period	Sequelae**
12	2.5 h + 3 mo	Female 45 yr 87 kg/1.68 m ASA 1	Arthroscopy knee (day surgery)	None	Methohexital 100 + 20 mg isoflurane N ₂ O/O ₂ ; F ₁₀₂ 31% fentanyl 200 µg vecuronium 8 mg 50 min	BP†	Felt the intubation, heard remarks about her body weight, felt her eyes were closed, noticed being wheeled from induction room to operating theater, could not move, tried to warm but found this impossible, felt anxiety and powerlessness, was afraid the operation would start	Fearful being alone in first postoperative nights, anxious dreams, sleep disturbances, flashbacks, lasting a few months (anxious dreams still present after 1 year)

? = missing data.

* Time interval between anesthesia during which awareness occurred and interview.

† Gender, age at moment of interview, weight, height, ASA physical status.

‡ Agent + dosage, time interval between premedication and start of anesthesia, reaction to premedication as noted on anesthetic record (all premedicants given orally).

§ Propofol = induction dosage, propofol Σ = total dosage used for maintenance of anesthesia calculated retrospectively; time interval = duration of anesthesia (patient 11 received nasal intubation, all others oral).

† HR† = heart rate > baseline + 30 beats/min; BP† = systolic blood pressure > baseline + 30 mmHg; BP† = systolic blood pressure < 80 mmHg; "awareness" = awareness noted on the anesthetic record.

** None = no manifest aftereffects in patient's opinion.

†† Combined general and epidural anesthesia.

anesthetic records are presented in tables 2 and 3. The mean age of patients was 39 yr (range 23–65 yr), and the time interval between the awareness episode and our interview varied from a few hours to 19 yr. The mean age at the time of awareness was 35 yr (range 18–57 yr). The anesthetics during which awareness had occurred had been administered for clinical elective surgery (n = 10), acute trauma surgery (n = 7), day-case surgery (n = 5), and Cesarean sections (n = 4).

The Interview

Question 1: What Did You Notice? The most frequently recalled aspects of the period of awareness are presented in table 4. Almost all patients had experienced some auditory perception, recalling voices, music, the sound of metal clattering, drilling, or other sounds. Of those patients who had experienced a sensation of paralysis, most (n = 20) mentioned the inability to move their arms and legs first. Nine patients experienced pain at the operation site, while one had felt pain in his jaw, caused by his extreme efforts to open his mouth and scream. Five patients reported having felt the operation, without experiencing pain. Visual perception was also recalled. One patient reported having seen light, and six others stated that they had been able to see people and surroundings.

Question 2: Did You Feel Something in Your Mouth or Throat? Four patients mentioned the intubation itself, while two others stated there had been something in their mouths.

Question 3: What Went Through Your Mind? Most patients (n = 24) recalled feelings of anxiety and panic during the period of awareness, and almost one-half (n = 12) recollected feelings of powerlessness or helplessness. Patients reported feelings of suffocation (n = 4), impending death (n = 4), a belief that they were in coma (n = 2) or might not emerge from anesthesia (n = 2), and the frightening sensation that pain might be experienced (n = 3). Some thought they had been left alone or unattended (n = 4), or that an anesthetic mishap had occurred (n = 4).

Question 4: Did You Believe You Were Dreaming? Only one male patient thought, initially, that he had been dreaming during the period of awareness, but he later changed his opinion.

Question 5: How Long Did It Last? The estimation of time was very difficult. Most patients reported that they had found the experiences so overwhelming that they were unable to estimate the exact length of time

involved. Their answers varied from "a few seconds" to "ten minutes." Three patients were unable to give any time indication at all.

Question 6: Did You Try to Alert Anyone? A fair number of patients ($n = 20$) attempted to alert someone, but found it impossible to do so. Of the six patients who did not even try, four found the period of awareness too brief. One patient was concerned that something had gone wrong with the anesthetic; another did not feel the need to warn because she was, after previous anesthetics, used to having dreams and "tunnel" experiences during anesthesia.

Question 7: How Was Your Mental State Before the Operation? About their preoperative mental states, 11 patients stated they had been very anxious, while 12 reported they had not. Three patients either could not remember or were not asked this question.

Question 8: Have There Been any Consequences? Sixty-nine percent of the patients ($n = 18$) stated they had experienced unpleasant aftereffects, and 42% ($n = 11$) still subjectively suffered from these at the time of the interview. The most frequently mentioned complaints were: sleep disturbances ($n = 8$), dreams and nightmares ($n = 8$), flashbacks ($n = 4$), and anxiety during the day ($n = 4$). One patient developed a phobia, and two others needed psychotherapeutic help.

Question 9: Did You Inform the Anesthesiologist/Hospital Staff? Almost 70% of the patients ($n = 18$) had tried to tell hospital staff what had happened while they were still in the hospital. Only one-half of these ($n = 9$) informed the anesthesiologist who had administered the anesthesia. Three patients criticized the anesthesiologist's reaction as being careless and denying. The remaining 17 patients had not informed their anesthesiologists, mostly because they had not seen him or her since the operation ($n = 14$). Six patients were confronted with disbelief or skepticism, either while in the hospital ($n = 4$) or with relatives ($n = 2$).

Question 10: Have You Changed Your Opinion About Anesthesia? Sixteen patients (62%) mentioned that the awareness experience had changed their attitude toward anesthesia. They said they had become more afraid. Almost everyone stated that, should they need another anesthesia, they would inform the anesthesiologist about what had happened.

In a *post hoc* analysis, we divided the patients into two groups, *i.e.*, those with and those without aftereffects (table 5). Although the percentage of patients experiencing pain was not statistically greater than that

in patients without pain, there was a trend ($P = 0.10$) indicating a difference. Almost all patients with aftereffects had changed their opinions on anesthesia, whereas no one in the group without aftereffects had done so ($P < 0.001$). Preoperative anxiety, as stated by the patient, did not differ between the two groups, nor did the number of patients who had informed the anesthesiologist or the hospital staff of their experience.

The Anesthetic Record

When we asked the colleagues who had been responsible for the anesthesia during which awareness had occurred for anesthetic details, we met with a clear reluctance to provide these data. Therefore, we restricted our analysis of the anesthetic records to those anesthetics administered in our own hospital.

Twelve anesthetic records could thus be reviewed, and details are provided in table 2. Different types of anesthetic techniques were used, varying from a volatile anesthesia supplemented with different kinds of anesthetic agents ($n = 6$) to total intravenous anesthesia ($n = 5$) and a combined general-epidural anesthesia ($n = 1$). Notes that the patient had been aware during the anesthesia were found on three records. On a fourth record (case #4), it was noted that 4 mg lorazepam had been given intravenously at a moment of extremely high blood pressure. It is very likely that the patient was awake at that particular moment, but awareness was not explicitly indicated on the record. Increases in blood pressures and heart rates > 30 mmHg or > 30 beats/min greater than baseline, respectively (score 2 on the PRST scale), were seen in five other records; however, in the remaining three records, there were no abnormalities, and blood pressure and heart rate were in a normal range (PRST scores 0 or 1).

For the case-control comparison (see materials and methods), seven anesthetic records of awareness cases could be completely matched. In two cases, there was a difference in one matching variable, and, in three others, in two variables. To establish, in the first stage, the number of correctly identified cases of awareness for each rater, we considered all ratings 3, 4, or 5 (on the five-point scale) as correct identifications in cases of awareness, and as false positives in the matched controls. Based on this criterion, our raters correctly identified 5, 3, and 2 awareness cases, but also scored 5, 3, and 2 false positives, respectively. Only one awareness case (#1, table 2) was correctly identified by all three raters, who stated that too few anesthetic drugs had been given for the time period before the child

Table 3. Awareness Cases without Known Anesthetic Details (n = 14) in Descending Order of Time Interval between Awareness and Interview

Patient No.	Time Interval*	Patient Details†	Operation	Experiences and Feelings during the Awareness Period	Sequelae
1	19 yr	Female 62 yr	Cholecystectomy (elective)	At start of anesthesia heard command about arm to be held up, could not move arm, tried to warn but was unable to do so, powerlessness, became angry and terrified, was in panic and thought it went all wrong and that it would never stop	Sleep disturbances, nightmares, anxiety, flashbacks, physical sensations in head and arm for over 1 year, ↑ fear of anesthesia
2	12 yr	Male 65 yr	Lower extremity fracture (emergency)	Noticed manipulating his leg, heard drilling sound, conversation, and a beeping sound of the ECG machine, tried to warn but found this impossible, sensation of complete paralysis, anxiety and extreme sense of powerlessness	Felt urge to move, right after surgery, was aggressive, pertinent dreams and sleep disturbances, phobia for intravenous drip, ↑ fear of anesthesia
3	11 yr	Female 53 yr	Cardiac valve implantation (elective)	Woke up suddenly, feeling intensive pain in the middle of her chest, tried to move backwards and scream but was unable to do so, terrified as if in a nightmare	↑ fear of anesthesia, sleep disturbances
4	9 yr	Female 52 yr	Cesarean section (emergency)	Felt intense pain in, and heavy pulling on, her abdomen, heard voices, could not move, felt powerless, tried to warn but was unable to do so, was frightened that she might suffer more pain, reached a state of panic	Anxious dreams for 2 yr, ↑ fear of anesthesia
5	8 yr	Female 41 yr	Sterilization (elective)	Inability to breathe at start of anesthesia, felt like choking, panicked, thought she was dying, lasted too short to warn anyone	None
6	8 yr	Female 26 yr	Fractured ankle (emergency)	Heard all kinds of sounds, did not know where she was, afraid they might still be operating on her, wanted to shout, was unable to move, afraid she might feel pain, panicked, completely paralyzed but her mind was alert	Still thinks about it every day, ↑ fear of anesthesia
7	6 yr	Female 32 yr	Lower extremity fracture (emergency)	Felt being operated on her leg, much pain, heard music, could not move, unable to warn anyone, terrified, called it "a nightmare," imagined that it would never stop	↑ fear of anesthesia
8	3 yr	Male 41 yr	Incarcerated umbilical hernia (emergency)	Heard surgeon talking about upcoming vacation, felt being operated, no pain, could not move, heard somebody asking if he "had really gone off to sleep," unable to warn anyone, anxiety and powerlessness	None
9	2.5 yr	Male 30 yr	Reostheosynthesis fracture lower leg (elective)	Awakened and felt intubation, heard talking, someone stated they needed a different kind of tube, completely paralyzed, unable to open eyes, talk, or breathe, tried to warn anyone but was unable to do so, got very frightened, panicked, had impression that something was going wrong	None
10	2 yr	Female 35 yr	Cesarean section (emergency)	Felt how layers of tissue were cut, no pain, felt as if she had "a big potato" in her throat, heard voices, recognized midwife announcing the baby was a girl, heard beeps of the ECG machine, terrified and powerless, found it very threatening	↑ fear of anesthesia
11	11 mo	Male 36 yr	Lower extremity fracture (elective)	Felt and heard being manipulated on his leg, heard drilling and tightening of screws, could see people, heard people talking about his leg, tried to warn anyone but was unable to do so, completely paralyzed, unable to open mouth, pain in his jaws, afraid to feel more pain, panicked, thought he might never get out of it and might become comatose	Pertinent dreams and sleep disturbances for about 4 mo, ↑ fear of anesthesia
12	10 mo	Female 31 yr	Arthroscopy knee (day surgery)	Felt something being inserted into her mouth, saw movements in front of her face, just for a few seconds, heard someone asking: "can we start?," afraid she might be conscious of everything	Sleep disturbances for a few weeks, ↑ fear of anesthesia
13	8 mo	Female 43 yr	Excisional biopsy breast tumor (elective)	Heard voices, felt incision and pain, could not talk, move, or warn anyone, got terrified, feared pain and powerlessness, panicked	Sleep disturbances for more than 6 mo, anxious dreams, fear of being alone (for a few days), anxiety during the day, physical sensations: pain and a tense feeling in upper legs, need for psychotherapeutic help, ↑ fear of anesthesia
14	2.5 mo	Male 28 yr	Hemorrhoidectomy (day surgery)	Felt increasing pain until pain was unbearable, heard voices, someone said he was waking up, wanted to warn anyone but was unable to do so, unable to talk, powerless, could not move or open his eyes, got frightened, imagined there had been an anesthetic failure, thought they were not being watchful	Anxious dreams, ↑ fear of anesthesia, anger toward anesthesiologist and hospital

* Time Interval between anesthesia during which awareness occurred and interview.

† Age at moment of interview.

AWARENESS AND RECALL

Table 4. Patients' Recollections (n = 26)

	N	%
Sounds	23	89
Paralysis	22	85
Pain	10	39
Visual perception	7	27
Intubation or tube	6	23
Feeling the operation without pain	5	19
Anxiety, panic	24	92
Helplessness, powerlessness	12	46
Aftereffects	18	69

was born. To assess the extent to which the raters were able to classify the anesthetic records as awareness cases or not, we calculated the agreement between their scores and the actual case-control distribution (12 cases, 24 controls). The kappas, for each rater, were 0.22, 0.14, and 0.10, respectively, which represent very poor agreement.

When, in the second stage, the forced-choice method was used, in which the judges were asked to identify the awareness case in each set of three records (*i.e.*, one awareness case and two matched controls), they identified 4, 2, and 7 cases. In the third stage, with additional detailed information, the first two raters changed their opinions in a few instances, which resulted in a total of 5 and 4 correctly identified cases; however, our third rater did not do so. When guessing, probability of successful identification of the awareness case, in each set of three records, was $\frac{1}{3}$, with an expected value of the number of correctly identified cases of 4. There was some evidence that the results of the third rater were better than could be expected by chance alone ($P = 0.07$, based on 7 or more successes in 12 trials; $P = \frac{1}{3}$, binomial distribution).

With regard to the more objective parameters in the anesthetic record, increases in blood pressure (>30 mmHg) and heart rate (>30 beats/min) were observed in 67% of the awareness cases and in 21% of the matched controls ($P = 0.01$).

Discussion

There are several similarities between our data and those of Evans.²¹ First, the topics our patients recalled from the time of awareness closely corresponded with his data. In both series, the two most frequently mentioned complaints were: (1) having been able to hear,

and (2) sensations of weakness or paralysis, followed by pain. Second, the rarely documented and little-known experience of visual perception was reported with approximately the same frequency. Third, the mean age at the time of awareness, the male:female ratio, and even the numbers of Cesarean sections were similar. This adds to the validity of the reported findings, particularly as we used a very different strategy for patient selection from that adopted by Evans.

A high percentage of patients had suffered aftereffects. Their symptoms correspond with those reported in the literature.^{17-20,24,25} Sleep disturbances, dreams and nightmares, and flashbacks and anxiety during the day were most frequently mentioned. Why some people experience aftereffects and others do not cannot be explained from our data. It is worth mentioning, however, that one-half of the patients with aftereffects recalled pain, but only one of the patients without aftereffects did so (table 5). This latter patient found a rational explanation for the occurrence: his happiness at having survived a car accident had simply eclipsed the sensations he recalled from the period of awareness during his prolonged operation.

Evans²¹ also pointed out the significance of experiencing pain. Although he did not specifically ask about any aftereffects, he did inquire whether the events had upset the patients. Of the 21 patients in his sample who found the experience distressing, 20 had experienced pain or discomfort; this was only the case in 2 out of 6 patients who did not consider the events distressing. Undoubtedly, other factors also play a role in the development of emotional disturbances after an awareness experience.^{26,27} However, both our data and those of Evans²¹ may indicate that the experience of

Table 5. Differences between Patients with and without Aftereffects (n = 26)

	Aftereffects				Fisher's Exact Test <i>P</i>
	Yes (n = 18)		No (n = 8)		
	N	%	N	%	
Male	4	22	4	50	0.17
Female	14	78	4	50	—
Experienced pain	9	50	1	12.5	0.10
Changed opinion	16	90	0	0	<0.001
Preoperative anxiety*	9	53	2	33	>0.50
Informed hospital staff	12	67	6	75	>0.50
Informed anesthesiologist	6	33	3	37.5	>0.50

* Data from three patients are missing.

pain is an important differential factor between those who do and those who do not experience uncomfortable aftereffects.

Some authors emphasize the significance of preoperative anxiety in relation to awareness and its psychologic consequences.²⁸ Furthermore, premedication may influence the incidence of awareness.²⁹ We, therefore, included in our interview the question about the preoperative mental state. In the current study, the reported preoperative anxiety did not differ between the groups with and without aftereffects. It should be noted, however, that we determined preoperative anxiety retrospectively, based on the patients' own assessments.

The actual awakening during an anesthetic does not seem to be the most distressing experience for patients. Some stated that it had not disturbed them as such, but when they found themselves "unable to move their arms and legs or open their mouths," without being able to communicate, this resulted in great anxiety and panic. Furthermore, the inability to interpret what was going on, and the sensation that "something must be completely wrong," contributed to the anxiety. Some patients reported fears of impending death, but others denied such feelings and said that they had been far more concerned about experiencing pain.

There is a widespread belief that meaningful words and remarks are recalled easier than neutral sounds, and have a greater impact on the patient.³⁰⁻³⁴ Our patients very clearly recalled remarks that had been insulting and emotionally distressing. Some of the comments about unexpected findings during the operation and remarks on the patient's body weight or size were recalled verbatim. In fact, some patients reported that they had tried to remember specific details, as best as they could, to be able to prove the validity of their remembrances afterward. The attentiveness to emotionally threatening remarks is maintained during the perioperative period, as illustrated below in the account of one of the three patients who were excluded from this survey. Their reports could not be accepted as cases of awareness and recall during general anesthesia, but some remarks are, nevertheless, worth mentioning. One awoke in the operating theater after the procedure was over, and heard remarks that he considered insulting. He interpreted the fact that he was able to hear these remarks as signs of insufficient anesthesia. The experiences of a second patient took place during the intensive care period following the operation. His arms had been restrained, and not being able to move

or communicate made him extremely anxious, and resulted in recall of traumatic wartime memories that had been suppressed for 40 yr. The third patient experienced a great deal of pain during a rectal procedure. It turned out that only midazolam had been given intravenously, without any anesthesiologist in attendance.

All three patients were very distressed by their experiences and all claimed to have "awakened during a general anesthesia," for which they blamed the anesthesiologist. This illustrates the fact that traumatic experiences related to anesthesia may arise either during the anesthesia itself, or during the perioperative phase. Furthermore, it is clear that it is often impossible for patients to distinguish between the periods before and after the anesthesia and the anesthesia itself. The story of the third patient illustrates that the effect of sedative drugs may be interpreted by the patient as regular anesthesia, simply because these drugs produce sleep and amnesia. To reveal, and possibly correct, misconceptions, patients who report recall from general anesthesia must be interviewed with accuracy and attention.^{34,35}

A remarkable finding is the low percentage of patients who informed their anesthesiologists about what had happened. Anesthesiologists may well ask themselves whether they really know what happens to their patients. Most patients in the current study were collected with the help of colleagues who were confronted with their stories during the standard preoperative screening procedure. After we had invited the patients to participate in the study, we were surprised to note that they were all quite eager to talk about their experiences. Furthermore, although we emphasized the purpose of the study, *i.e.*, a survey of experiences, all patients were grateful for the opportunity to talk. This emphasizes the anesthesiologist's role in discussing traumatic anesthetic experiences and, where possible, providing relief. It also stresses the importance of asking about previous anesthetic experiences. The value of the "preoperative visit" by the anesthesiologist is beyond dispute. A *postanesthetic* visit has, however, not yet become the norm in all countries.

Routinely asking about anesthetic experiences should be an integral part of proper anesthetic care, especially if unfavorable aftereffects are to be detected. Asking for anesthetic experiences not only reveals the opinion of patients,³⁶ but, while doing so, patients in need of psychologic help can be identified at an early stage.

AWARENESS AND RECALL

When the data from the anesthetic records are reviewed (table 2), the question may arise whether certain drugs, or combinations of drugs, result in more problems than others. Neuromuscular relaxants were used as part of all of the anesthetics for which we could find records, and 85% of patients complained of sensations of weakness and paralysis. The sensation of weakness and paralysis causes a great amount of anxiety, and the inability to move and alert anyone may lead to panic. In our survey of 12 records, propofol was used for maintenance of anesthesia in 6 cases. As stated in the introduction, awareness and recall have been reported in anesthetics with various types of anesthetic agents, but, until now, only one well documented case report had been published in which propofol had been used during a total intravenous anesthetic technique.¹⁴ It is also interesting to note that only three patients in our survey were adequately sedated after premedication.

Special attention has to be paid to case #4 (table 2). At a moment of increased systolic blood pressure (190 mmHg), 4 mg lorazepam was administered intravenously. It is possible that the patient was, at this particular moment, awake. Perhaps this illustrates that a drug with a known anterograde amnesic action does not necessarily cause retrograde amnesia.

From the data related to the assessment of the anesthetic records for the likelihood of awareness, we conclude that the current results do not justify the notion that anesthesiologists are able to correctly identify an awareness case by judging the anesthetic record. This is even more remarkable if one considers the differences between cases and controls in the objective parameters of blood pressure and heart rate (67% vs. 21%), underscoring, once again, the importance of a careful check of these parameters at all times. On the other hand, a handwritten anesthetic record may not always be a reliable reflection of the period of anesthesia. This is clearly illustrated by a study of Cook *et al.*,³⁷ in which substantial differences between handwritten recordings of blood pressure and those derived from automatic blood-pressure devices were found. Personal motives in the anesthesiologist may cause such discrepancies, as shown by Galletly *et al.*,³⁸ who carried out a confidential survey among 325 anesthesiologists and found that 55% of the respondents acknowledged that, on occasion, they deliberately wrote down incorrect data. Therefore, it seems very difficult, or even impossible, to retrospectively confirm a period of awareness, based on these parameters from a handwritten anesthetic re-

cord only. Although blood pressure and heart rate are cornerstones of anesthesiologic practice, the data from our survey confirm that the handwritten recording of anesthesia is of limited value to retrospectively explain why awareness and recall have occurred.

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