Guidelines for preventing and managing accidental awareness during general anesthesia

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Introduction

The reader is kindly asked to imagine a virtual situation.

A 30-yrs old lady is brought to the operating room (OR) for sterilization surgery.

She passed a completely uneventful general anesthesia, including normal vital signs during all the procedure. But once in the Recovery Room she became restless, agitated and was trying all the time to explain confusing things. Half an hour later, when awake she said that she could recall discussions in the OR ("Where the hell have you been?! The patient is asleep already half an hour!!") and also remembered pain like a knife cutting her skin!!

This can be considered a typical case of **true awareness** during general anesthesia (AGA), as per Sandin et al definition (1). In this case there is no doubt that the patient was, at least a part of the anesthesia maintenance time, aware and able to memorize details from the OR.

The incident is not as rare as some of us might think. It is more frequent in some categories of patients and during anesthesia for some specific surgical interventions.

AGA can have serious implications for the patient psychological condition and this is an enough reason for knowing how to prevent it and how to address it when it happens.

Monitoring of central nervous system during anesthesia

General anesthesia is supposed to cover a number of tasks during surgery: analgesia, pharmacological sleep, amnesia, prevention of disturbing body

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movements and, of course, as a result, prevention of sympathetic response to stress and pain.

Unfortunately, until now, the anesthesiologist does not possess a reliable method of monitoring depth of general anesthesia (GA) which could help him in achieving all the above aims in every single patient.

Hemodynamic signs (blood pressure, heart rate) are often stable and normal during episodes of AGA. In only 15% of AGA cases, the anesthesia chart records hypertension and/or tachycardia.

Patient movements, as an expression of awareness, are useless once the patient gets muscle relaxants. Beside, movements can be involuntary and even in the case of purposeful movements they are not always associated with true awareness.

The last fifty years witnessed a long list of studies using various parameters of cortical electrical function, used as variables to be monitored during GA in order to adjust anesthetics dosage and prevent over-or under-dosage.

Here is a short list of computerized EEG descriptors used in clinical practice in the last years: spectral edge frequency (SEF), spectral median frequency, bispectral analysis (BIS), burst suppression rate. No one proved to be reliable in all cases and this is why even when using any of them, cases of AGA still happen.

Awareness during general anesthesia (AGA), an every day reality

AGA definition includes two compulsory aspects: episodes of intraoperative consciousness **and** postoperative recall. AGA means explicit memory, a situation in which the patient is able, spontaneously, to report periods of awareness and reproduce exact details from the OR activity during his/her surgery.

We are not describing here the phenomenon of implicit memory, in which the patient could be aware during anesthesia but he/she would need a „hint" (a word, an order given to him during anesthesia), which would help remembering items from the time of surgery.

AGA is well known from the very early periods of modern anesthesia (it seems that Mr. Abbott, Bill Morton famous patient in October 1846 was alert during ether anesthesia!), but Levinson was the first one in 1965 (2) who accurately described this incident in a very interesting study done in the OR.

Due to advances in anesthesia techniques and drugs AGA incidence dropped in the last decades and reached today a constant rate of 0.2% of all GA cases.

Apparently it might seem as a minor incident, but only in the USA the translation of this percentage brings the number of AGA cases to 100 each day!

AGA accounted for 2% of all medico-legal claims in the ASA Closed Clai-

ms Project (3), a percentage similar to other post-anesthetic complications, such as aspiration pneumonia or myocardial infarction.

Some patients are more at risk to develop AGA.

The list includes cases of hemodynamic instability (trauma, shock, ASA 4 and 5), morbid obesity for which an exact anesthetic dosage could be difficult to obtain, obstetric surgery (the anesthesiologist being alert to fetus condition and uterine tonus), cardiac surgery, mostly during bypass and last, but not least total intravenous anesthesia (TIVA).

In spite of its evident advantages (greater hemodynamic stability, more rapid recovery of consciousness, less pain in the immediate postoperative period, decreased discharge time from recovery room, etc.) TIVA is accompanied by a higher percentage of AGA.

In large series of TIVA (4), AGA rate was not more than 0.1%, but in Gordon et al series (5), one patient out of 10 who had a coronary artery bypass surgery under TIVA presented a real AGA.

Why AGA is still with us?

Beside the fact that we do not have a perfectly reliable method of assessing depth of general anesthesia, we all know that during anesthesia and surgery the interaction between the amount of anesthetic drugs administered **and** the varying levels of surgical stimulation is not always perfect and this could lead to episodes of AGA.

Sandin (1) interviewed almost 12,000 patients, first immediately after surgery and twice more in the following two weeks. 19 patients reported AGA, 12 females and 7 males. All got an inhalator drug for maintenance and 18 out of 19 were ASA 1 and 2 patients. A rather long list of possible explanations was found in some of these 19 cases: technical faults (vaporizer turned off after refill, muscle relaxants administered before the hypnotic drug, etc) and in some cases prolonged intubation or awakening starting too early have been incriminated for producing AGA.

But the striking fact of this study was that in ten cases no possible explanation for AGA was found!

In other words, AGA is still with us even if we will take all the necessary precautions to avoid it. The individual difference was addressed by Kerssens and Sebel in a recent textbook chapter on AGA (6). For instance they found that patients with good preoperative memory were more likely to develop memories during anesthesia.

The impossibility of bringing AGA rate to zero makes the average anesthesiologist's work a hard one and implies the need for a very careful observation and surveillance of the patient during GA.

Why AGA is so bad?

Data from literature (7-9) show that AGA afflicted patients remember pain in more than 15% of cases. Beside, 80% of those patients who experienced AGA proved to be at risk to develop anxiety disorders in the first three weeks, 50% remained at risk for the next 2 years and between 20 and 84% of them (depends on the report quoted) might develop long term sequelae.

So the main negative consequence of AGA is development of posttraumatic stress distress (PTSD), or the so called „traumatic neurosis".

Some studies showed that out of 100 patients with AGA 15% would need postoperative psychotherapy and 20% would suffer from PTSD.

The criteria for diagnosing PTSD have been established by the American Psychiatric Association in 1994 and they include compulsory exposure to a life-threatening event, persistent avoidance of stimuli associated with that specific event and persistent symptoms belonging to the syndrome.

The list of symptoms of PTSD is too long to make it exhaustive. We would only mention sleep disturbances, recurrent nightmares, anxiety, inability to cope with stressful situations, violence and irascibility.

Without any doubt, the main obstacle related to PTSD is the difficulty of establishing a cause and effect direct relationship. The hope that hypnosis would solve the problem proved to be too optimistic, since some studies showed an increasing number of false witnesses during hypnosis.

Nevertheless PTSD remains a real problem in case of AGA and it has to be seriously taken into consideration when dealing with a patient which witnessed an awareness episode during general anesthesia.

Can we reduce the incidence of AGA?

The common sense would say that unjustified use of muscle relaxants should be avoided. A non paralyzed patient could be able to signal awareness. In Sandin et al study (1), twice as many patients developed memories of awareness episodes when paralysis was maintained throughout all surgical procedure.

But in the same time, non use of relaxants does not prevent AGA in all cases.

Some would advice the use of benzodiazepines, a class of hypnotic drugs which offer anterograde amnesia. But this technique might, in fact, hide the true AGA and replace it with **implicit memory,** a situation there would be no free recall of OR events but some data would remain in the sub-consciousness domain and produce untoward psychological effects as well.

As already said, clinical signs cannot offer an useful solution, but we have tried years ago to combine blood pressure (BP) variations with EEG spectral

edge frequency (SEF) variations (the so called „Gurman matrix"-10-11). In our studies a significant relationship between BP and SEF variations was found in only 75% of the studied patients.

Neither BIS could prove efficient in every single case.

Kerssens and Sebel (12) mentioned the fact that „ BIS titration to BIS 50-60 does not necessary curb memory function under general anesthesia and that „deriving from a data base, BIS remains a probabilistic measure with imperfect prediction probabilities" (6).

Lately he American Association of Anesthesiologists published an expert report (13) on EEG use for preventing AGA which recommended the use of a brain function monitor ONLY for selected patients, those in high risk to develop this incident.

Due to this special situation, in which no single measure could be considered an universal panacea, specialists on the field recommend a series of points to be taken into consideration for preventing AGA.

Preanesthesia period

The anesthesiologist is obliged to identify those patients at higher risk to develop AGA. To the risk list presented above one has to add history of drug abuse, previous episodes of AGA and difficult intubation (during which the hypnotic effects of induction drugs wore off).

We discussed in a relatively recent paper (14) the aspect of informed consent in these cases. In our opinion, patients whom the individual clinician considers to be at substantially increased risk of AGA should be informed of the possibility of this complication. This would be not only a formal step to be taken but also a good opportunity to discuss the item with the patient and to explain her/him that in spite of all the measures the anesthesiologist is preparing to use, some isolated episodes of AGA could appear. Beside, the patient would be asked to report postoperatively AGA episodes in order to give the physician the chance to assess the magnitude of the psychological burden and the need for further care and/or surveillance.

The OR management

The anesthesia machine should be careful checked and any technical failure uncovered in time, especially regarding vaporizers, infusion pumps and the backflow valves.

In case of high risk for AGA benzodiazepines could be use on a case-to case-basis (very anxious patients, immediate preinduction hypertension etc.).

The use of TIVA should be done with accuracy and with a careful supervision of patient's reaction to pain. As per our experience, the use of a brain

function monitor during TIVA becomes compulsory (like in all the other cases of high risk of AGA).

Clinical signs are to be monitored properly and any sign of increased sympathetic activity should be explained.

The use of muscle relaxants should be restricted only for facilitating tracheal intubation, mechanical ventilation and difficult surgical maneuvers (such as in abdominal surgery).

When in doubt, ask the patient to squeeze your hand. In many cases you will be surprised by his/her aware reaction.

Also the end tidal volatile concentrations could be used as an indicator of proper vaporizer functioning.

But beside everything **an OR etiquette** is to be strictly observed! There is no place for uncontrolled expressions and dialogues. A possibility that **each patient** can hear voices during surgery and anesthesia is to be taken into account.

Postoperative management

The need for routine postoperative visit of the anesthetized patient cannot be overemphasized. It demands time but it is a rewarding activity, to be performed on a every day basis.

The first rule refers to the fact that patient is always right unless otherwise proved!

Any report of AGA should be treated with the highest priority.

The anesthesiologist has to approach the patient, to record complain and to explain the fact that such an incident cannot always be prevented.

A structured questionnaire for interviewing the patient can be easily found in the literature (6) and used in every case, with the aim of properly defining those cases of true AGA.

For those proved AGA cases counseling and psychological support is to be immediately offered.

These patients are to be followed up during the first few weeks and signs of PTSD are to be immediately recognized. PTSD demands a psychiatric examination and counseling and earlier the psychiatrist intervention better the results of the treatment.

Future directions for research

The problem of monitoring depth of anesthesia remains open.

AGA is a result of the failure to find a proper brain monitor, reliable in 100% of cases and which could early detect any episode of over-or underdosing of anesthetic agent.

Since up to now no entirely proved method of AGA detection was found out, future research should be focused in an another direction.

One single parameter will never be enough to detect every single case of episodic AGA.

We are of an opinion that a **combination of clinical signs, a computerized EEG variable and on line measurement of anesthetic drug plasmatic concentration** is right thing to be developed and tested.

Lessons to be taken home

1. AGA is unavoidable in every single case of general anesthesia and isolated cases (01-0.2%) could be encountered in every single hospital and OR.
2. AGA might have severe consequences, among them PTSD, a serious psychological and sometimes psychiatric development.
3. The anesthesiologist, by visiting postoperatively his/her patient, must offer the surgical patient a chance to complain about episodes of AGA and thus trigger a series of therapeutic measures for minimizing the gravity of the situation. An emphatic approach is always useful.
4. AGA is not a short episode of psychological sufferance. PTSD may persist for extended periods of time and in many cases needs a proper surveillance and care.
5. AGA might have medico-legal consequences, too. This is why the anesthesiologist has to accept the reality told by the patient, must reassure him/her, but in the same time report immediately to the defense company, for preparing a possible future complain in court.
6. Last but not least: inform immediately the surgeon about this incident and also put a comprehensive note in the patient's chart about the AGA circumstances.

Above all, one cannot forget our duty, to provide proper anesthesia to every single patient.

It seems that we owe our patients a real chance to be kept unconscious during general anesthesia and avoid unpleasant and sometimes dangerous episodes of awareness.

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