

The automated anesthesia record

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Summary

Many phases of modern anesthesia keep the anesthetist too busy to obtain and plot physiologic data or to record anesthetic events. Yet the anesthesia record serves as a log book, a clinical management tool, a trend and pattern plotter, as well as a medical-legal document. If these functions are important, an automated anesthesia recording system is needed for charting the data reliably and accurately. Automating the anesthesia record also lays the ground work for abstracting the data and generating records with specific information sought by the anesthetist, the physicians in the recovery room and intensive care unit, the administrators of the hospital, as well as representatives with interest in medical-legal problems.

When the first anesthesia records (1) were written at the turn of the century, the variables that had to be charted included heart rate, rate of spontaneous ventilation and arterial blood pressure. In addition a note recorded such events as the time at which ether or chloroform administration was begun and stopped, the time of incision and the occurrence of pallor, sweating or vomiting. Even though the anesthetist had his hands full with dripping the anesthetics on the mask and with supporting the chin of the patient, he could interrupt the administration of the anesthetic long enough to record the few variables he had to chart.

In the intervening decades one trend has made charting the course of anesthesia easier while another has made it more difficult. It has become easier because with modern anesthesia the anesthetist's hands are no longer tied up with supporting the chin of the patient or dripping ether or chloroform: the majority of patients now breathe through endotracheal tubes that guarantee a free airway; and modern anesthesia machines come

equipped with vaporizers that require only occasional adjustments.

Another trend makes the task more difficult. Instead of the handful of variables to be recorded, the modern anesthetist is confronted with an imposing variety of variables and events that must be recorded. For many years these two trends, one making record keeping easier and the other making it more difficult, have kept a balance. This balance is now threatened.

In the past it took over 15 minutes to induce a typical ether anesthetic before the surgeon could stimulate the patient without running the risk of triggering reflexes that might have included vomiting and aspiration. During this quarter of an hour the anesthetist may have checked the blood pressure three times – each taking at least one minute, counted heart rate three times, each taking 10 seconds, and charting these data – each recording taking about 20 seconds. Thus he was occupied with obtaining the data and recording them for almost five minutes or a third of the time of induc-

tion. If no other problem occurred, keeping a record of these events was quite feasible.

In modern anesthesia the course of events during a typical induction is quite different. The administration of an inducing and intubating dose of thiopental and succinylcholine takes about 30 seconds, allowing for the exchange of syringes. A minute after the succinylcholine has been injected, the patient is ready for intubation. Up to another minute may pass before the anesthetist can assure himself that the endotracheal tube is properly placed. He then tapes the tube in place, connects the breathing tubes, turns on the ventilator, adjusts the gas flows, protects the eyes of the patient and secures the surgical drapes at the top of the table. All of this takes about 5 minutes if he is swift and if complicated positioning of the patient is not necessary. During the induction thiopental will have decreased arterial blood pressure, succinylcholine will have stopped ventilation, and intubation will have accelerated heart rate and elevated blood pressure. Oxygen saturation may have fallen and CO₂ excretion ceased during apnea and then returned if the trachea rather than the esophagus was intubated. Yet no opportunity will have presented itself to measure all of these changes nor to chart them. Indeed, in difficult cases the induction can take 20 minutes during which time the anesthetist will have occupied his attention and both hands with clinical tasks leaving no time available to measure nor to chart any vital signs. Certainly there will have been no time available to record doses or times of administration of the several drugs he will have used.

Eventually the anesthetist can catch up with filling out the chart. But the data that are now entered are either subject to the frailty of memory or they are outright estimates. This includes vital signs and the timing and dosing of drug administration (2 & 3).

When the anesthetist is very busy during critical phases, for instance when many units of blood have to be given rapidly and when several drugs have to be administered in an emergency, again a record cannot be written, even though the most dramatic changes may be underway.

Substantial issues are raised here. If the record is often not accurate at the very time the largest

changes occur and if there is no evidence that many accidents could be prevented if only an accurate record had been available, we must ask: what is the value of the anesthesia record? To answer this important question let us examine, at least in theory, what the record might contribute under two perspectives. We can look at the functions of the record and at the users of the record.

The different functions of the anesthesia record

The functions can be discussed under four convenient, if overlapping headings, namely the record as a log book, as a clinical management tool, as a trend and pattern plotter and finally as a medical-legal document.

The anesthesia record as a log book

The log book functions can be divided into two categories, one dealing with the demographic and historical data of the patient, the other with intra-operative events. The preoperative data have now become so voluminous that an extra sheet of paper is necessary to record them.

Data entered on the anesthesia record proper recapitulate from the preoperative evaluation form essential information that the anesthesiologist may want to have at his fingertips in the operating room. In addition log book data include the preoperative diagnosis, the position of the patient on the table, the precautions taken against physical injury and the surgical procedure. It is also important to record items such as the lot number of a spinal drug used. Should a patient develop complications after a spinal anesthetic, one must be able to identify the drug and details of the spinal puncture. A difficult intubation and how the difficulties were overcome, the number of the anesthesia machine (in case of a failure), the location of the procedure (should there be a problem related to the room such as high rate of infection, difficulties with gas supply) and events that have been timed such as the start and finish of the operation, the time at which a tourniquet was applied all fit into the category of the anesthesia record as a log book.

The anesthesia record as a clinical management tool

Giving anesthesia consists of a series of well defined and important activities. These include the administration of many drugs. The identity and dosage of the drug and the time at which it was administered must be recorded. The record now must also show how the patient responded to the drugs. A drug-dose-response is essentially a clinical bioassay that describes the patient and guides the clinician. The timing of drugs that have a limited duration such as narcotics or muscle relaxants and that may have to be reinjected or require antagonists is important so that reinjection or the administration of antagonists can be anticipated. The administration of fluids and keeping a fluid balance is part of the clinical management. This information is of interest not only in the operating room but also to personnel in the recovery room and intensive care units. By the same token it is important to record the identity of blood units, should the patient develop an adverse reaction to the blood.

The record as a trend and pattern plotter

A large number of physiologic variables is monitored by conscientious clinicians during the progress of each anesthetic. When these variables are plotted over time, they show evolving trends and patterns. In many routine cases no significant trends or patterns emerge. But when a trend does develop it is of great clinical importance. For instance, plotting the oxygen saturation may reveal a slowly decreasing saturation while simply looking at variable data may fail to make a trend obvious. The trend plot shows not only the direction but also the rate of change. Thus a trend plot encourages the clinician to extrapolate and trends thus can become important clinical guidelines.

When a number of trends are plotted simultaneously, typical and diagnostically more useful patterns may emerge. For example a rising heart rate alone could have many explanations, but seen together with falling blood pressure, a pattern emerges that may suggest hypovolemia or cardiac failure. When simultaneously central venous pressure is shown to decrease with time and end-tidal

CO₂ also falls, the diagnostic pattern typical for hypovolemia and reduced cardiac output clearly emerges.

Another pattern that is clinically well recognized consists of blood pressure and heart rate decreasing simultaneously. This may be nothing more than vagal stimulation but if it occurs together with a falling oxygen saturation it may signal an impending cardiac arrest.

The anesthesia record as a medical-legal document

At least in the United States more and more anesthesiologists are brought to court by patients or their families. Almost invariably plaintiff's attorney has the anesthesia record much enlarged so that he can scrutinize it in court before the jury. In such light a poorly documented anesthetic will harm the case of the anesthetist, even though the anesthetic may have been well conducted.

Some anesthesiologists are concerned about automated records that would show all swings of vital signs and perhaps even errors that have been committed by the anesthesiologist. There is now a growing opinion that it is much preferable as early as possible to recognize the anesthetic in which a patient was harmed and in which anesthetic mismanagement may have played a role. Litigation usually takes years to run its course and it consumes large sums of money. To go through the process of litigation with depositions and a lengthy trial is a psychologically draining experience for the anesthesiologist. If a well kept record reveals an error in management we much prefer immediately to offer the patient a financial settlement. This assures the patient early financial compensation. If he elects to go through a lengthy and costly court procedure the outcome is uncertain and even if he wins in court, the financial reward may come years after the event for which he has sued.

The different uses of the anesthesia record

The different functions of the anesthesia record can now be viewed from the perspective of the user, namely the anesthetist, the postoperative clinician,

the administrator, the future anesthetist and the attorney.

We have discussed the record as a tool for the anesthetist in the operating room. But the record is also consulted by physicians in the recovery room, intensive care unit or on the patient's ward. There the clinicians are more likely to search for information about events that took place in the operating room but that influence subsequent clinical decisions, such as those linked to the administration of digitalis, antibiotics, fluids or to renal function. The traditional anesthesia record would look quite different if it were written only for the convenience of these colleagues.

The administrators of the hospital also scrutinize the record, but they look for information relating to billing, personnel policies and stocking of drugs. Again, a record prepared for their convenience would be radically different from the current appearance of the anesthesia record.

Much of the information crammed into a modern anesthesia record would be omitted as irrelevant to an anesthetist who prepares to anesthetize the patient during a later admission to hospital. The next anesthetist would be satisfied to learn which drugs the patient tolerated without adverse reaction and in what ranges the vital signs remained throughout the anesthetic and whether intubation was easy. Of course he would want to have details on all difficulties encountered. Thus in the majority of cases where all went well he would need to see no more than a sentence or two instead of a whole record.

Even the plaintiff's attorneys who are wont to examine a record in minute detail when they are attempting to show that the anesthetist should have done better (or the defense attorney showing that he could not have done better) would be helped by the different abstractions of the record, one showing the entire clinical course as it was viewed by the anesthetist, one showing the drugs and other features of interest to the subsequent care of the patient, one showing the times of start and finish and other events and the personnel involved, and finally one showing the overall assessment of the case as it was summarized for the review of a future anesthetist.

Must anesthesia records be accurate?

Now we can come back to the question whether or not the anesthesia record must really be kept accurately. No definitive answers are available for the different features of the record. Yet many clinicians believe that the record can help as a clinical management tool and as a trend and pattern plotter. If future studies substantiate these beliefs or if the belief of many clinicians becomes the conviction of those who formulate the standards for the safe practice of anesthesia, then the days of the handwritten record are numbered. That may be to the good. Every clinician has observed in the operating room many occasions when considerable physiologic changes occurred, significant trends developed, important patterns emerged, many drugs were given, but when the anesthetist was simply too busy to record any of this. Thus the patient was deprived of the clinical advantages an accurate and well kept record might have offered.

The alternative to the handwritten record is the automated anesthesia record (4), of which many versions have been proposed. All offer automatic plotting of physiologic variables and all propose different solutions to the problem of how to record a long list of events, including items such as intubation or the type and dose of a drug, changes in position, and number of blood transfusions.

The automated record will have the additional advantage that it will lay the ground work for the convenient preparation of computer generated abstractions of the record that could be tailored for use by the postoperative clinician, the administrator, the future anesthetist as well as the attorney.

References

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