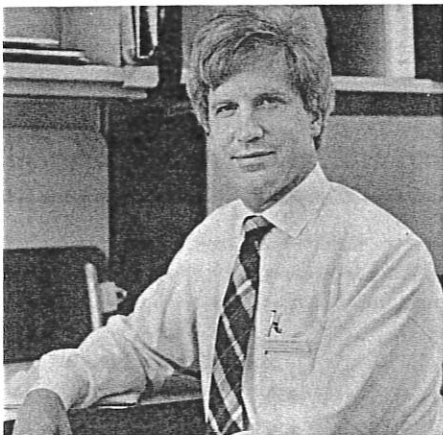


PRESIDENTIAL ADDRESS



Robert Crone, M.D.
SPA President

It has been a pleasure to watch the Society for Pediatric Anesthesia grow from its informal formation three years ago to its present size of over 600 members. As such, it is a great honor to assume the Presidency of this very vital and growing organization and help guide it during its next stages of development.

My first important duty is to officially thank Dr. Myron Yaster for all of his energy, creativity and genius which sparked and nurtured the inception of this organization. Myron clearly catalyzed the fusion of the elements necessary to create an organization that is meaningful to all practitioners of pediatric anesthesia.

The quality of the educational program at our Second Annual Meeting held in San

Francisco was an excellent example of Myron's vision. It is my aim to continue such excellent scientific as well as clinically relevant symposia such that we can learn something new from science that is related to our specialty, while also focusing on timely and clinically important issues that affect our daily practices in the operating room. Contributions will continue from individuals in both the academic as well as private sector; lending a very broad-based experience in the field of pediatric anesthesia to our symposia.

In addition to continuing this very important educational activity, it is my hope that we can begin to make available to you other educational opportunities relevant to our specialty, including bibliographies, listings of pertinent conferences as well as discussions of important clinical topics in our Newsletter. To achieve that end, Drs. Roger Moore and Randall Wetzel have agreed to edit the Newsletter. It is a pleasure to welcome them to the management team of SPA. We expect the Newsletter to become one of your most valued periodicals!

Lastly, as our Society develops further, I look forward to its becoming an important voice for pediatrics within the membership of the American Society of Anesthesiologists and a strong advocate for child health to the medical community at large.

Along with the officers and board members of SPA, I encourage you to let us know what you would like from your Society and hope that you will help us continue to build an outstanding organization devoted to improving the anesthetic care of infants and children. □

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THE ANNUAL MEETING

By *Randall C. Wetzel, M.D.*

The Second Annual Meeting of the Society for Pediatric Anesthesia took place in San Francisco on Friday, October 7, 1988. Three hundred Society members attended, doubling the attendance of the first meeting. Although last year's program was exciting

and well received, the general opinion was that this year's program was noticeably improved and reflected a maturation of the Society and the program agenda. The Board of Directors and the President organized a

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The information presented in the SPA Newsletter has been obtained by the Sub-Committee on Publications. Validity of opinions presented, drug dosages, accuracy and completeness of content are not guaranteed by SPA.

Dues and Costs

The cost of the second meeting (guest speaker costs, meeting place expenses, and food) was underwritten by membership dues. We hope to continue this policy of using membership dues and corporate donations to pay for the annual meetings in the future. Indeed, we believe that the dues structure of the organization is such that members will get "their money's worth."

Please note that a new fiscal year has started and members should send their dues of \$100 with an application form. Interested physicians can apply for membership by mailing the enclosed application form with \$100 to:

THE SOCIETY FOR
PEDIATRIC ANESTHESIA
515 Busse Highway
Park Ridge, IL 60068

Help Wanted Future Projects

The Officers and Board of Directors are interested in the continuing involvement of the Society's membership. Members interested in running for office or participating in the newsletter are encouraged to write to us at the SPA office in Park Ridge. We hope to expand the newsletter next year and include features such as literature review and debates on controversial subjects.

The Newsletter

Publication of the Newsletter and its contents continues to evolve. New Departments include "Experts Opinions", "A Literature Review", and a "Calendar of Meetings". Volunteers to help with the Newsletter, or who may have suggestions should notify one of the Editors:

Randall Wetzel	Roger Moore
The Johns Hopkins Hospital	Deborah Heart and Lung Center
(301) 955-7612	(609) 893-6611

ASK THE EXPERTS

Editor's Note: This section of the Society for Pediatric Anesthesia Newsletter has been formulated to deal with questions the readership may have concerning pediatric anesthesia problems. Should any members of the Society have questions concerning pediatric anesthesia problems that they would like answered, please submit such questions to the offices of the Society for Pediatric Anesthesia. Your input is anticipated and desired.

R. Moore, M.D.

Question:

At what post-gestational age in a previously premature infant would it be safe to anesthetize a child as an outpatient?

Answer: Charles J. Cote', M.D.
Massachusetts General Hospital

Since the early reports of Gregory (1981) and Steward (1982) noting the high incidence of post-operative apnea in premature infants, i.e., infants older than 37 weeks gestational age, a great deal of attention has been devoted to defining which population of patients is in fact at risk. Gregory reported that 25 percent of preterm infants suffered from post-operative apnea while Steward reported an incidence of 18 percent: both of these studies were retrospective but certainly raised the red flag regarding this association.

Our pediatric anesthesia group (Liu et al., 1985) prospectively examined a large series of full-term and premature infants undergoing a variety of surgical procedures. A total of 214 infants were studied: 173 full-term and 41 ex-premature infants. Fifteen of the 41 ex-premature infants had a history of apnea, six developed post-operative apnea, two were ventilated because of the nature of their surgery, and seven recovered uneventfully. The conceptual age of all patients who developed apnea was 41 weeks or less, whereas none of the older children developed apnea. Although all types of surgical procedures were included, three of the six infants who developed apnea had had inguinal herniorrhaphies. There was no association of apnea with ASA risk category.

Welborn et al. (1986) prospectively studied 86 infants, of which 38 were ex-premature infants, all of which were undergoing inguinal herniorrhaphy repair. Twelve of 16 ex-premature infants were older than 44 weeks conceptual age and none developed post-operative apnea. Eighteen of 22 ex-premature infants were younger than 44 weeks conceptual age and

none developed post-operative apnea but 14 of these 18 developed periodic breathing. The authors concluded that outpatient inguinal herniorrhaphy could be safely performed in ex-premature infants older than 44 weeks conceptual age who were free of major cardiac, neurologic, endocrine or metabolic diseases. Kurth et al. (1987) examined pre- and post-operative pneumograms in 47 ex-premature infants of younger than 60 weeks conceptual age. They defined two types of apnea: long, which is greater than 15 sec or associated with bradycardia; and short, which is equal to greater than 6 and less than 15 sec. These infants underwent a variety of surgical procedures. Episodes of apnea were observed after 25 of 49 operations with two of the infants who were older than 44 weeks conceptual age (52, 54 weeks). Usually the apnea events were inversely related to conceptual age and a history of necrotizing enterocolitis. The pre-operative pneumogram was not a reliable test in predicting post-operative apnea. The authors concluded that preterm infants younger than 60 weeks conceptual age should be monitored post-operatively for at least 12 apnea-free hours in order to prevent apnea-related complications. The major defect of this study was that the length of the pre-operative pneumogram study was relatively brief and may, in fact, have missed infants having subclinical apnea spells. It is interesting that 14 of 18 patients who had abnormal pre-operative pneumograms had abnormal post-operative pneumograms. This suggests that the pneumogram is highly predictive but not 100 percent accurate.

Mestad et al. (1988) studied 100 ex-premature infants scheduled for inguinal herniorrhaphy or lacrimal duct probing. They found that infants less than 40 weeks post-conceptual age or infants with a history of apnea or lung disease were the infants at risk for developing post-operative apnea. The absence of apnea in recovery did not guarantee that apnea would not occur later.

Each of these studies has limitations and problems with methodology. None has a large series of ASA 1-2 patients undergoing the same operative procedure with the same anesthetic technique, by the same anesthesiologist, the same surgeon, or the same operating room conditions. Many factors contribute to the development of apnea including temperature, hematocrit, glucose and calcium homeostasis, anesthetic agents, and perhaps anesthetic techniques. The bottom line is that a history of prematurity is a red flag which means these infants must be observed very carefully for

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"The Annual Meeting"

Continued from page 1

program which was a remarkable success. Ample time was provided both at the luncheon and in the evening at a wine and cheese reception for communication between anesthesiologists concerned with the care of children from across the country. Many old friends were met and many new friends were made.

indicating the importance of both thyroxine and T3. Serum T3 decreased significantly in subjects 2-24 hours postoperatively following minor surgical stress; however, in patients who are critically ill, markedly elevated levels of T3 can be found. Dr. Chernow also commented on the role that prolactin plays in the response to both surgery and critical illness. This role has only recently become clear and, although an intricate facillatory background mechanism is suspected, the exact role of prolactin,

in premature than in full-term infants. Taken together, these results indicate that the premature infant seems less able to mount a humorally induced stress response. Interestingly, the consequences are that surgical stress induced more catabolism in premature than in full-term infants.

Dr. Anand also reported the results of a study, which is currently in progress, comparing conventional morphine, diazepam and halothane anesthesia with large dose sufentanil anesthesia (45 mcg/kg), either without or combined with a sufentanil infusion post-operatively (2-4 mcg/kg/hr). Preliminary results of this study of 45 patients (15 in each group) clearly demonstrated that high dose sufentanil administered intra- and post-operatively was associated with a marked decrease in the metabolic markers of stress. Additional new and dramatic findings also were evident. Deaths only occurred in the halothane anesthesia group. Indeed, 33 percent of these patients died. There were no deaths in either of the two groups anesthetized with sufentanil. Additionally, the length of patient stay in the intensive care unit was decreased in the post-operative sufentanil infusion group. In the conventional anesthesia group, the average length of PICU stay was 10 ± 3 days, whereas in the infusion group it was 6 ± 3 days. A notable finding among the non-survivors in the halothane anesthesia group was that they had a massive increase in glucagon, with reversal of the usual insulin-glucagon ratio. There was also a marked hyperglycemia and lactic acidosis. In summary, adequate pain management is important not only on humane grounds, but also in terms of mortality as well.

The keynote address was provided by Dr. Gavril Pasternak, Memorial Sloan Kettering, New York, who discussed opioid receptors and their implications in the management of pain. Dr. Pasternak's discussion of their mediation of pain, the role of the endogenous opioid system, and the recent developments in specific opioid agonists was masterful and insightful. He pointed out that, based on receptor specific research, it is becoming possible to differentiate respiratory depression and analgesia. This holds promise for the development of specific opioid agonists which will provide analgesia without the usual side effects. As an example, mu-opioid receptors, which are the receptors to which morphine and fentanyl bind, can be differentiated into 2 groups. The mu-1 receptor appears to mediate supraspinal analgesia and the mu-2 receptor appears to mediate respiratory depression. Agonist binding of the mu-1 receptor does not result in alternation of gastrointestinal motility or respiratory depression, hence mu-1 receptor agonists

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The Morning Symposium on pain mechanisms and management was presented by (from left to right) Dr. Charles Berde, Dr. K. S. Anand, Dr. Gavril Pasternak (the Keynote Speaker), Dr. Bart Chernow and Dr. William Greeley.

The Morning Session

Following a continental breakfast, the morning symposium on pain mechanisms and management began. Dr. Bart Chernow led off with a discussion on the neuroendocrine response to stress. Dr. Chernow's experience in endocrinology and as director of the medical intensive care unit of the Massachusetts General Hospital have provided him with a particular insight into this area. His overview of the multiple endocrine responses to stress laid a firm background for the acute humoral responses to critical illness and surgery. In an engrossing and gregarious style, he delineated the graded neuroendocrine response which is proportionate to the degree of stress patients suffer. Furthermore, the humoral response to stress is transient, lasting no longer than 24 hours after uncomplicated surgery. In addition, he emphasized that anesthesia is able to markedly reduce the humoral responses to routine surgical stress to the point where it is negligible.

Dr. Chernow underlined the role that thyroid metabolism plays in stress responses,

which shows dramatic increases in circulating concentration in response to stress, is unclear.

Dr. Anand's description of the "Stress Response - How is the Newborn Different?" was introduced by Dr. Chernow. Dr. Anand reviewed some of his findings over the last few years. He and his colleagues at Boston Children's Hospital have been looking at the differences between stress response in premature and full-term infants in an attempt to find if there are indeed correlations in mortality and morbidity between groups based on their intra- and post-operative anesthetic management. Dr. Anand noted that in his original report, insulin, gluconeogenic amino acids and total amino acids increased in response to stress in full-term infants. More recently he has shown that in premature infants undergoing surgery, both cortisol and insulin did not increase and indeed, gluconeogenic amino acids such as glycine, valine, proline and lycine all decreased sharply. In addition 3-methyl-histidine, a marker of endogenous protein catabolism, was increased to a greater level

"The Annual Meeting"

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normal human subjects, provides the potential for opioid analgesia without respiratory depression. Over the next few years, newer specific receptor agonists will be developed that may work at the spinal and supraspinal levels. Indeed, a further understanding of endogenous opioids may open up a golden era in parenteral pain management.



Dr. William J. Greeley, SPA Treasurer, was one of the lecturers at the SPA Annual Meeting which was held in San Francisco in October.

Following a coffee break, Dr. William Greeley provided a most amusing and enlightening discussion of opioid pharmacokinetics in neonates, infants and children. Perhaps his major point was that although we were certainly capable of pharmacokinetic analysis of opioid metabolism in premature infants, full-term infants and younger children, it only provides a means to an end. Our key need is to understand the mechanisms of pain and how to abate them in children. Developing a greater pharmacokinetic and pharmacodynamic understanding of the interactions of opioids in children will provide us with newer techniques for automated drug administration, continuous infusions, and better designs of patient controlled analgesia.

In neonates, infants and children, opioid disposition is influenced by multiple factors. There are clearly age-related pharmacokinetic differences for morphine, sufentanil, fentanyl and alfentanil. Most notably, in children greater than one month of age and prepubertally, opioids appear to be cleared more readily than in adults. This would lead one to suspect that more frequent administration of perhaps larger doses of drugs is necessary in children. In neonates, on the other hand, opioids have highly variable

pharmacokinetic properties with a tendency for prolonged clearance. Perhaps more distressing than this, however, is the fact that their dose response relationships are extremely unpredictable in the neonate. This is potentially due to differences in protein binding, adipose tissue, hepatic metabolism, and volume of distribution in the younger age group. All of these have led anesthesiologists who care for children to be especially conservative in their use of opioids as intravenous anesthetic agents. Dr. Greeley reminded us to maintain a cautious approach and watch for the development of side effects, but not to be sparing in the provision of analgesia.

The morning session was concluded by Dr. Charles Berde, director of the pediatric pain service at the Boston Children's Hospital. Dr. Berde discussed the management of post-operative pain in children and adolescents. He strongly asserted that post-operative pain in children is remarkably common and that it is frequently unrecognized and untreated. He adamantly stated that there was absolutely no evidence to support the notion that children experience pain with less intensity than adults, and indeed felt that the pain threshold was lower in infants rather than higher. Even when safe methods of pain management existed, such as penile blocks, or the use of other local anesthetic techniques, they were remarkably underutilized.

Dr. Berde outlined an integrated multidisciplinary pain management system, which provided 24-hour pain service coverage. This group uses continuous parenteral analgesia; local anesthetic nerve blocks, including continuous caudal and spinal anesthesia; and the use of intermittent bolus narcotics where indicated. Interestingly, Dr. Berde outlined the need, whether using regional analgesia or not in children, to monitor blood pressure, electrocardiogram and respiratory rate, and that the incidence of complications of regional anesthesia in children was remarkably low.

Dr. Berde pointed out that it was certainly possible to assess pain and analgesia in children of the youngest age. He felt that it was axiomatic that children may lay immobile post-operatively, not because they are comfortable, but because they hurt too much to move. He emphasized the need to ask patients how they felt and to anticipate their pain, rather than waiting for them to report it. Absence of screaming does not imply comfort. He outlined three different kinds of pain scales: those that rely on self-reporting which are usually good for children older than 3 years of age; behavioral, which observe the behavioral adjuncts of pain such as tossing and turning, or lying still while holding a painful area, and screaming and shouting; and the physiologic adjuncts of pain such as hypertension,

tachycardia and tachypnea. He ended his discussion with a call for further research and development of new techniques to assess pain which would then be useful in developing strategies for providing adequate analgesia in pediatrics.



The SPA Annual Meeting included a question and answer session.

The Afternoon Session

The afternoon session followed the luncheon. Dr. Frederic Berry, the University of Virginia, moderated the first session which addressed the questions of premedication and preinduction medications—what are the best techniques?

Dr. Jeffrey Morray from the Children's Hospital in Seattle presented the view of the advocates of rectal induction and sedation. He pointed out that a wide variety of agents including diazepam, midazolam, etomidate, chloralhydrate, ketamine, morphine and multiple barbiturates such as thiopental, thiamylal, and methohexital all have been used and reported to be safe for inducing anesthesia in children. Methohexital remains the most popular in a dose between 20-30 mg/kg. He pointed out that a dose of 20-25 mg/kg of rectal methohexital in 10 percent solution induced sleep in 90 percent of children in 6-8 minutes. In the 10 percent who fail, they are often sedated enough to take an alternative means of induction, such as inhalational or intravenous induction, or can be adequately sedated with a repeated dose. The serum level following this dose range between 0.7 to 7 mcg/ml, which is quite variable; the mean is approximately 4.3 ± 2.4 mcg/ml. A concentration of above 2 mcg appears to be associated with clinical loss of consciousness. Although this is a commonly used technique, there are a few reported side effects. Reputed side effects include defecation in

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"The Annual Meeting"

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10 percent of patients, hiccuping in 10 percent of patients, laryngospasm (which occurs very rarely) and respiratory depression, which mandates close observation by the anesthesiologist. Hemodynamic compromise has not been reported. The other advantages of this form of sedation are that they allow the parent to stay with the child until consciousness is obtunded.

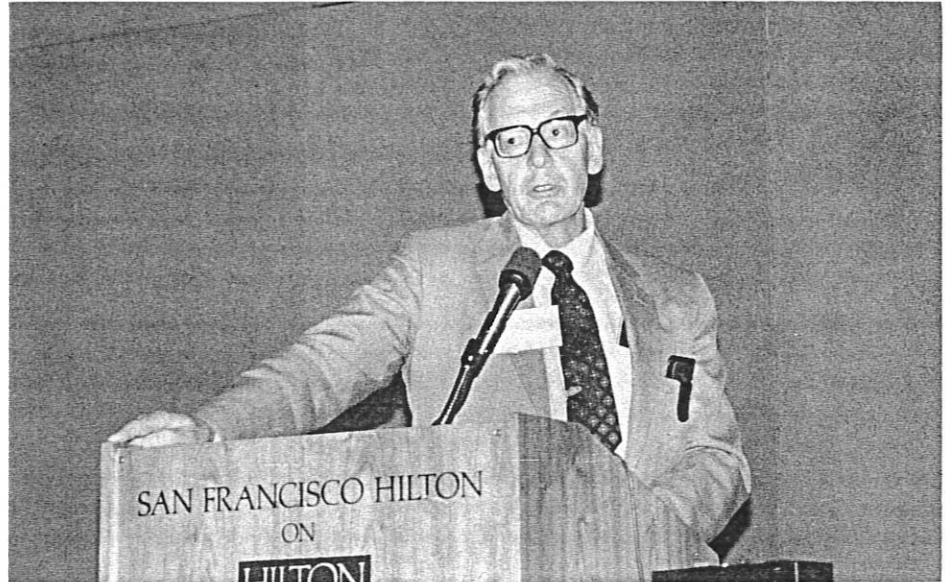
Dr. Willis McGill of the Children's Hospital National Medical Center in Washington, D.C. discussed parental participation in anesthetic induction. He felt strongly that the presence of the parents allayed the child's anxiety and the parent's psychological stress of being removed from a child. This smoothed inductions and provided nearly optimal conditions for parent-child interactions during this stressful time. Dr. McGill is a strong advocate of allowing parents to remain with the child until totally obtunded and pointed out that this occurred in the vast majority of patients he has anesthetized at his hospital.

This presentation provoked quite a remarkable discussion from the floor, and it was clear that among the anesthesiologists present a wide variation in practice exists. Some anesthesiologists favor totally shunning parents in the operating suite or preventing parents from being with the child at any place past the check-in line. Others felt quite strongly that full parental involvement, including accompanying the child into the operating room during induction was appropriate. Dr. Berry's lively moderation challenged the views of those who felt parental involvement during the induction of anesthesia was inappropriate and likened it to the antediluvian view that fathers should not be in the delivery room. Additionally, since outpatient surgery is so common, this is often the only time available to meet the parents face-to-face.

Oral premedication was discussed by Dr. Susan Nicolson. She strongly advocated that the induction of anesthesia by any route (inhalational, intravenous, rectal, transnasal) was much smoother in a child who was already premedicated. The preference of her and her colleagues at the Children's Hospital of Philadelphia was to premedicate by the oral route and to avoid needles at all costs. Despite these statements the quest for the ideal oral premedicant continues. It must taste good, produce a predictable and reproducible effect, act quickly, be contained in small volume, and preferably be pharmacologically reversible. At the Children's Hospital of Philadelphia, the oral meperidine 3 mg/kg, pentobarbital 4 mg/kg, and an antispasmodic, atropine 0.02 mg/kg, in an orange flavored suspension has been adopted for the use of both in-

out-patients. The desired effect occurred within 30-45 minutes and has been used in nearly 40,000 anesthetics without complications.

the Children's Hospital in Pittsburgh. The first speaker was Dr. Donald Tyler who spoke about guidelines for monitoring regional analgesia on a hospital ward, parti-



Dr. Robert Creighton of the Hospital for Sick Children in Toronto, discussed the benefits of intravenous induction of anesthesia in children during the SPA Annual Meeting.

This session was closed by Dr. Robert Creighton from the Hospital for Sick Children in Toronto. He began his discussion pointing out that most Canadian anesthesiologists prefer the intravenous induction of anesthesia in children. The rapid smooth induction with a short period of stress using small needles might even be preferable in children. Certainly the anesthesiologist would prefer to have an intravenous line established at the time of obtundation. In a study quoted by Dr. Creighton, which involved a questionnaire taken between two and six months after surgery, the results favored intravenous induction. For example, the overall impression that the child did not like the hospital was held by 7 percent of children who were intravenously induced and by 11 percent who were induced by inhalational agents. Thirteen percent of children felt reluctant to be submitted to intravenous anesthesia, whereas 43 percent could not face inhalational anesthesia again. Unfavorable children's comments were obtained in 38 percent of inhalational induction and only 8 percent of intravenous induction. Dr. Creighton concluded with the comment that children should be allowed to choose; however, in the child who would not choose between the two options, he felt that "it was much better that a child be stabbed in the back of the hand rather than suffocated".

The session, "Who Needs Monitoring", was moderated by Dr. Etsuro Motoyama of

cularly following epidural narcotic administration.

The major problems for which one is required to monitor post-operatively clearly involve hemodynamic and respiratory compromise. The most significant of these is respiratory compromise. In children, respiratory depression is manifest by hypoventilation characterized by decreased tidal volumes with the respiratory rate maintained. For this reason, merely monitoring respiratory rate may be inadequate. End tidal CO₂ measurement and transcutaneous CO₂ may be more beneficial, although adequate, inexpensive monitors do not currently exist. The current rage for monitoring is the use of pulse oximetry. However, this must be tempered by the fact that it measures a late event, i.e., hypoxemia. The best available monitor is a well trained clinical nursing staff who understand the complications involved and closely observe patients. He felt that continuous awakening and monitoring the state of consciousness was the most sensitive method. In addition, he pointed out that his practice was to include cardiorespiratory monitoring, hourly assessment, and pulse oximetry in 100 percent of patients on a nursing ward who are receiving post-operative regional anesthesia.

Dr. William McIlvaine provided a stimulating and rousing discussion of the indications for post-operative anesthesia monitoring in infants at risk for apnea, raising the

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By James Viney, M.D. and Randall C. Wetzel, M.D.

question "Monitoring, Who Needs It?". He gave a summation of the studies in the literature and exhorted all anesthesiologists to be familiar with these studies in order to make their own decisions. Clearly, the younger, smaller, premature infant is at greater risk for post-operative apnea than a full-term infant. Nevertheless, he recommended post anesthetic apnea monitoring for at least 24 hours, even in full-term infants up to 46 weeks postconceptual age. Post-anesthetic apnea monitoring in premature infants, or those with a history of apnea, should be extended until 52 weeks past conceptual age. The topic of avoidance of elective surgery prior to 52 weeks past gestational age also was raised. Several members of the audience, particularly Dr. John Downes of the Children's Hospital of Philadelphia, recommended post-anesthetic apnea monitoring for all prematures up to 60 weeks postconceptual age, and raised the issue of whether this should be extended to full-term newborns as well.

Dr. William Feaster concluded this session with a discussion of who needs oximetry post-operatively. Pulse oximetry has become a standard of care in the operating room; however, with the current awareness that children seem to become hypoxic during transport and in the pediatric recovery room, greater emphasis may well be placed on monitoring following anesthesia as well. Children are at risk post-operatively because they have decreased pulmonary function, markedly decreased FRC, and CNS respiratory depression. Post-operative pain also leads to ventilatory dysfunction and is frequently inadequately treated in children. Clearly children with pre-operative respiratory compromise, such as children with congenital heart disease, bronchopulmonary dysplasia, neurologic dysfunction, and who were born prematurely are at particular risk. In an ideal world, some monitoring of patient oxygenation should be available for all children; however those children who are particularly at risk to develop post-operative hypoxemia are those who have undergone thoracic surgery, major abdominal surgery, intracranial procedures and spinal fusion orthopedic procedures. Further standards of monitoring will require much consideration, but requirements for monitoring can certainly be expected to increase in the next few years.

The concluding afternoon session, which was chaired by Dr. Alvin Hackel, concerned discharge criteria for ambulatory surgery. Dr. Randall Wetzel of The Johns Hopkins Hospital initiated the discussion by ques-

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The following literature reviews have been selected from various issues of *Anaesthesia*, *Anesthesiology*, the *British Journal of Anaesthesia*, the *Journal of Pediatrics* and the *New England Journal of Medicine*.

A Boy with an Anterior Mediastinal Mass
John, RE and Narang, VPS
Anaesthesia, Volume 43, p. 864-866, 1988.

A Case Report

This paper presents a 12-year-old boy who had an anterior mediastinal mass. The child was symptomatic with shortness of breath, especially after strenuous exercise or when lying prone. Chest x-ray showed a larger anterior mediastinal mass and computerized axial tomography showed minimal airway narrowing. The decision to biopsy the mediastinal mass under general anesthesia was made. The child's anesthesia was induced by an inhalational technique with oxygen and halothane. He developed stridor and respiratory arrest. Via a bronchoscope, he was subsequently intubated with small tracheal cannulae through which he could be oxygenated.

Comment

In the discussion, the authors point out the extreme risk of anesthetizing children with anterior mediastinal masses. Symptomatic patients are at extreme risk, furthermore, patients with airway obstruction on CT scan also are extremely high anesthetic risks. Flow volume loops, if the patient is cooperative, with demonstrated inspiratory and expiratory obstruction also have been advised and useful. The anesthetic management of these patients has been reported to include awake intubation and fiberoptic intubation.

Despite all of these recommendations these children remain at extreme risk. It is well worth considering biopsying these lesions under local anesthesia by needle aspiration, and if this cannot be done, the oncologists and surgeons must be completely informed of the extreme risk to the patient. In our institution, we frequently forego tissue biopsy prior to steroids and irradiation of the mass. Biopsy of the mass or biopsy of another site following reduction in the mediastinal mass is suggested. The alternate suggestion of having extracorporeal membrane oxygenation available in the operating room is fine, but it must be realized that cannulas need to be in site prior to induction to ensure rapid establishment of bypass should the airway be lost.

Oxygen Administration Prevents Hypoxemia During Post-anesthetic Transport in Children

Patel, R; Norden, J and Hannallah, RS
Anesthesiology, Volume 69, p. 616-618, 1988.

This article compares two groups of ASA I-II children between two months and nine years of age. Each group consists of 100 patients. All children were monitored with a Model N-100 Nellcor pulse oximeter during transportation between the operating room and the pediatric recovery room. One group of patients was transported in room air. The second group of patients was transported with face mask oxygen at 6 L/min. Those patients who received supplemental oxygen had a higher arterial saturation (94.9 ± 5.8 percent) during transportation than those who did not receive supplemental oxygen (91.7 ± 10.1 percent). In addition, it was noted that the room air group had three children while the oxygenated group had two children out of 100 who developed desaturation to the range of 70-80 percent.

Comment

Not surprisingly this study showed that supplemental oxygenation elevated the saturation in children during transport. Added now to the series of studies from this group, we clearly know that children are at risk for developing hypoxemia in the short few minutes (in this study less than two minutes) during transport. The real question is how important is this? Hypoxemia should be avoided at all times as a general principle. Of note is that severe desaturations, which almost certainly are evidence of airway obstruction, occur just as frequently with or without oxygen supplementation. The main point, which has been adequately demonstrated for all anesthesiologists dealing with children, is that children during transport desaturate. This can in part be ameliorated by supplemental oxygenation and, indeed, this probably should be provided for all children following surgery during transportation. However, the mere provision of oxygenation does not totally eliminate the risk of potential life-threatening hypoxemia during transport of the post-operative child to the recovery room.

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"Literature Review"
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Rapid Inhalation Induction of Anaesthesia
Drummond GB

British Journal of Anaesthesia 61:373-375.

Drummond points out Ruffe, et al's first study published in the *British Journal of Anaesthesia* in 1985 (57:607-611) which described the rapid induction of inhalational anesthesia in adults. This technique consisted of 4 percent halothane, held in the lungs for 30-90 seconds, and consciousness was eventually lost. Coughing was not a problem. Other people have 4 percent halothane in a 67 percent nitrous oxide-oxygen mixture. Isoflorane has also been useful for this. This technique appears to give rapid smooth inhalation induction. Additionally, 50 percent of the patients have recovered in 4½ minutes, compared to a recovery time of 12½ minutes for IV methohexitone. Thus, additionally, this technique not only provides a rapid smooth induction, it provides a rapid emergence.

Comment

The notion of a 4 percent inhalational anesthetic induction has been around for some time. Several pediatric anesthesiologists have commented that for the screaming terrified child, an anesthetic circuit filled with 4 percent halothane in oxygen provides a two- or three-breath very rapid induction. The speed of this induction technique is not dissimilar from that of cyclopropane. However, it is in contrast to low dose halothane in which slowly increased coughing and airway irritation appear to occur rarely, especially in the crying child. The great fear of course is that laryngospasm will occur or that excitement during this bolus induction will lead to an airway which is difficult to manage. This is counterbalanced by the rapid uptake of anesthetic and therefore a rapid wake-up should the patient present difficulty. With appropriate patient selection, due caution, and proper airway management techniques, this technique may be useful for rapid induction in the uncontrollable child.

Reliability of pulse oximetry in hypoxic infants

Fanconi

Journal of Pediatrics, March 1988, vol. 112, No. 3, P. 424-427.

This study looked at beat-to-beat oximetry

infants under five months of age in 20 children. They only looked at values of SaO₂ under 65 percent. They found increasing error at lower SaO₂'s with the oximeter usually over-estimating the true SaO₂.

Comment

This confirms a clinical impression that at low saturations, oximetry is more useful as a trend monitor than a true predictor of SaO₂. Pulse oximetry reliably differentiates normoxia and hypoxia but a low SaO₂'s, its your guess as to the true value.

Pulmonary hypertension in infants with bronchopulmonary dysplasia

Goodman, et al.

Journal of Pediatrics, January 1988, Vol. 112, No. 1, P. 67-72.

These investigators looked at 17 infants with oxygen dependent BPD, RVH and pulmonary hypertension with cardiac catheterization. Six had large systemic to PA collaterals, all six had deleterious reactions to hydralazine. Fifty percent of those with persistent PA hypertension despite oxygen therapy died in followup. All 17 had a fall in PA pressure with oxygen.

Comment

This is more evidence of how sick severe BPD children are. Vasodilation can be hazardous in the sickest of these infants. Should we modify our requirements to prevent it when anesthetizing them? How does this relate to spinal anesthesia? This study would suggest it wouldn't be appropriate for all of them.

Growth failure in BPD: elevated metabolic rates and pulmonary mechanics

Kurzner, et al.

Journal of Pediatrics, January 1988, Vol. 112, No. 1, P. 73-80.

This study looked at a common problem in BPD, growth failure. Of interest was confirmation of an elevated oxygen consumption, greater than control in BPD children. In BPD children with growth failure, oxygen consumption is 10 ml/kg/min vs controls 6.6 ml/kg/min. The more pronounced the growth failure, the higher the oxygen consumption. The increased metabolic rate was not totally accounted for by increased work of breathing.

Comment

Growth failure has some predictive

value for severity of pulmonary disease. These kids will get hypoxic even faster than usual with small infants.

Gastroesophageal reflux and respiratory disease in children

Orenstein & Orenstein

Journal of Pediatrics, June 1988, Vol. 112, No. 6, P. 847-857.

Comment

This is a useful review article of the interaction between gastroesophageal reflux and respiratory disease.

Factors associated with brain herniation in the treatment of diabetic ketoacidosis

Duck & Wyatt with associated editorial on p. 65.

Journal of Pediatrics, January 1988, Vol. 113, No. 1, P. 110-4.

CT scans show cerebral edema is common in severe DKA. Looking retrospectively they found herniation was associated with high fluid administration rates and falling NA⁺. They found elevated levels of ADH beyond what one would expect with dehydration.

Comment

Fortunately we don't see many severe DKA's in the OR. They are acidotic, hypovolemic, maximally hyperventilating and they have the potential for catastrophic cerebral edema. They are anesthetic nightmares. The therapy for elevated ICP is mannitol. If they need anesthesia they will probably need volume replacement with isotonic fluids. Should they also all have ICP monitors?

Pain and Its effects in the Human Neonate and Fetus

Anand and Hickey

New England Journal of Medicine, Vol. 317, No. 21, p. 1321-1329.

This very nice review article lays out a schema for looking at the response of newborns to noxious stimuli. It examines CNS development, pain pathways, neural transmission and hormonal reactions. Infants hurt and respond to noxious stimuli, whether or not they "feel pain" is irrelevant.

□

"Ask The Experts"

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episodes of post-operative apnea.

When can these infants be safely operated upon? The sum total of cases reported in the literature is approximately 300, therefore, it is difficult to make definitive statements which are all inclusive. It has been our experience with a limited number of infants that the majority of ex-premature infants, even those with a history of apnea who are older than 46 weeks conceptual age, may be safely anesthetized as outpatients. It must be emphasized, however, that it is safer to err on the conservative side than to discharge a patient who later gets into trouble. Until more extensive, meticulous, prospective studies are carried out, it is reasonable to admit all ex-premature infants less than 50 weeks post-conceptual age and monitor them for possible apnea. The infants at greatest risk are those younger than 46 weeks post-conceptual age with a history of apnea. Obviously there must be a middle ground between the conservative 60 weeks recommended by Kurth and our early recommendations of 46 weeks. It appears that as the child matures the tendency toward apnea greatly diminishes but no one knows the age when all babies are safe. A recent report of a full-term infant developing post-operative apnea suggests that perhaps any infant is potentially at risk; perhaps infants should be the first case of the day, observed for a prolonged period of time, and if there is the slightest suggestion of a problem even the full-term infant should be admitted and monitored.

Answer: John J. Downes, M.D.
The Children's Hospital
of Philadelphia

In developed industrialized nations, a remarkable increase in the survival of prematurely born infants (younger than 37 week gestation) has occurred over the past 20 years. Recent data from major tertiary neonatal care centers indicates that since 1980 a dramatic improvement in the survival of newborns with birthweights between 700-1000 gm can be anticipated, even as high as 70 percent. The surviving infants have a remarkably good outcome, at least to the ages two through five years.

Infants born pre-term, especially those less than 1500 gm and those with intrauterine growth retardation, have an increased incidence of inguinal hernia, ranging from 5 percent (b.w. 1251-1500 gm) to 27 percent (b.w. 751-1000 gm) to 39 percent (b.w. 501-750 gm). Also, preterm infants tend to

require numerous other procedures requiring general anesthesia, including bronchoscopy for airway lesions, gastrostomy, central venous line insertion, gastric fundal plication for reflux, and ventriculoperitoneal shunts for hydrocephalus.

The preterm infant has immaturity of the central control of ventilation to a greater degree than does the term neonate. This becomes manifest clinically as periodic breathing which occurs in 50 percent of preterm newborns in the first week of extrauterine life. Half of these infants develop prolonged apnea (younger than 15 sec), usually with bradycardia.

For the anesthesiologist these facts can be summarized as the following problems:

1. The number of surviving preterm infants is increasing.
2. Preterm infants frequently need operations that require general anesthesia.
3. Preterm infants have immature central control of ventilation that predisposes them to irregular breathing and potentially harmful, even fatal, apnea.
4. Because of the many medical and economic benefits of day surgery, pressure

exists to send infants home on the same day following uncomplicated operative procedures.

CLINICAL STUDIES

Random anecdotal reports circulated among pediatric anesthesiologists in the late 1970s of occasional post-operative apneic episodes occurring without warning in former preterm infants who had undergone relatively simple operations and uncomplicated anesthesia. We at CHOP experienced an apneic-related death in a former preterm infant who was apparently healthy at 42 wk post-conceptual age (two mo post-natal born at 34 wk gestation), during the second post-anesthetic hour. This and similar events stimulated studies at Toronto HSC, Boston's MGH, the Children's Hospital in Washington, DC and at CHOP which were published between 1982 and 1988.

In a retrospective study (Steward, 1982) of 33 former pre-term infants, ASA PS 1,2 who had inguinal hernia repair under N₂O/halothane without relaxants, apnea occurred in six (18 percent) of the infants during anesthesia or up to 12 hours (post-conceptual age not given). Apnea did not occur in a

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BECOME A MEMBER OF THE SOCIETY FOR PEDIATRIC ANESTHESIA

Since SPA was formed in October 1986, more than 700 physicians with an interest in Pediatric Anesthesia have applied for membership in the Society. The Board of Directors of SPA would like to encourage more of its colleagues to become active members of the Society. On page 11 of this Newsletter is a membership application. Simply complete the application and mail it

along with your check for \$100 to the SPA office in Park Ridge, Illinois. Your membership and participation in SPA will enable the Society to continue bringing you the Annual Meeting and a Quarterly Newsletter, plus your support will allow SPA to expand its programs to bring you new information and technology on a timely basis. □

TIME TO RENEW MEMBERSHIP IN SPA FOR 1989

Members of the Society for Pediatric Anesthesia are asked to renew their membership in SPA for 1989. Complete lines 1, 2, 3, 5 and 6 of the application found

on page 11, check-off the renewal line and mail this form with your \$100 dues payment to the SPA office. □

"Ask The Experts"

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similar group of 38 full-term infants.

Liu, et al. (1983) prospectively monitored 41 preterm and 173 full-term infants, ASA PS 1, 2, 3, undergoing a wide variety of operative procedures. She observed no apnea in the full-term infants but eight (20 percent) of the preterm babies experienced apnea. Seven of these infants required mechanical ventilation for hours though they had not been ventilated just prior to the operation.

Kurth, et al. (1987) prospectively studied 47 former preterm infants (younger than 37 week gestation at birth) with a post-conceptual (PC) age of younger than 60 wk who received N₂O/halothane or isoflurane/pancuronium anesthesia on 49 occasions for a variety of infants had pre-anesthetic and post-anesthetic pneumocardiograms followed by cardiorespiratory monitoring in a recovery room or transitional infant ICU. *Prolonged apnea (greater than 15 sec or 10-15 sec with bradycardia) occurred in 18 (37 percent) of the infants.* The PC age of these infants (mean 43 week) was significantly less ($p < 0.01$) than that of the non-apneic infants (mean 50 wk). Neither the history of prior apnea nor the pre-operative pneumocardiogram were highly specific predictors but only suggestive. The incidence of apnea was inversely related ($p < 0.025$) to post conceptual age, with *those infants younger than 42 wk experiencing a 60 percent incidence of prolonged apnea*, although the oldest infant to suffer prolonged apnea was 56 wk post-conception. The onset of apnea began as early as immediately after extubation (one infant) to as late as 48 hour post-anesthesia (two infants), and the duration of apnea also was inversely related to post-conceptual age.

Welborn et al. (1986) after reporting no prolonged apnea but an increased incidence of periodic breathing in a prospectively studied group of healthy former preterm infants following general anesthesia, went on to observe (1988) on the presence of post-anesthetic pneumocardiograms prolonged apnea in eight of eleven (73 percent) of untreated former preterm infants (mean PC age 41 wk) treated after anesthesia induction with 5 mg/kg caffeine i.v. However, the incidence of short apnea (less than 15 sec) was greater in the treated patients.

Recently, Tetzlaff (1988) reported a full-term infant who had prolonged and repetitive apneic episodes following anesthesia for eye surgery at a PC age of 42 wk and a post-natal age of 21 and 27 days. Mestad (1988) reported at the recent ASA Annual Meeting a prospective study of 100 former

preterm infants who had general anesthesia for inguinal herniorrhaphy and underwent 18 hours or more cardiorespiratory monitoring in the hospital. Prolonged apnea occurred in 31 infants (31 percent), all of whom had a PC age younger than 41 wk, and all but one of whom had a prior history of either apnea or chronic lung disease (usually BPD).

RECOMMENDATIONS

From the foregoing it seems clear that: 1) post-anesthetic apnea occurs in one-third or more of former preterm infants who are younger than 60 wk PC age, and is most likely to occur in infants who are younger than 42 wk PC age; 2) the onset of apnea may be delayed as long as 12 hours post-anesthesia and last as long as 48 hours; 3) although suggestive, the presence or absence of a history of apnea or an abnormal pneumocardiogram does not predict outcome with sufficient reliability to withhold hospitalization and monitoring that is indicated on the basis of PC age or other factors; and; 4) caffeine may be an effective prophylactic treatment although the number of infants studied is small and from only one institution.

We therefore recommend at this time:

1. Defer elective operations until PC age is over 60 wk in the former preterm infant.
2. In the term infant defer elective operations until the PC age is over 44 wk.
3. In the infant who must be operated at young PC ages, provide cardiorespiratory (and if available pulse oximetry) monitoring for 12-18 hours.
4. If apnea occurs monitor for at least 24 hours, and for at least 12 hours following "last apnea".
5. Inform parents and surgeons of the relative risks of apnea following anesthesia in former preterm infants.

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□

"The Annual Meeting"

Continued from page 6

tioning the audience about discharge criteria for children who have undergone regional anesthesia. It was apparent that the majority of pediatric anesthesiologists perform regional anesthesia on children for outpatient procedures. It also became obvious that virtually all anesthesiologists who do so do not assess the status of the regional block immediately before discharging the child home, and that frequently there was no post-operative telephone contact. It was the general feeling of the audience that regional anesthesia is incredibly safe in children and was associated with very few complications. Indeed, no one present seemed to have ever seen any complication with these techniques. Dr. Wetzel suggested that minimum discharge criteria should include: the child is going to a safe, reliable home situation; ambulation with little assistance; taking liquids and keeping them down; stable vital signs; and demonstration of clear regression of the block prior to discharge. Additionally, the anesthesiologist should provide a mechanism for telephone follow-up to the child's parents.

Dr. Edgar Canada of the Children's Hospital of San Diego presented his views on discharge criteria for day surgery in children under six months of age. He did not recommend day surgery for young premature infants. He felt that prematures less than 48 weeks postconceptual age should not be discharged home within the

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first 24 hours following surgery because the necessity for stable vital signs, adequate upper airway reflexes, and ability to take oral fluids with minimal vomiting could not be assured. Additionally, prior to discharge, all children should be alert, oriented and interactive, and have the availability of a responsible person in the home setting. The need to use adequate anesthetic techniques with short acting agents was again emphasized.

Dr. Theodore Striker concluded this session with the discussion of what to do with the child with post-anesthetic croup. Clearly there is a group of children such as those with Down's syndrome, a history of recurrent croup, inflammatory upper airway problems, and previously intubated infants who are at particular risk. The admonition that children who require racemic epinephrine aerosols for their upper airway obstruction should be admitted was repeated. Children who had very mild croup were observed from six to eight hours and, if their disease was nonprogressive, and their oxygen saturations remained above 95 percent on room air, they could be discharged home. Dr. Striker reiterated that prevention is better than treatment and advocated the use of cuffless endotracheal tubes in children under 10 years of age. He advised the use of formula: $(16 + \text{age})/4$ when deciding on the appropriate endotracheal tube for children over two years of age. Rounding tube size downwards to help minimize the damage of a "tight" endotracheal tube to the child's trachea was suggested.

Lively discussion continued into the wine and cheese party that followed the day-long meeting. It became clear that this format of scientific didactic lectures in the morning, followed by short discussions of current clinical problems in pediatric anesthesia with a great deal of interaction with the participants in the meeting was nearly ideal. The Program Committee is eagerly planning next year's Annual Meeting which will again be held the Friday before the ASA Annual Meeting in New Orleans. □

Note:

Suggestions for future topics to be discussed at the Annual Meeting should be submitted to the Programming Committee or the SPA President.

SPA CALENDAR OF EVENTS

- JAN. 23-26 **Sixteenth Neonatal and Infant Respiratory Symposium.**
The Lodge at Vail, Vail Colorado.
For Information Write: Arlene Rogers, The Ohio State University Hospitals, Department of Anesthesiology, 410 W. 10th Ave., Columbus, Ohio 43210.
- JAN. 27-29 **Twenty-Seventh Clinical Conference in Pediatric Anesthesiology.**
Airport Marriott Hotel, Los Angeles, California.
For Information Write: Katherine Barky, M.D., Program Director, Division of Anesthesiology, Children's Hospital of Los Angeles, P.O. Box 54700, Los Angeles, California 90054.
- FEB. 11-18 **New Horizons in Anesthesia.**
Cooper Mountain, Colorado.
For Information Write: Continuing Medical Education, Emory University School of Medicine, 1440 Clifton Road, N.E., Atlanta, Georgia 30322.
- FEB. 26 -
MAR. 1 **Team Approach to Pediatric Cardiac Disease.**
Beaver Creek, Colorado.
For Information Write: Ms. Lana Flemmer, Cardiac Surgery, The Children's Hospital, 1056 E. 19th Avenue, Denver, Colorado 80218.
- MAR. 10-12 **Society of Neurosurgical Anesthesia and Critical Care — Barrow Neurologic Institute Joint Winter Workshop.**
Camelback Inn, Scottsdale, Arizona.
For Information Write: Society of Neurosurgical Anesthesia and Critical Care, 11058 Allecingie Parkway, Suite C, Richmond, Virginia 23235.
- MAR. 10-12 **Annual Spring Meeting of the American Academy of Pediatrics Section on Anesthesiology.**
Disney World Village, Orlando, Florida.
For Information Call: Within Illinois: 1-800-421-0589 and Outside Illinois: 1-800-433-9016.
- MAR. 25 -
APR. 1 **Pediatric Trauma.**
Kauai, Hawaii.
For Information Write: Edith S. Bookstein/AIPE, P.O. Box 2586, La Jolla, California 92038.
- MAR. 30 -
APR. 2 **Annual Midwest Pediatric Anesthesia / Annual Chicago Obstetrical Anesthesia Meeting.**
Holiday Inn — Chicago City Centre, Chicago, Illinois.
For Information Write: M.R. Salem, M.D., Illinois Masonic Medical Center, Department of Anesthesia, 836 West Wellington, Chicago, Illinois 60657.
- APR. 10-14 **ABA Oral Examination.**
For Information Write: American Board of Anesthesiology, 100 Constitution Plaza, Hartford, Connecticut 06103.
- APR. 20 **Visiting Professor Lecture Series 1989 — "Management of the Child with Critical Airway Obstruction: I. David Todres, M.D.**
Bethesda, Maryland
For Information Write: Sheila M. Muldoon, M.D., Uniformed Services, University of the Health Sciences, Department of Anesthesiology, 4301 Jones Bridge Road, Bethesda, Maryland 20814.
- MAY 13 **Second European Congress of Pediatric Anesthesia.**
Rotterdam, The Netherlands.
For Information Write: H.J. Manschot, Sophia Children's Hospital, Gordelweg 160, 3038 GE Rotterdam, The Netherlands.
- JUNE 3-5 **Educational Symposium on Pediatric Critical Care Medicine.**
New Orleans, Louisiana.
For Information Write: Timothy Yeh, M.D., Children's Hospital of Oakland, Department of Anesthesia, 747 52nd Street, Oakland, California 94609, or call (415) 428-3714.
- JUNE 6-9 **Society of Critical Care Medicine Eighteenth Annual Educational and Scientific Symposium.**
New Orleans, Louisiana.
For Information Write: 251 East Imperial Highway, Suite 480, Fullerton, California 92635.
- SEPT. 11-15 **ABA Oral Examination.**
For Information Write: American Board of Anesthesiology, 100 Constitution Plaza, Hartford, Connecticut 06103.

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