

Chapter 7

Incidents Captured by Video versus Self-reporting

Reports of human error in medicine are, in general, based on retrospective recall of events (e.g., Cooper *et al.*, 1978; Cooper *et al.*, 1984) and focused on injuries suffered by patients. The Harvard Medical Practice Study reported the results of a population-based study of iatrogenic injury in patients hospitalized in New York State in 1984. Nearly 4% of patients suffered an injury that prolonged their stay or resulted in measurable disability (Brennan *et al.*, 1991). These and similar studies have used patient chart reviews to determine adverse events from what is recorded, but these reports may suffer from factual uncertainty, data that cannot necessarily be checked and rationalizations made by the reporters once they were aware of the outcome. Caplan, Posner, and Cheney (1990) showed that knowledge of patient outcome changed peer reviewer's perception of appropriateness of care.

Using the data acquired during airway management for patients with trauma, we could contrast incidents reported by clinicians and captured by videotaping. Cheney, et al (1991) found that inadequate ventilation, esophageal intubation and difficult tracheal intubation were frequent causes of critical events during airway management and the most common mechanisms of respiratory-related adverse outcomes. Among 2046 cases with adverse outcomes from anesthesia examined in the American Society of Anesthesiologists Closed Claims Project (Cheney *et al.*, 1991), 762 (37%) were associated with respiratory events and of these 678 (89%) were problems associated with airway management. In 300 cases with airway trauma, obstruction, aspiration, bronchospasm or pneumothorax (all events seen with increased frequency in trauma patients) the incidence of severe injury (brain damage and death) was 47% [141/300] (Cheney *et al.*, 1991).

The Anesthesia Record is a hand-written form completed by the anesthesia care provider at regular intervals (usually every 5 minutes) concurrently with provision of patient care. This record provides details of the anesthesiology care providers airway management for medical and legal purposes. Recording of vital signs or written comments on this record may be briefly deferred if a higher priority task occurs. The Anesthesia Record prompts the anesthesia care provider to record vital signs every five minutes. It provides spaces to record comments unique to a particular patient's management. Prior Anesthesia Records can be used to plan an individual patient's subsequent anesthetic management.

The Anesthesia Quality Assurance (AQA) process is designed to capture all untoward occurrences some of which result in harm or a poor outcome. The AQA reports are made if the anesthesia care provider enters "yes" in response to the question, "Were there any untoward occurrences?" appearing on the computer record entered for each new patient at the end of anesthesia care. After peer review of the reports, changes are recommended if indicated, to prevent recurrences.

We compared the analyses of performance deficiencies identified on the videotaped record of events with three sources of retrospective self-reports, the written Anesthesia Record, a Post Trauma Questionnaire (PTQ) completed after videotaping, and the AQA reports. The written Anesthesia Record and identification of AQA occurrences are routinely completed on every patient managed by the anesthesia care providers, not just those patients' whose care was videotaped. The PTQ was designed to gather data in association with videotaping. The current study was designed to identify how performance deficiencies in airway management for trauma patients were reported and captured, and to identify the primary cause of such performance deficiencies so that methods could be developed to optimize patient care and prevent errors in management.

7.0.6 Methods

Post Trauma Questionnaire (PTQ)

We requested that each anesthesia care provider who was videotaped complete a 30-item questionnaire (PTQ; described earlier) as soon as possible after the end of the case. The PTQ was a no-fault means of reporting in which the recording of personal opinions was requested. The PTQ had no official status as a medical document; it was designed specifically for gathering data during the time that videotaping occurred and was used for several different aspects of a research project examining performance and decision-making under stress.

Anesthesia Quality Assurance (AQA)

AQA reports were official medical center documents that documented AQA activities for the Joint Committee on Accreditation of Health care Organizations. AQA files of the same 48 cases that were recorded on videotape were analyzed for incidents under the general headings of cardiac, respiratory, equipment and drug-related events.

Anesthesia Record

Each anesthesia record was photocopied (patient identifiers were removed). These were reviewed to determine whether events shown on the videotape were recorded on the anesthesia record.

Video Analyses

Video tapes of the events occurring 10 min before, during, and for 10 min after tracheal intubation were analyzed. In all about 20-25 minutes of videotape for each of 48 cases in which intubation occurred were included. The videotapes were analyzed by one or more subject matter experts (SME's), often with the assistance of a trained graduate research assistant who used the Observational Coding System of Tools (OCS Tools, Triangle Research Collaborative Inc, NC), a commercial video-analysis software package. The SME's were all trauma anesthesiologists who participated in videotaping their own patient management. For this study they only analyzed video tapes in which they did not carry out the patient care. When it was unclear from the videotape and other records what had occurred, the topic was discussed with the anesthesia care providers who were videotaped.

When a task was omitted or a performance deficiency was noted during review of a videotape, the cause was determined by reference to patient vital signs data, together with the written Anesthesia Record made at the time, consultation with SME colleagues, and in most cases an audio-taped interview with the anesthesia care provider who treated the patient. The audio taped interview sought background information about the case management, what happened, the experience of the participant anesthesia care provider with similar occurrences, and factors that may have contributed to the occurrence of the performance deficiency. The SME's also requested the anesthesia care providers to identify possible means to prevent a recurrence.

On the basis of these analyses, the task omission or performance deficiencies noted on videotape review were categorized into failures in training, human factors (equipment design, equipment configuration, work place layout, organizational factors), omission of standard operating procedures, and lack of teamwork.

7.0.7 Results

Rate and Reporting of Problems

Eleven videotapes (23%) showed cases in which 28 independent performance deficiencies occurred during airway management. These were often subtle oversights or shortcuts that did not usually in and of themselves jeopardize the patient. Rather, they were performance deficiencies that lessened the margin of patient safety, including the following failures: to examine the patient; of timely patient vital signs monitoring; to check the mechanical ventilator before patient connection; to adhere to standard operating procedures for airway management during induction of anesthesia and tracheal intubation; or to complete preparatory tasks (preoxygenation, neck stabilization, inadequate intravenous access for the planned surgical procedure). Of these failures, none resulted in an adverse outcome directly attributable to the problems identified on videotape. In two of these eleven cases the patients did die, but death was due to uncontrolled hemorrhage from multiple gunshot wounds to the abdomen, and to the head and neck. How Were These Videotaped Events Captured by Other Reports?

Anesthesia Quality Assurance

There were no entries in the AQA records about cardiac, respiratory, equipment or drug related untoward occurrences among the cases that were videotaped. Except for the two patient deaths that occurred unrelated to the intubation sequence and outside the time frame of video recording, none of the performance deficiencies were identified through AQA review.

Anesthesia Record

Esophageal intubation occurred in one patient and remained undetected for over 6 minutes (Mackenzie *et al.*, 1996b). This was reported on the anesthesia record as 'direct laryngoscopy #1 esophageal intubation'. There was no report of the low level of patient oxygenation or the other two attempts of tracheal intubation. In another patient, bleeding into the airway was noted on the anesthesia record, but the omission of neck stabilization during intubation was not recorded despite this omission causing possible injury to the patient's neck.

Post Trauma Questionnaire

Inadequate preparation of the mechanical ventilator in one case in which the ventilator was incorrectly set, was noted on the PTQ. In another case, when intubation was attempted, it precipitated patient vomiting, and in the same case, a drug was given into poorly perfused muscle. The PTQ included the comments "would not attempt intubation and poor drug absorption with poor circulation". The PTQ completed on the patient with the esophageal intubation (decided above) included the comment "in retrospect would rely on clinical signs of oxygenation rather than monitoring". In another patient in which the ventilator was not prepared, the PTQ noted "everyone thought the other had set the ventilator up". In a patient with an inadequate number of intravenous (IV) access sites for the planned surgical procedure, the PTQ recorded "ensure all IVs in place before start of operation.

The PTQ provided an opportunity for the participants who were videotaped to explain apparent deficiencies in their management. Some of the information provided may have been affected by the knowledge that the videotape record existed, but there were no comments at all about self-consciousness leading to inhibition and performance deficiencies. Indeed, there were videotaped episodes of joking, contentious interactions and non-optimal performance that would be unlikely to occur if the anesthesia care providers were constantly aware of being videotaped. We did, however, note comments on the PTQ about stress factors (e.g., the clinical situation, the constraints of time and work-load, and pressure from other clinicians) which were subjectively felt to have contributed to some occurrences of non-optimal performance.

7.0.8 Discussion

The videotapes each recorded a 20-25 min segment of airway management, but the Anesthesia Record and the AQA reports covered all the essential information of a case that sometimes lasted 15 hours or more. The PTQ, however, only addressed self-reporting of events associated with videotaping and although it was more specific in identifying events and possible solutions for performance deficiencies seen on videotape than the Anesthesia Record, it only identified 5 of the 28 deficiencies. The anesthesia care providers completing the PTQ concentrated on specific issues that they often considered a failure of their own performance (e.g., everyone thought the other had set the ventilator up) rather than identifying the underlying problem associated with having the ventilator alarm continuously when put in the ready-mode before patient arrival.

Videotaping in our trauma center revealed the inadequacy of information collection about factors contributing to problems in emergency medical care. Leape (1994) notes that self-reporting systems have low yields compared to active investigations. He advocates data collection methods that will accurately discover and describe the errors that occur, so that something can be done about errors and injuries. Videotaping of events in the naturalistic environment is such a method. Videotapes taken in this way revealed problems during tracheal intubation that were not detected by the AQA reports, the PTQ form, or the hand-written Anesthesia Records, confirming Leape's belief. We do not think that the gaps in information or problems in our trauma center are unique in occurrence; it is generally considered to be among the country's finest trauma centers. Other trauma centers have used videotaping as a training tool to reduce patient resuscitation times, evaluate performance, and increase adherence to assigned responsibilities and found a similar incidence of performance deficiencies in adherence to Advanced Trauma Life Support protocols (Hoyt *et al.*, 1988).

It was the SME's impression that identification of the causes of these performance deficiencies was greatly assisted by repeated review of the video and accompanying audio recording. Circumstances surrounding the performance deficiency would not necessarily have been revealed without the video and audio recording to focus the discussion about what occurred and how a recurrence could be avoided. The videotapes also provided information on the context of the system problem, thus allowing identification of the predisposing factors that may have been operative at the time. When it was unclear what had occurred, repeated review of specific parts of the videotape with the anesthesia care providers enabled the SME's to test different hypotheses about why the performance deficiency occurred and discuss explanations that could then be confirmed or refuted by viewing the videotape.

All of the participant anesthesia care providers were shown the videotapes of their cases. This ability to review the videotapes in private was considered to be a great asset, as it allowed them to identify their performance deficiencies and make constructive self-criticism of their own performance. Other trauma centers have found videotape review to be useful training tool for individual self assessment (Green *et al.*, 1983; Hoyt *et al.*, 1988). The omission of standard operating procedures identified on video analysis has been addressed by such videotape review and by presentations at the Anesthesia Staff meetings.

Although clinical examination is a simple maneuver, this study found it was often omitted

by the anesthesia care providers or was delegated to a non-anesthesia team member. In one instance, this delegation of clinical examination to a medical student lacking experience in airway management was associated with a prolonged undetected esophageal intubation. The medical student incorrectly determined that there was air entry in the lungs and the anesthesia care providers failed to examine the patient with a stethoscope, the oxygenation monitor failed to produce a signal and ventilation (ETCO₂) monitoring was not used, so the esophageal intubation remained unrecognized. The importance of standard operating procedures such as clinical examination, checking the ventilator set-up before use and ETCO₂ after intubation, are all well known to the anesthesia care providers. Omission may have occurred due to time pressure or other factors resulting in lack of team coordination.

Self-Reports

There are several possible reasons why there were so few self-reports of these videotaped performance deficiencies. One is that the anesthesia care providers have worked in the high-paced environment for so long that they have become tolerant of the problems identified by video analysis of tracheal intubation. Another possible reason is that no adverse outcomes occurred and the AQA review and Anesthesia Record did not identify these omissions or deficiencies. However, the AQA reports are not designed to capture performance deficiencies unrelated to an adverse outcome. Still other possible reasons are that the anesthesia care providers may fail to recall these transient and non-injurious lapses in standard operating procedures in emergency management of a difficult patient. It is also unlikely that the knowledge-based training problems would be self-reported, as these anesthesia care providers were unaware that a deficiency existed until review of the videotape with one of the SME's.

It has been previously observed that AQA tends to be outcome-oriented (Edsall *et al.*, 1992), and the terms of the AQA report used in this trauma center conform to that approach. It has also been noted that the AQA system depends on reports that may have limitations in gathering data (Small *et al.*, 1994). Among those limitations are embarrassment, fear, and lack of awareness that an error has taken place. The AQA system is not specifically designed to seek out what the videotape recorded and it is to be expected that we would find limitations compared to video analysis.

There may be a higher reporting rate of occurrences associated with intubation and possibly other organizational, ergonomic and medical human factors issues if anonymous reporting were encouraged. The Aviation Safety Reporting System (ASRS) operated by the Federal Aviation Administration is such an anonymous system of reporting performance deficiencies. Using ASRS, an incident can be recorded and analyzed without the pilot being blamed. However, if an accident or a serious infraction of regulations occurs, the pilot is reprimanded. The ASRS reports are fed back to the airline community as "Alert Bulletins".

The Anesthesia Patient Safety Foundation, an organization dedicated to improving safety during anesthesia, has drafted a position paper modeled on ASRS (D.M. Gaba: Personal Communication, 1994). If this was introduced nationally, through educational anesthesia societies, it would enable anesthesia care providers to report performance deficiencies without fear of legal reprisal. The Australian Anesthesia Incident Monitoring System

(AIMS) is such an anonymous reporting system implemented for the capture and analysis of anesthesia incidents (Webb *et al.*, 1993). An extensive analysis of 2000 incident reports was published in 1993 as a symposium (Runciman *et al.*, 1993). Nearly 4000 reports have now been received from 17 different countries using a standardized reporting form (R. Webb: Personal Communication, 1995). A recent addition is the Anesthesia Critical Incident Reporting System (CIRS) available as an Internet-based reporting system at the University of Basle, Switzerland, (D. Scheidegger. <http://www.medana.unibas.ch/index.htm> - select CIRS). Anonymous reporting is important because in medical performance deficiencies it is the individual that is investigated, and such a system tends to discourage self-reporting.

It is easy to criticize the performance of people dealing with difficult and uncertain situations where even good decisions carry a potential risk (Reason, 1990). The videotapes analyzed in this study show, in the majority of instances, exemplary airway management and skilled creative responses to unusual events that occur with relatively great frequency in emergency trauma patient management. Nonetheless, the fact that these performance deficiencies occurred at all suggests the value of considering ways to avoid exposing patients to such unnecessary risks. One way is for industry to design equipment from the user's perspective, i.e., with consideration of the stresses and environmental factors impacting on the user.

The findings from this study have been presented to the anesthesia care providers at Anesthesia Staff meetings, and recommendations made that standard operating procedural checks should be more rigorously carried out. Clinical examination should occur after tracheal intubation and be repeated after institution of mechanical ventilation. These checks ensure a redundancy of confirmatory signs that the patient is adequately oxygenated and ventilated.

Teamwork Training may be improved by Cockpit Resource Management (Helmreich, 1984) or Anesthesia Crisis Resource Management training (Gaba *et al.*, 1994). In addition, standardized communication procedures in the sequence of tracheal intubation and minimizing the distraction and noise caused by non-task related conversations may be helpful (Mackenzie *et al.*, 1996b). The Federal Aviation Administration stipulates that non-essential conversations be avoided for flight crew members during take-offs and landings (Federal Aviation Regulations, Part 135:100–Flight Crew member Duties, 1995). A similar requirement may prevent distractions during checking of correct placement of the tube in the trachea and confirmation of function of the mechanical ventilator and the reduced noise level may make monitor alarms more easily heard.