Society for Neurosurgical Anesthesia and Neurologic Supportive Care Annual Meeting
October 12, 1984
New Orleans, Louisiana

The 12th Annual Meeting of the Society for Neurosurgical Anesthesia and Neurologic Supportive Care was held at the New Orleans Hilton on October 12, 1984. Some of the areas of current investigation included: 1) effects of anesthetics on cerebral blood flow (CBF) and metabolism; 2) the role of adenosine in control of CBF; 3) new technology in neuroanesthesia; and 4) new agents for controlled hypotension.

Mark Scheller (San Diego) presented "Effect of Halothane and Isoflurane on Cerebral Blood Flow at Various Levels of Arterial PCO2 in Rabbits." He described changes in intracranial pressure (ICP) and cerebral blood flow (CBF) measured by hydrogen clearance techniques in response to halothane or isoflurane anesthesia at three different levels of arterial PCO2: 20–25 mmHg; 35–40 mmHg; 50–55 mmHg. During the study, arterial blood pressure was maintained at awake values with infusion of angiotensin II. ICP increased at all levels of arterial PCO2 with both halothane and isoflurane. As expected, the greater the arterial PCO2, the greater the increase in ICP with either agent. Only halothane, however, increased CBF at all levels of arterial PCO2, whereas isoflurane decreased CBF at the low (20–25 mmHg) arterial PCO2 level and did not change CBF at the arterial PCO2 level of 35–40 mmHg. Since ICP increased with both drugs, they should be used with caution during anesthesia for neurologic surgery. This suggestion was confirmed in a clinical report by Grosslight, Colohan, and Bedford (Charlottesville) who demonstrated that 1% inspired isoflurane may result in a marked increase in ICP and a decrease in cerebral perfusion pressure in the presence of intracranial mass lesions, despite hyperventilation to arterial carbon dioxide tensions of 29 mmHg. Increases in ICP were correlated with presence of midline shift on preoperative head computed tomography (CT) scans.

Reicher, Oren, Rasool et al. (Los Angeles) discussed the mechanism of ketamine-induced cerebral vasodilation in the rabbit. They found that ketamine increased CBF, cerebral metabolic rate for oxygen, and sagittal sinus flow. The effect on CBF, however, could be blocked by very large doses of scopolamine. Furthermore, the effect of scopolamine could be reversed by the introduction of physostigmine, indicating that the vasodilatory effect of ketamine may depend on the cholinergic vasodilator mechanism as well as its metabolic effect.

A series of papers on the cerebral effects of midazolam were presented by Baughman, Hoffman, Albrecht, and Milekic (Chicago) in collaboration with Cook and Gutzman (Milwaukee). First, they compared the cerebrovascular and metabolic effects of midazolam and fentanyl on young versus aged Sprague-Dawley rats. They found a significantly larger decrease in CBF and cerebral metabolic rate for oxygen in response to midazolam in old rats as compared with younger rats. The responses of the same parameters to fentanyl in the aged versus young rats was much smaller and less dramatic. Thus, there appears to be a differential action of aging between the receptors affected by benzodiazepines, such as midazolam, and the receptors affected by opioids such as fentanyl. In a subsequent study using benzodiazepine antagonist in Fisher 344 rats, these authors demonstrated that there are possibly two populations of benzodiazepine receptors, central and peripheral, and that midazolam appears to affect these two populations of receptors differently. Midazolam produced a decrease in CBF and cerebral metabolic rate for oxygen, a decrease in myocardial blood flow, and an increase in renal blood flow, despite declining blood pressures, whereas benzodiazepine antagonist reversed these changes. Benzodiazepine antagonist alone was found to stimulate CBF, cerebral metabolic rate for oxygen, and myocardial blood flow, but had no effect on renal blood flow either in the presence or absence of midazolam. The authors suggest these findings may point the way for further benzodiazepine development and more specific molecular targeting of the central benzodiazepine receptors. Finally, these investigators described the potentiation of midazolam's depressive activity by alcohol and its reversal with benzodiazepine antagonist. Intraperitoneal injection of ethanol caused no decrease in CBF or cerebral metabolic rate for oxygen, whereas midazolam injection produced significant depression of cerebral metabolic rate for oxygen and CBF. The addition of intraperitoneal ethanol potentiated this depression by midazolam. Infusion of benzodiazepine antagonist reversed the depression of cerebral metabolic rate for oxygen and CBF produced by the combination of midazolam and alcohol. The authors concluded that the effects of ethanol on midazolam CNS depression may be due to an impact at the GABA-benzodiazepine receptor-chloride inophore complex.

A special lecture in honor of Dr. Harvey Slocum was presented by H. R. Winn (Seattle) on "Adenosine and the Cerebral Circulation." Dr. Winn described the effects of adenosine as a modulator of neural activity through its inhibiting effects on the synaptic junction, and its role as a regulator of CBF through its vasodilator effects. Adenosine in the central nervous system is metabolized via inosine and hypoxanthine to uric acid, which then is broken down and excreted via the kidneys. Important to this pathway are adenosine kinase and hydrolyase enzymes producing either adenosine monophosphate in the CNS or 5'-adenosyl homocysteine. Dr. Winn explained that a blood brain barrier exists for adenosine in that 1) intracarotid injection of adenosine does not affect CBF; 2)
adenosine is not metabolized in the CNS; 3) topically applied adenosine dilates pial vessels and increases CBF; 4) adenosine in the cerebral spinal fluid is reincorporated into brain nucleotides. He concluded by presenting evidence that the increases in CBF observed during hypoxia, ischemia, and seizures can be due to an increase in adenosine in CSF and/or brain tissue. Further work on adenosine was presented by Fujiwara, Sasaki, Kassell, and Yamashita (Charlottesville), who described the presynaptic inhibitory action of adenosine on neuromuscular transmission in the canine cavernous carotid artery. Using transneural stimulation, which normally causes frequency-dependent contractions of the carotid artery in the dog, they demonstrated an inhibitory effect of adenosine. This effect was antagonized by theophylline but not affected by diprydiamole. Thus, the vasodilating effect of adenosine in the cavernous carotid artery of the dog is mainly due to its inhibitory effect on neurotransmission rather than a direct relaxing effect on smooth muscle.

Papers dealing with new technology in neuroanesthesia included the use of mass spectrometry as an indicator of venous air embolism by Matjasko, Cohen, Petrozza, and McKenzie (Baltimore). Mongrel dogs underwent graded air embolism while being monitored with end-tidal nitrogen, end-tidal carbon dioxide, mean arterial pressure, and a precordial doppler. The results indicated that end-tidal nitrogen is as sensitive as end-tidal CO2 monitoring and was slightly more sensitive than pulmonary artery pressure measurement. Further studies may reveal a means of quantitating the amount of air introduced into the venous system by the amount of nitrogen recovered in the expired air. Gleski, Cucchiara, and Michenfelder (Rochester, Minnesota) compared transesophageal echocardiography and transcutaneous oxygen measurement for the detection of venous air embolism. In supine mongrel dogs, they found transesophageal echocardiography to be more sensitive than the precordial doppler in detecting venous air. Transcutaneous oxygen measurements also were compared with end-tidal carbon dioxide measurements and were found to be comparable in detecting the presence of venous air. Gonzalez-Mendez, Litt, Hamilton et al. (San Francisco) described nuclear magnetic resonance spectroscopy for the study of repeated episodes of cerebral hypoxia and cerebral ischemia in rats. Results of these investigations demonstrate that the nuclear magnetic resonance of phosphate 31 molecules can reproducibly characterize brain high-energy phosphates during brief periods of hypoxia and global ischemia. While currently a research instrument, they proposed that NMR may be of use eventually in the evaluation of patients during treatment for these insults.

New agents for controlled hypotension included the use of “Urapidil as a supplement to neurolept analgesia during neuroanesthesia” by Van Aken, Puchstein, Zander, and Lawin (Munster, Belgium). Urapidil is an antihypertensive that inhibits norepinephrine release and is a partial alpha receptor antagonist. Urapidil decreases blood pressure without increasing ICP and/or CBF. It blunted the acute increases in blood pressure seen on induction and emergence from anesthesia. They concluded that this drug appears to be a useful adjunct for anesthesia in patients with increased ICP. Mezzoni, Capuano, Cotrell et al. (New York) described the use of the calcium entry blocker, diltiazem, for deliberate hypotension and its effects on ICP. When mean arterial pressure was reduced by 40% in unanesthetized dogs with both normal or increased ICP, the decrease in mean arterial pressure was accompanied by a concomitant increase in ICP and a marked decrease in cerebral perfusion pressure. These results are in agreement with previous studies, observing increases in ICP in response to nifedipine and verapamil. Alan Artru (Seattle) described the metabolic and electroencephalographic consequences of hypocapnia plus hypotension induced by sodium nitroprusside or trimethaphan in dogs. During anesthesia with halothane and nitrous oxide, a variety of conditions were studied, including normocapnia, hypocapnia (arterial PCO2 of 20 mmHg), and the reduction of mean arterial pressure with either sodium nitroprusside or trimethaphan to 60 mmHg, 50 mmHg, or 40 mmHg. Cerebral metabolic rate for oxygen, CBF, and the electroencephalogram were measured. Brain biopsies were obtained for ATP, ADP, AMP, phosphocreatine, lactate, pyruvate, and glucose determinations. The results suggest that the reduction of arterial blood pressure with either sodium nitroprusside or trimethaphan produced predictable decreases in electroencephalographic activity and cerebral metabolic values. There appeared to be less of an effect on cerebral metabolic values when sodium nitroprusside was used as compared with trimethaphan, especially at levels of hypotension to a mean arterial pressure of 50 mmHg or lower. It was apparent, however, that decreases in arterial carbon dioxide did not affect the metabolic or electroencephalographic changes induced by either sodium nitroprusside or trimethaphan.

The next meeting of the Society will take place on Friday, October 11, 1985 at the San Francisco Hilton.

WAYNE K. MARSHALL, M.D.
Department of Anesthesiology
Hershey Medical Center
Hershey, Pennsylvania 17033

ROBERT F. BEDFORD, M.D.
Department of Anesthesiology
University of Virginia School of Medicine
Charlottesville, Virginia 22908

AAMC Symposium on Medical Informatics

Two hundred medical school deans, department chairmen, and other leaders in medical education gathered in Washington, D.C., on March 7-8, 1985, to learn the potential impact of, and implementation strategies for, new information technologies in research, education, and clinical decision making. Subtitled “Medical Education in the Information Age,” the Symposium on Medical Informatics was organized by the Association of American Medical Colleges (AAMC) and supported by the National Library of Medicine (NLM).

In his keynote address, “Computers in Science, Communication, and Education,” Joshua Lederberg (New York) drew the parallel between the first printing press and the modern computer, noting that their societal value lies in their capacity to achieve coherence of critical judgments rather than merely
rapid dissemination of ideas. Computers enable a social process of feedback and correction with greater potential than that afforded by other media. Because knowledge is growing so rapidly, teachers, students, and practitioners need better access to the current facts and controversies. Whereas books are static and leave much to the imagination, computer-based media enable the modeling and dissection of complex processes, as well as the practice of intellectual skills in a cost-effective way. The "dollar processor" is the heart of powerful desk-top computers and is embedded into devices that control other machines. The promise of information systems, however, as "figurative books" for the lifelong medical education process and as "expert systems" (presentations of medical knowledge and heuristics) to assist in clinical decision making awaits the development of a coherent, mutually consistent body of knowledge data bases. These data bases, in turn, require the improvement of medical language (a topic that others expanded upon).

Daniel C. Tosteson (Boston) spoke on "Medical Education in the Computer Age." He related the growth in medical knowledge to the rise of technology, noting the technology (e.g., Leuwenhoek's microscope) allows previously unthinkable images, perceptions, and terms that lead, in turn, to new knowledge, more technology, and other perceptions. Computers accelerate this progression but place unusual demands upon us to develop consistency. This progress has spawned a medical industry that supplies our tools, increased specialization, fragmented medical practice, and increased the need for learning. In education there has been an increasing preoccupation with content, with less attention to attitudes, skills, and integration. New information systems will accelerate the growth of medical knowledge and increase the disparity between what we can know and what we can manage; physicians increasingly will perform tasks that humans do better than devices; empathy and encouragement will again be the "heart of doctoring"; and the goals and process of medical education will move away from being an expert and toward managing life and being a better person. A new curriculum being established at Harvard Medical School, which prepares students for this new environment and embodies many recommendations of the GPEP Report, emphasizes problem-oriented and case-based teaching, with active participation in small groups and reduced use of lectures and other systematic, didactic presentation. Computers will provide rapid access to data bases, case records, and literature and will enable analysis of complex data for model building and decision making. Teachers will assume a new role as catalysts or facilitators of learning rather than substrates; achieving this role transformation will require development of faculty into a multidisciplinary group for general medical education.

Discussing "Computers in Basic Science Education and Research," Thomas G. Coleman (Jackson, Mississippi) briefly noted that computers had revolutionized research because of their use in direct data acquisition, storage, analysis, modeling, and graphics. He felt that students need not be taught much about computers but rather should be taught by them. Instead of dul "drill" software, which emphasizes facts rather than analytic processes, he stressed the educational value of the simulation—a mathematical description of a biologic process that serves thereafter to predict the effect of a stimulus upon the described system. Simulations can capture complex life processes that traditional education often oversimplifies, demonstrate biologic variability during the preclinical years, display results that are not intuitively obvious in the analysis of a dissected process, and represent very short or very long processes that are otherwise not easily measured. However, there also may be inaccuracy due to a faulty underlying differential equation, risk of poor communication to the student at the terminal, and lack of meaning unless the student appreciates the assumptions underlying the model.

Donald A. B. Lindberg, NLM director (Bethesda), spoke on "Evolution of Medical Informatics," noting that "evolution is orderly only in retrospect." Remarkably, in 1879, Dr. John Shaw Billings established Index Medicus—the medical bibliographic data base that in 1971 became accessible as MEDLINE at remote terminals—characterizing it then as "current medical literature of the world." The modern NLM operates seven regional centers in the United States, with another 14 throughout the world, linked by earth satellites. The potential of this communications network for medical applications, however, awaits exploitation, for 70% of current satellite transmission is consumed in trading dollars and yen between New York and London. In the coming years, optical disks will store information and images to enable pictures to accompany characters on the computer monitor; artificial intelligence will be used in differential diagnosis, specialty consultation, and a wide variety of research applications. Medical informatics will become increasingly important for four reasons: Increasing medical specialization has created a greater need to communicate between increasingly narrow fields; medical care is becoming increasingly effective so that it matters that the physician has the best information at his disposal; environmental contamination is an increasing problem and chemical and toxicologic data bases are needed to deal with the health impact; and medical informatics has emerged as a discipline. Among NLM priorities are development of expert systems for both teaching and clinical decision making; institutional development programs to advance medical informatics in four centers of excellence; creation of integrated academic information management systems (IAIMS); and, the creation of a unified medical language system, with more meaningful codes and overall integration, which can be used by health care providers, insurers, and information specialists. Drawing a parallel with geology, where major theoretic advances followed the creation of a standard nomenclature, he predicted that medicine would become a true science only when the clinical record can be linked to the medical literature through such a unified medical language.

Simultaneous seminars followed. G. Octo Barnett (Boston) discussed "Educational Uses of Computers," noting first that the present educational systems has many weaknesses, including

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emphasis on the rapid increase in magnitude and complexity of content, domination by passive lecturing, inadequate emphasis on problem solving, suboptimal integration of multidisciplinary content, evaluation primarily on immediate factual recall rather than management of stored information, and slow acceptance of decision-support tools. Computers facilitate acquisition of vocabulary and facts, understanding of complex physiologic systems, and competency in complex pattern recognition and problem solving. Computer-based medical education is interactive and self-paced, convenient, private and nonpunitive, reproducible and objective, and economical. He highlighted computer-based patient simulations that offer learning without danger or inconvenience to the patient, remove time limitations, allow greater variability of cases, provide unlimited range for student decision making, and respond to the student's management. Among many obstacles to implementing computer-based education are high start-up costs for staffing and hardware, lack of faculty awareness and time, related lack of nontrivial software and faculty reward for coursework development, and difficulty in integrating into the present curriculum. Edward H. Shortliffe (Stanford) and Stephen Pauker (Boston) demonstrated functioning “Clinical Decision Support Systems” that use artificial intelligence and Bayesian decision analysis, respectively, to facilitate clinical decision making, especially where the decision is complex and offers “trade-offs” in patient outcome and cost. Providing an example of “Databases in Support of Clinical Decision-Making,” Homer R. Warner (Salt Lake City) described implementation of extensive patient information systems at two university hospitals, which maintain data on several hundred thousand patients, help obtain a more comprehensive patient history by interactively testing computer-generated clinical hypotheses, “flag” aberrant laboratory results, and warn of likely drug interaction, among other functions. Robert A. Greene (Boston) demonstrated the use of an “authoring program” to create interactive education software; the “reader” finds an unfamiliar term, places the cursor on the word and presses a key, and a “window” opens on the monitor screen to define or illustrate the term. Harold M. Schoolman (Bethesda) described “The Role of the Medical Library in Support of Clinical Decision Making,” emphasizing that literature citations are insufficient. NLM is striving to establish a system that provides information (e.g., probabilities for use in clinical decision analysis) from within textual material; he also described Herculean efforts to incorporate information from images (e.g., ECGs, x-rays) into such data bases.

Rep. Timothy Wirth (Colorado), chairman of the telecommunications subcommittee of the Committee on Science and Technology, discussed “Federal Leadership in Information Technology.” Known as an “Atari democrat,” he had formed a coalition encouraging national investment in high technology to enable the United States to be more competitive in international markets. Noting that the basis of our society is changing from manufacturing to information, he emphasized that we must invest in the future by training our youth for careers in information systems. He stressed the importance of increasing the funding for NLM because computers are now increasingly contributing to improved health care. He acknowledged, however, that we must not allow computers to supplant, only supplement human judgment; that this technology does not come without risks, such as potential breach of confidentiality that requires protection; and, that congressional support must be sought under “R and D” rather than research and that it is unlikely that there will be support for specific manpower training.

William Y. Arms (Hanover, New Hampshire) concluded the formal presentations by discussing “Institutional Decision-Making and Commitment to Computers in Education,” highlighting his experience in implementing a campus-wide information system at Dartmouth College. He stressed the importance of administrative leadership “from the top,” combined with support from potential academic users and technical personnel. Excitement required for success includes early implementation of easy but important applications, personal equipment, and sufficient decision making at departmental levels. Indecisive, inconsistent leadership, combined with an initial failure, unfulfilled promises, or a poor infrastructure squelches excitement. Among his many other recommendations are decentralized decision making; regular user meetings; listening to, but not worshipping experts; avoiding the exploitation of junior faculty (e.g., software development); adoption of general purpose software to satisfy most applications, with options to meet specific needs; and standardization of equipment. Noting that equipment is relatively inexpensive, he offered several “rules of thumb”: direct support consumes 20% annually, equipment prices decrease by 25% annually, doubling system capacity requires 50% more personnel, and equipment will be replaced in 4 years. The presence of gifts and grants makes it “often cheaper to be a leader than a follower” in implementing an information system; he cautioned, however, that the institution should ask for what it wants, lest it find that the gift is worth less than the floor space.

The symposium concluded with small group discussions from which no consensus viewpoint emerged. Perhaps because of unfilled promises of audiovisual education equipment in the 1970s, coupled with the large entry investment, there seemed to be little enthusiasm for an aggressive national strategy. Instead, most favored local programmatic initiatives tailored to particular institutional needs and capabilities. Among the problems to be overcome are lack of sufficient manpower in medical informatics, inadequate rewards for young faculty to produce meaningful software, and absence of an external peer review mechanisms equivalent to those existing for other scholarly work. However, there seemed to be broad support for the AAMC coordinating informational system resources. Although financial resources are limited, it was suggested that the new prospective reimbursement environment offers an extraordinary opportunity to develop the clinical data base needed for cost-effective medical practice and that the Health Care Financing Administration should be interested.

Although specialty-specific applications were not emphasized, some informatics applications relevant to anesthesiology were obvious: In addition to word processing, sophisticated data analysis and bibliographic retrieval are now within the means
of individuals. Departments also can use computers for budget preparation, scheduling, and related administrative functions. Relatively inexpensive laser printers and software now permit cost-effective preparation of illustrations. Artificial intelligence systems will soon critique anesthetic and ventilator management. With the commercial availability of “authoring programs” soon, more cost-effective teaching modules can be created to suit local needs. Finally, departments can “network” inexpensively now to share information and meet common needs.

The AAMC will publish the symposium proceedings in late 1985.

FREDICK K. ORKIN, M.D.
Associate Professor of Anesthesia
University of California Medical Center
San Francisco, California 94143

ALAN W. GROGONO, M.D.
Chairman and Merryl and Sam Israel, Jr.,
Professor of Anesthesiology
Department of Anesthesiology
Tulane University
New Orleans, Louisiana 70112

ROBERT W. VAUGHAN, M.D.
Professor and Chairman
Department of Anesthesiology
University of North Carolina
Chapel Hill, North Carolina 27514

International Symposium on Preventable Anesthetic Morbidity and Mortality
Boston, Massachusetts, October 8–10, 1984

An International Symposium on Preventable Anesthesia Morbidity and Mortality was attended by approximately 50 participants from five English-speaking countries. Those invited, identified by work or interest in the field, shared information and provided the forum for discussions. The ultimate purpose of the meeting was to consider methods for reducing anesthetic morbidity and mortality. This purpose might have been better served if relevant studies of cause and incidence were available from comparable data bases with common methods and uniform terminology. This was not the case. No new truths were revealed, but the meeting provided an opportunity to consider new approaches to this uniquely complex issue.

Opening presentations dealt with a review of existing data, which unfortunately relied heavily upon anecdotal reporting and retrospective judgments rather than upon prospective case finding. At best, the gathering of such data is beset with difficulties. A reluctance to report incidents, concern about confidentiality, incomplete reporting, and inconsistencies in report format were all cited. It was not surprising, therefore, that reports from various countries could not be compared with each other, even accepting national differences in education and practices. It was also not surprising that there was little enthusiasm for undertaking new large-scale studies in any format used in the past.

Presentations of specific topics followed by workshops related to these topics constituted the structure of the symposium. For example, lectures on the classification of causes and outcomes were followed by four simultaneous workshops that addressed Defining Terminology, Taxonomy of Outcomes, Taxonomy of Occurrences, and What are the Incidences of Morbidity and Mortality? Additional workshops included monitoring requirements, equipment design, techniques and priorities of data collection, physician training, education, and competence and quality assurance.

Different approaches to the classification of outcome demonstrated the difficulties in finding a common ground for terminology. For example, the mechanism (process) of a harmful outcome was described by one contributor as a cascade initiated by an occurrence, followed by a potentially harmful outcome, a complication, and a final outcome. Intervention may halt the cascade at any point, and these interventions require classification. Another participant defined undesirable outcomes in therapy, diagnostic costs, and length of stay in terms of deviations from expectations of the patient and the physician. Other approaches were based on classification by organ affected, by anesthetist management area (airway, circulation, drugs) or simply a list of all adverse anesthetic occurrences.

A recurrent theme was the frequent inability to document the relationship between anesthesia and undesirable outcome except in instances where the cause may be obvious and known, such as, a drug error or ventilator disconnect, or esophageal intubation. In many instances the relationship depends on circumstantial evidence, which then requires that a judgment be rendered. The extent to which the preoperative condition of the patient and the operation itself contributed to morbidity was not even discussed. Another uneasy and unanswered question was whether a brain-dead patient maintained on life support systems constituted morbidity or mortality, while another, related to the title of the symposium, asked if major morbidity and mortality were not always preventable.

The participants at each of the dozen workshops were asked to address specific questions related to the topics. The questions were insightful and provocative. The discussions were discursive and answers absent simply because no data were available to support any position. Questions posed in the workshop on taxonomy of outcomes included: What is the objective in categorizing untoward anesthesia outcomes? What is the most meaningful way to classify such outcomes? What are the 10 most frequent anesthesia related preventable untoward outcomes? Asked in another workshop: "Is there an acceptable definition for which anesthesia-related deaths are preventable?" Some questions were semantically raveled. What distinguishes preventable from nonpreventable deaths? Would not attributable and nonattributable better fit the purpose? A case cited to illustrate the issue concerned a death following a thoracoplasty induction in an elderly, acutely ill patient. Does one ascribe
this to overdose or wrong drug, or hypovolemia, or failure of an intervention, or none of these? Is this preventable mortality?

The workshop on monitoring during anesthesia generated heated discussions, and in no other area were the differences between national practice patterns more in evidence. Clearly, the availability of a plethora of monitoring devices and the malpractice climate in the United States have created pressures for their use. Anesthesiologists in the United States have yielded to these pressures. An attempt to list monitors in terms of their importance to optimal anesthesia care elicited little agreement, primarily because their contribution to care never has been measured. The need for such study was apparent, since any contribution must be weighed against potential downside risks of decreased vigilance, equipment failure, and erroneous information. A clearly expressed concern, and here was ready consensus, was the legal implications of establishing a standard of minimal acceptable monitoring during anesthesia, particularly in the absence of supporting data.

Finally, there was general agreement about the timeliness of this symposium to provide momentum for the formation of an international group to share information and plan studies that may be conducted more effectively in one country than another. An international committee would assume the responsibility for initiating joint efforts that would include interim arrangements for a next meeting possibly in 1986. The most important aspects of this symposium were that it was held, that the problems discussed had international relevance, that there is an extraordinary dearth of data to apply to the questions and the need to stimulate their collection.

Arthur S. Keats, M.D.
Houston, Texas

E. S. Siker, M.D.
Pittsburgh, Pennsylvania