Much of today's risk management literature reviews anesthesia mishaps that have been reported as malpractice claims against anesthesia care providers. Cooper and his associates looked at potential mishaps by studying the most frequently occurring incidents which take place during the administration of anesthesia. They also looked at factors which they believed were most frequently associated with causes of the incidents. Awareness of the most frequently occurring incidents and their associated causes should aid anesthesia providers in developing effective risk management programs.

The critical incident technique
In 1978, Cooper published a paper that looked at preventable anesthesia mishaps, using the critical incident technique. As defined by Flanagan, critical incidents are significant occurrences that have either negative or positive effects in whatever setting the investigator is studying.

Cooper chose to study critical incidents in preventable anesthesia mishaps through interviews of staff and resident anesthesiologists. An incident was labeled critical when “it was clearly an occurrence that could have led or did lead to an undesirable outcome.”

A total of 359 incidents were identified from inter-
views of 47 individuals. Human error was involved in 82% of the incidents reported and equipment failure was involved in 14% of the incidents. As a group, staff anesthesiologists reported an average of seven incidents per interview, while residents reported an average of eight.

Cooper and his associates reviewed the critical incidents and classified them into ten categories of the most frequently occurring incidents. These ten categories were: (1) breathing circuit disconnections, (2) inadvertent gas flow change, (3) syringe swap, (4) gas supply problem, (5) intravenous apparatus disconnection, (6) laryngoscope malfunction, (7) premature extubation, (8) breathing circuit connection error, (9) hypovolemia, and (10) tracheal airway device position change.

The time of day when incidents occurred fell into a pattern that approximated the occurrence of cases at that hospital. Of the incidents upon which a time could be placed, 79% occurred during the day and 21% during the night. Of the total number of surgical cases, 85% were done during the day and 15% during the night.

In 1981, Cooper reported on a similar study he conducted in which anesthesiologists, anesthesia residents and nurse anesthetists were interviewed. This study yielded 790 critical incidents relating to anesthesia mishaps. In the second study, approximately 77% of the incidents were attributable to human error and only 11% were due to equipment failures.

Most frequent incidents

Following are the ten most frequently occurring anesthesia incidents in order of occurrence from the most frequent to the least frequent:

1. Breathing circuit disconnection occurred in 27% of the incidents and was the most commonly reported incident. The disconnects usually occurred at the endotracheal tube and were associated with visual restriction of the connection by drapes. Some ventilators will alarm and others will not when a loss of pressure is perceived. Disconnect alarms built into anesthesia ventilators should minimize this potentially lethal hazard. Every attempt should be made to keep the breathing circuit in clear view.

2. Reduced oxygen flow was the direct result of a design peculiarity of the anesthesia machines used in the sample hospital. Regardless, this is another potentially lethal problem that is recognized by all anesthesia care providers. The newer models of anesthesia machines, through the inclusion of oxygen pressure interlock systems, will not allow unsafe concentrations of oxygen to be delivered by concurrently reducing/stopping the flow of nitrous oxide. Oxygen analyzer and mass spectrometer monitoring throughout the administration of the anesthetic will also help reduce the potential of disaster from improper oxygen concentrations. Regular notations of inspired oxygen concentrations should be made on the anesthesia record.

3. Syringe swap was reported 19 times and referred to incidents wherein the wrong medications were given 16 times and almost given three times. The use of brightly colored medication labels for syringes should almost completely eliminate this problem. Practitioners must make a conscious decision not to administer any medication that is unlabeled or improperly labeled, even in emergency situations. Furthermore, the color of the label alone is not a substitute for careful reading of the labels on vials and ampules.

4. Gas supply problems included situations where oxygen and nitrous oxide supply were lost due to disconnection from the central gas supply or where cylinders had become exhausted. Continuous monitoring with oxygen analyzers, mass spectrometers or both will quickly alert the provider of drops in oxygen concentrations. Drops in the concentrations of nitrous oxide will become apparent quickly through the regular use of the mass spectrometer. It appears more and more that pulse oximeters, transcutaneous oxygen analyzers and capnometers will be utilized in daily anesthesia practice to monitor cellular oxygen and carbon dioxide levels.

5. Intravenous disconnect was reported 11 times. Minimizing the occurrence of this incident will require keeping the intravenous lines as visible as possible and making frequent checks to ascertain good connections. Where it is not possible to view the lines, intravenous sites must be protected from inadvertent disconnection through the movements of the surgeons. A lack of response to drugs administered by the intravenous route should serve as a clue to disconnection as well.

6. Laryngoscope malfunctions were also reported 11 times. These can be absolutely minimized by performing a pre-anesthesia check and keeping a backup blade and handle immediately available.

7. Premature extubation was reported 10 times and was due to errors on the part of the anesthesia provider wherein the patient was extubated sooner than was clinically indicated. In most cases this problem can be related to the inexperience of the provider.

8. Breathing circuit connection errors were related to transposition of the reservoir bag with the gas scavenging hose. This problem can be eliminated by using 17 ml connections on the scavenging system and 19 ml connections on the breathing system. "Jury rigged" connections or apparatus should never be accepted.

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9. Hypovolemia is a situation that can occur quickly in the presence of sudden blood loss but can be minimized by preparation commensurate with the anticipated surgery. Routine use of one or two large bore intravenous catheters is the best preparation. Central venous lines or even Swan Ganz lines may need to be placed. A pre-anesthesia check to see if blood is quickly available is essential. A blood filter, tubing and warming coils should be readily available even when significant blood loss is not anticipated.

10. Tracheal airway device position changes were reported seven times. Since the anesthetist’s prime responsibility is airway management, it follows that the endotracheal tube is the key to a safe anesthetic. Secure placement of endotracheal tubes is necessary, with careful skin preparations, adhesive sprays, taping, tying or even suturing, depending on the particular situation. The best security in the end remains the vigilant anesthetist.

The most frequently associated contributory factors

In Cooper’s study, it was apparent that inexperience was the most frequently occurring factor (77 incidents) involved in critical incidents. Cooper felt most of these errors could be averted through a more structured approach to preparing anesthesia practitioners from the study group.

Unfamiliar equipment was the next most frequently occurring factor (45 incidents). There can be no doubt that every active practicing anesthetist has had problems in the past with unfamiliar equipment. Haste, poor communication and inattention/carelessness all were mentioned as factors that led to incidents involving anesthesia providers. Each was cited approximately 26 times or so and represents a significant percentage of the potential cause of critical incidents in the practice of anesthesia.

Fatigue was mentioned as a factor in 24 incidents. Relief of anesthesia personnel for breaks and for meals is a practice that is common in some anesthesia practice settings and opposed in others. Cooper found that in nine of the incidents, the anesthetist who did the relieving discovered the “presence or cause” of an incident in progress. In only one case was the exchange of personnel found to be a negative factor. Inattention/carelessness can certainly be caused by fatigue and may certainly make a case for regular relief of anesthesia personnel. Fatigue needs to be studied more closely in the anesthesia setting, where vigilance must remain high for extended periods of time.

Associated with the concept of fatigue is the finding that 42% of the incidents occurred in the middle of the procedure, whereas 25% of the incidents occurred during induction and only 9% occurred at the end of the procedure. These findings should make practitioners rethink the commonly held idea that most problems occur during induction and emergence. Fatigue and inattention could certainly account for this surprisingly high percentage of incidents occurring when the case is “safely” underway.

Excessive dependency on other personnel was reported 22 times and probably demonstrates a failure of practitioners to prepare themselves for potential events that can occur during the administration of any anesthetic.

Failure to perform a normal check was also reported 22 times. It is quite simple to develop an anesthesia equipment checklist and to complete this checklist prior to beginning the administration of anesthesia. Checklists have been used in the airline industry for many years and are accepted as one reason airlines have such an outstanding safety record. This idea is no less valid in anesthesia. Safety checks are a vital part of safe anesthesia practice.

Recommendations

Every anesthesia department should develop a daily safety checklist for each anesthesia machine in the hospital, whatever its location. These lists should include checks of gas sources and reserve tanks, oxygen monitors, suction and ventilator equipment, and leaks in the anesthesia circuit. Each list should be developed with the needs and the specific equipment of the department clearly in mind.

Mandatory monitoring standards should be established through departmental policy. At a minimum, one should monitor cardiac electro-activity, heart and breath sounds and blood pressure. Oxygen analyzers or mass spectrometers or both should be employed on each case requiring general anesthesia and disconnect alarms should be employed when ventilators are in use.

Documentation of inspired oxygen concentrations should be required on every anesthesia record to ensure that this parameter is being closely monitored. Pulse oximeters, transcutaneous oxygen monitors and capnometers will give further data on the levels of these gases in capillary blood.

Every time a new piece of equipment is about to be introduced into the anesthesia department, an inservice program should be given so that every member of the anesthesia care team can attend. This will prevent unfamiliarity from becoming a cause of preventable anesthesia mishaps. If the department is changing anesthesia supplies, mandatory inservices should also be carried out. This holds true when new drugs and anesthetic agents are introduced as well. These inser-
vice programs can be videotaped and made available to members of the staff who are unable to attend.

Departments should consider rest and meal break policies based on needs within their particular setting but also upon careful examination of the departmental morbidity and mortality conference reports. Does it appear that fatigue could be a factor in the mishaps and, if so, could more breaks make a positive difference?

Overview

It is extremely important to point out that all the checklists and monitors in the world will do little good if they are not employed in daily practice. Furthermore, checklists and monitors cannot take the place of continuous vigilance. The anesthetist who does not continually make a circular check of the patient, the infusing solutions, the monitors, the anesthesia machine, the chart, and the surgery itself, is an unsafe practitioner. Each and every one of us is responsible for his or her own actions and, as such, can prevent “preventable” anesthesia mishaps.

Do not assume that once the induction is over and the case has started, that all is safe until emergence begins. Four out of 10 of the reported critical incidents in Cooper’s study occurred in the middle of the surgical procedure.

It is important to ensure that equipment is maintained regularly, that a schedule is established for this maintenance and that the schedule is followed! Preventive maintenance is another proven tool employed by the airlines to decrease the incidence of equipment failures and reduce the number of mishaps, and it is another practice which the anesthesia profession could emulate.

A program of prompt reporting of incidents should be established within the anesthesia department. The sole purpose of reporting critical incidents would be to heighten awareness of preventable anesthetic mishaps that occur in the practice setting. Reporting should be accomplished in a non-threatening way to encourage cooperation.

In spite of the best intentions, anesthetic mishaps can and will occur. Having a well developed plan for management of mishaps may reduce the impact on all parties involved. The latter portion of this article will discuss the essential elements of a plan as well as describe the application of those elements.

Each anesthesia department should have a policy and procedure outlining the steps to be taken in the event of an anesthetic mishap. All of the elements discussed up to this point in this article should be included. The specific application will depend on the resources available, as well as the type of practice setting. Included in this document should be a list of criteria for review. These criteria will be discussed later in this article.

Case report

A 51-year-old female was admitted as an AM-Admit patient for a total abdominal hysterectomy. The underlying medical diagnosis was post-menopausal hemorrhagia. She was seen two days preoperatively by anesthesia personnel during her pre-admission visit. Her history and physical were reviewed. Lab results were within normal limits except for a hematocrit of 31 and a hemoglobin of 10.3 (Normal: HCT 37 to 49; Hgb 12.5 to 16.5). The patient was physically active and had no other physical limitations. The anesthetist discussed anesthetic options, and the patient chose to “go to sleep” and requested a general anesthetic. The anesthetist explored the patient’s fears and concerns about anesthesia and assisted the patient in reducing her fears about “being awake” during the procedure or not “waking up” at all. The risks and potential outcomes were also discussed and explained to the patient. An anesthetic permit was signed and witnessed. The anesthesia instructions were then completed by the anesthetist.

The patient arrived for surgery on time and the anesthetist reviewed the anesthesia preoperative note that she had written two days previously. The patient was interviewed again for N.P.O. status and any other possible changes.

The anesthesia was administered, and the surgery was begun on time. Approximately one and one half hours into the case there was a dramatic increase in blood pressure and a concomitant decrease in pulse.

The surgeon stated that there were no obvious indications for the change in vital signs. The vaporizer settings were checked and inhalation anesthetic could be smelled in the anesthetic circuit. The blood pressure was unresponsive to increased inhalation anesthetic levels. The pupils were unequal, and the right pupil reacted to light. The patient was placed on 100% O₂, an arterial line was started, and sodium nitroprusside (Nipride®) was used to control hypertension. The arterial blood gases were essentially normal except for controlled hypocapnia to assist in decreasing the suspected increased intracranial pressure. The surgery was quickly finished and the patient was transported to the intensive care unit with continuous electrocardiographic and arterial blood pressure monitoring.

The surgeon and the anesthetist discussed the patient’s condition and agreed that a neurology consult was in order. The patient’s husband was then told of the developments. Both the anesthetist and the surgeon were with the husband for support. Although they were un-
sure of the cause or the outcome, the picture that was portrayed was bleak at best; the fact that the patient was alive was viewed as a blessing in and of itself. No false hope was given. However, assurances were given that everything possible would be done for the patient and that the husband would be provided with information as it became available. The anesthetist alerted the religious affairs office of the occurrence and a chaplain was dispatched to the family.

In the meantime, the chief nurse anesthetist had the anesthesia machine, cardiac monitor and noninvasive blood pressure monitor removed from the room and serviced. The bio-medical engineering department and the contracted service representative were called in to perform a service check on all three components. According to hospital policy, these pieces of equipment could not be used on another patient until the results of the service check were reviewed and released by the medical chairperson of the anesthesia department.

The chief nurse anesthetist then contacted the risk management/legal affairs office of the hospital. The anesthetist involved in the case contacted her liability insurance representative. The risk management office staff contacted the insurance carrier for the hospital. A sequential documentation form was initiated by the chief nurse anesthetist to document all actions taken.

The anesthetist reviewed her anesthetic record thoroughly to assure accurate documentation and compliance with departmental charting policy. The serial number of the equipment used was placed on the record. A note was placed in the patient's progress notes as to her condition upon arrival at the ICU. The anesthetist also completed a factual narrative of the incident including a description of her preparation and planning for the case, the names of all persons in the operating room at the time of the incident, her observations, what interventions were made and the patient's response to those interventions. She included communications made to or by other staff members.

The hospital also required narratives from other members in the operating room as well. The anesthetist cooperated in pinpointing exact times because she knew this information could be valuable at a later date. This narrative then became part of the risk management investigation by the hospital as well as the insurance carrier. The anesthetist kept the original in her files, marked all copies as confidential and gave one copy to the risk management office and one copy to the medical director for anesthesia services.

The anesthetist also completed a morbidity and mortality review form to be discussed at the next anesthesia morbidity and mortality meeting.

Peer review

The medical director reviewed all information concerning the case including a review of the anesthetic record. He appointed a peer review committee based on the hospital rules and regulations as well as departmental policy.

The peer review committee met and discussed the case. The anesthetist was given the opportunity to describe the event and provide justification for her actions. The committee reviewed the report from the neurologist indicating conclusively that the patient had suffered a massive cerebral vascular accident. The patient died secondary to the CVA two days after surgery. The following objectives were established by the committee in reviewing the case.

1. Was the patient adequately prepared for the scheduled procedure based on her preoperative medical history?
2. Were departmental policies, procedures and guidelines followed in preparing, planning and implementing the anesthetic care?
3. Was the choice of anesthesia appropriate for the patient's conditions and planned surgical intervention?
4. Was the process of anesthesia (actual delivery of care) appropriate?
5. Was the condition/event detected in a timely manner?
6. Were the interventions made in response to the event appropriate and timely?
7. Did the anesthetist communicate the change in the patient's condition in a timely manner and in a manner consistent with departmental policy and procedure?
8. Did the patient receive adequate information to provide an informed consent based on the type of anesthesia chosen and the patient's medical status?
9. Was the documentation thorough, accurate and in accordance with departmental policy?

Based on the answers to these objectives, the peer review group submitted its findings to the anesthesia department chairperson as follows:

1. All care provided by the anesthetist in question was found to be appropriate and in accordance with department standards and policies.
2. The anesthetic and subsequent interventions by the anesthetist were found to be non-contributory to the event suffered by the patient.
3. The anesthesia equipment was found to be in good working order, and was not believed to be contributory to the occurrence or the outcome of the mishap.
4. It was recommended that the anesthetist in question be commended for her thorough preparation, degree
of patient and family rapport and management of the mishap.

The anesthesia department chairperson reviewed the peer review committee’s findings with the anesthetist. The findings were discussed at the anesthesia morbidity and mortality meeting, and a copy of the findings was placed in the anesthetist’s file for review when privileges are renewed biannually. The results were also shared with the risk management administrator who was responsible for assuring that peer review was conducted in a timely and appropriate manner. The chief nurse anesthetist then completed the sequential documentation form and filed it with the findings of the peer review. The time from the occurrence of the mishap to reporting by the peer review group was 10 days, within the recommended time interval for the particular institution involved, which was 14 days. Had there been some indication of inappropriate care, the anesthetist’s privileges could have been suspended pending further investigation according to medical staff rules and regulations.

Synopsis

The following is a synopsis of the steps that should be followed when a mishap occurs:

1. Establish patient/family rapport. At no time is rapport more important than in the event of a mishap. Following a mishap, respond immediately to the patient, family, and significant others. Give a factual sincere accounting of the occurrence; do not offer false hope. Commit to doing all that you can for the patient and for the family. Contact a patient ombudsman or chaplain to provide the family with additional support.

2. Obtain informed consent. Following hospital guidelines as well as the guidelines from the hospital’s insurance carrier and legal counsel.

3. Keep thorough and accurate records. Document all actions, observations and interventions following departmental policy. Review the chart for accuracy and thoroughness. Prepare a factual narrative of events, as soon after the mishap as possible. Document all administrative actions regarding each event.

4. Suspect all equipment. This should be done intraoperatively as well as postoperatively. Establish a protocol in the department for the checking of all equipment used during a procedure in which a mishap or critical incident occurred. Document services rendered to the equipment, both preventive and corrective. Notify the Food and Drug Administration immediately if a defect in workmanship or design is found. The problem should also be reported to the manufacturer. No equipment should be released for use until all inspections are completed and cleared through the medical director and risk management office.

5. Contact the hospital risk management and insurance carrier. Involvement of these specialists, without concealment of events, can help reduce or prevent potential losses.

6. Discuss all critical incidents and mishaps at the monthly morbidity and mortality meetings. Document discussion and suggestions.

7. Report any identified problems through the departmental quality assurance program. (This is in addition to ongoing monitoring.)

8. Utilize the hospital’s established peer review process. Perform peer review based on objectives. The anesthesia department chairperson should oversee all activities and act upon the recommendations of the peer review committee. The chairperson may have to suspend privileges pending investigation if there is a serious question of practitioner competence. State regulations must always be taken into consideration (such as in the case of an impaired practitioner). Results of the peer review process should be considered when it is time to renew privileges.

9. Offer support to the practitioner. Colleagues should offer and provide a support mechanism to the practitioner. This informal support mechanism will assist the practitioner involved in a mishap in working through normal guilt feelings and dealing with the stress associated with the peer review process.

This article has attempted to explore the primary identifiable reasons for the occurrence of anesthetic mishaps. It is through understanding of causes that the incidence of mishaps can be significantly reduced. Application of the steps outlined in this article will help reduce losses and provide effective mishap management.

Test Yourself

1. Describe the process for handling suspect equipment in the case of an anesthetic mishap.

2. How can one maintain objectivity in peer review?

3. Who should be notified when a mishap occurs?

4. Describe critical incidents and the critical incident technique, as employed by Cooper.

5. Discuss recommendations for reducing anesthetia mishaps.

(Answers appear on page 328.)
SUGGESTED READING

AUTHORS

Colonel George P. Haag, CRNA, PhD, USA, AN, is a graduate of St. Francis Hospital School of Anesthesia. He earned a BSEd from West Chester State College, and an MEd from Boston University. He received a PhD in Adult Education from the University of Wyoming. He is director of the nurse anesthesia program at Brooke Army Medical Center in San Antonio. He is a member of the Council on Nurse Anesthesia Practice, and has served as an on-site visitor for the Council on Accreditation of Nurse Anesthesia Educational Programs/Schools. Colonel Haag has had clinical articles published in the AANA Journal, Critical Care Quarterly, and the Anesthetist Update Series. He has spoken at national educational functions on the topics of student evaluation and instructor effectiveness. He is a current delegate to the AANA Education Committee.

Jeffery M. Beutler, CRNA, MS, holds a BS and MS in Anesthesia from Wayne State University College of Pharmacy and Allied Health Professions in Detroit. He is currently involved in the development of a Product Problem Reporting System as a member of the Technical Advisory Panel to the U.S. Food and Drug Administration. Mr. Beutler is a member of the Editorial Board of CRNA Forum, and serves on the Liaison Committee. He also is a member of the Technical Advisory Committee of the Center for Health Economics Research (CHER), which is performing a study on reimbursement alternatives for CRNAs for the Health Care Financing Administration (HCFA). He has lectured to state and national associations and university groups with a particular focus on the topics of anesthesia mishaps and quality assurance. Currently, Mr. Beutler is Director of Anesthesia, OR and PAR Services at Rose Medical Center in Denver.

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