

Organization of an Obstetric Anesthesia Service

Sol M. Shnider, M.D.*

APPROXIMATELY 75 per cent of the 5 million births per year in the United States are conducted with the aid of some form of anesthesia.^{1, 2} This constitutes one-quarter of the estimated 16 million anesthetics administered each year in this country. The obstetric patient should receive anesthetic care that is as competent and freely available as that provided for surgical patients. Optimal professional anesthesia coverage requires 24 hours a day, 7 days a week care by qualified anesthesiologists. Furthermore, the anesthesiologist should be present for all deliveries, regardless of the type of anesthesia employed.

At the present time there is a lack of suitably trained personnel to provide optimal obstetric anesthesia coverage in the United States. Despite the great demand for anesthesia, only 14 per cent of American hospitals have qualified anesthesiologists responsible for the anesthesia for vaginal deliveries.³ Even in communities with large numbers of anesthesiologists, many avoid obstetric anesthesia because of the demands upon their time, especially at night, and because of the numerous emergency calls involved. Others consider obstetrics as a minor anesthetic problem, not warranting professional attention, and take little interest in the unique problems involved. Since 1955, several papers dealing with the organization of an obstetric anesthesia service have been published.²⁻¹⁰ However, none have appeared in journals devoted to anesthesiology. Perhaps this is a further indication of the lack of interest by anesthesiologists in this important area.

The primary aim of this report is to consider in some detail the nature of the organization necessary to provide optimal anesthesia coverage. Regrettably, the ideal solution to

obstetric anesthesia care will remain beyond the resources of most communities in this country for many generations. Mention, therefore, will be made of possible alternative methods to cope with this unfortunate situation. First, however, let us closely examine the rationale behind an obstetric anesthesia service and the benefits that would accrue to the mother, the infant and the physicians involved.

The Mother

Obstetric anesthesia is a varied, often treacherous and technically difficult field. It is one of the four leading causes of maternal mortality.¹¹ During the past decade there has been a lesser reduction in death from anesthesia than in any of the other major causes of maternal mortality.¹¹

The obstetric patient is frequently the classic unprepared emergency surgical patient. Fear and apprehension for herself and the infant are commonplace. Premedication may vary from none to gross overdosage with narcotics or barbiturates. Disorientation owing to excessive use of scopolamine and other drugs may be present. A stomach partially filled with food or retained gastric secretions is always a possibility. Furthermore, the following physiological changes occur during gestation which can affect anesthetic management: increase in cardiac output,¹² blood volume,¹³ and oxygen consumption¹²; decreased hepatic function¹⁴ decreased vital capacity and total pulmonary resistance¹⁵; decreased glomerular filtration rate and renal plasma flow¹⁶; reduced serum cholinesterase activity¹⁷; increased likelihood of regurgitation and aspiration¹⁸; higher incidence and degree of hypotension during spinal anesthesia¹⁹ and the occurrence of the supine hypotensive syndrome of pregnancy.²⁰⁻²² The problem may be compounded by the presence of pathological conditions such as reduced blood volume due to chronic anemia or acute hemorrhage, dehydration, acidosis, ex-

* Assistant Professor of Anesthesia and Attending-in-Charge of Obstetric Anesthesia, University of California Medical Center, San Francisco.

From the Departments of Anesthesia and Obstetrics and Gynecology, University of California Medical Center, San Francisco, California.

cessive breath holding, straining or hyper-ventilation. All of these problems can usually be managed safely provided the anesthesiologist and obstetrician are aware of them beforehand and present to take care of them.

The Infant

Each year in the United States many infants die at birth from respiratory inadequacy or failure. The predominant causes are drug depression, trauma during delivery and asphyxia at birth. The severity of each factor at any one birth is frequently unknown and always unpredictable. Some of these infants might have been salvaged by a qualified anesthesiologist who could provide the rapid and effective resuscitation necessary.

The Obstetrician

Obviously, a patient can be assured of greater safety if an anesthesiologist administers the anesthetic while the obstetrician devotes full attention to the delivery. Nevertheless, many an obstetrician believes that he is qualified both to manage a spinal anesthetic and deliver the baby at the same time.⁴ On the other hand, in the absence of a trained anesthesiologist, an obstetrician may have no choice other than to administer the anesthetic and perform the delivery himself.

The obstetrician should encourage the organization of an obstetric anesthesia unit to make available the services of a consultant in anesthesia. Obstetricians can benefit from the anesthesiologist's knowledge of depressant drugs and his assistance in the management of patients whose lives are threatened by hemorrhage or toxemia, as well as in conditions which endanger the fetus, such as prolapsed cord or premature separation of the placenta. Through mutual respect and cooperation, the co-captains of the obstetric team, obstetrician and anesthesiologist, can prevent the development of potentially harmful situations. For example, the concomitant use of ergot compounds and vasopressors leading to a dangerous elevation of blood pressure can easily be avoided.

The Pediatrician

In one-third of all teaching hospitals in the United States, a pediatrician is solely or partly

responsible for the immediate treatment of asphyxia neonatorum²³; yet, in only one-half of these hospitals is appropriate instruction in resuscitation available. There is little doubt that anesthesiologists, by the very nature of their daily work, are those best qualified to instruct others in techniques of airway maintenance, tracheal intubation, intermittent positive pressure respiration, treatment of drug depression and management of cardiovascular collapse. All physicians involved in resuscitation of the newborn should receive instruction in these disciplines from their respective obstetric anesthesia departments.

The Obstetric Anesthesia Service— Its Organization

At the present time in the United States there are several types of organization of obstetric anesthesia service.

(1) Anesthesia services provided by anesthesiologists on a 24-hour basis.

(2) Services provided by nurse anesthetists under the direction either of obstetricians or anesthesiologists.

(3) Services provided both by anesthesiologists and nurse anesthetists, each independently working a part of the 24-hour period.

(4) Anesthesia coverage in which nurse anesthetists or anesthesiologists are either not available or available only for special problems. In such circumstances the obstetrician usually administers the anesthetic himself.

Regrettably, there is no information available on the percentage of American hospitals in each of these categories. We do know, however, from a survey of approximately every tenth hospital in the United States, reporting statistics,³ that nurse anesthetists give anesthesia for vaginal delivery in 31 per cent of the hospitals. In another 28 per cent, anesthesia is given by other personnel such as delivery room nurses, medical students or non-specialist physicians. Obstetricians are responsible for anesthesia in 26 per cent of the hospitals, and anesthesiologists in only 14 per cent.

The basic principles of organization of an obstetric anesthesia service are the same whether the obstetric unit is in a university hospital, a charity institution or private hospital.

The ideal is: (a) provision of adequate maternal pain relief with little or no untoward effects on mother, infant or course of labor; (b) cooperation between anesthesiologist and obstetrician for the best application of their respective services in the perinatal period; and, (c) adequate financial support to attract and retain highly qualified anesthesia personnel.

Personnel

The optimal number of anesthesiologists assigned exclusively to obstetric anesthesia will depend primarily upon the number of births per month. One anesthesiologist at a time in a delivery suite is usually sufficient to care for as many as 300 deliveries a month. However, because of the unpredictable nature of obstetrics, additional anesthesia personnel should be available. Twenty-four hour rotation of personnel is practiced in many institutions. At the University of California in San Francisco, two residents in anesthesia are assigned exclusively for a month at a time to the obstetric suite and work alternate 24-hour periods. These residents administer anesthesia while a member of the staff in anesthesia is present to teach and to supervise the work.

In a recent study of United States hospitals supporting anesthesia resident training programs,²³ it was found that in 39 per cent of the hospitals, anesthesia departments supply around-the-clock obstetric coverage. Resident anesthesiologists are assigned on an exclusive basis for obstetric anesthesia in 17 per cent, and staff anesthesiologists in 22 per cent of the hospitals.

In hospitals lacking residents in anesthesiology, obstetric coverage must be assumed by staff anesthesiologists. The exact method of rotation of anesthesiologists varies with the individual group. In most cases, each anesthesiologist in a group is responsible exclusively for obstetric anesthesia care over a 24-hour period. He then returns to the surgical suite after a day's leave. The number of days each works in obstetrics obviously will depend upon the number of anesthesiologists in the group.

Qualified nurse anesthetists may also provide or supplement the coverage, especially in institutions faced with a shortage of anesthesiologists. In these situations, however, it is better if the nurse can be supervised, or at least have an anesthesiologist immediately

available for consultation. In other words, in hospitals where there are more than 300 births per month it would be necessary to have a physician and one or more nurse anesthetists in attendance at all times.

So far this discussion has centered around the ideal obstetric anesthesia service, staffed primarily by full-time anesthesiologists. Admittedly, compromises must be made and accepted if there is a lack of suitably trained personnel. In this situation, of course, the obstetrician must provide and assume complete responsibility for anesthesia. Regardless of who gives the anesthetic, that person should have received basic training at least in the principles and safe practice of anesthesia and resuscitation. It follows, therefore, that in most instances the obstetrician should have obtained this training during his residency training in obstetrics. A step in this direction has been taken by the Maternal Welfare Committee of the American Society of Anesthesiologists. This committee has formulated a set of recommendations on training in anesthesia for the obstetric resident, to be considered by the American College of Obstetricians and Gynecologists. Unfortunately, in many obstetrical training programs obstetric anesthesia is not covered or taught by anesthesiologists.

This raises the basic question of how to train physicians in obstetric anesthesia in the face of a shortage of competent instructors. The problem applies equally to the obstetrician and anesthesiologist in training, as well as to those already in practice. For the present, there appears to be only one possible solution: organized anesthesia (American Society of Anesthesiologists) and organized obstetrics (American College of Obstetricians and Gynecologists) must assume the responsibility in the development of obstetric anesthesia training centers throughout the country. At these teaching centers, obstetricians would receive a brief intensive course of instruction in basic anesthetic techniques and resuscitation. In addition, the centers could also tutor anesthesiologists who wished to receive basic or advanced training in the field.

Role of the Obstetric Anesthesiologist

The mother should be seen before and after delivery: ideally, preanesthetic evaluation of

patients should take place before the onset of labor. The interview should be designed to establish a firm, friendly relationship and to produce a calm, confident patient. Under these conditions the need for medication is reduced and the cooperation of the patient enhanced. The exact method of conducting the initial interview will vary primarily with the size of the obstetric unit. In hospitals with fewer than 1,000 deliveries a year, the method of Sheely and Urbach is feasible.²⁴ During a prenatal visit in the last 6 weeks of pregnancy, every patient is sent with her prenatal record to visit the anesthesiologist. The expectant mother is given the opportunity to ask questions regarding anesthetic techniques and to express her views on anesthesia. A history of previous anesthetics is taken and she is cautioned against ingestion of liquids or food once labor has begun. Although a mutually satisfactory plan of anesthetic management may be chosen, the patient is made to understand this is tentative and that the final choice of anesthesia for delivery will depend on the course of labor. In the larger hospital where it may be impractical for the anesthesiologist to see each patient on an individual basis during the prenatal period, group discussions with expectant mothers can be held at weekly intervals.

As soon as possible after a patient is admitted to the labor suite, the anesthesiologist on duty should visit the patient and discuss the management of anesthesia. Prior to delivery, the anesthesiologist should be certain that the necessary anesthetic and resuscitative drugs and equipment are available and in good working order.

Under ideal conditions, the anesthesiologist should be present at all deliveries regardless of the type of anesthesia employed. This is true even if anesthesia is not required, as during "natural childbirth." Some of the reasons for such attendance are as follows: (1) There is increased safety in the undivided attention of a trained person who observes closely the patient's condition during the final phases of labor and delivery. (2) The anesthesiologist is at hand to care for unexpected anesthetic and obstetric complications such as convulsions or hemorrhage. (3) The anesthesiologist is present to attend the newly born and perform resuscitation when necessary.

Equipment

It is not uncommon practice to furnish a surgical suite with new anesthesia equipment while the older equipment is shunted to the delivery room.²⁵ Obstetric patients deserve the advantages of up-to-date, well-maintained anesthetic apparatus. Each delivery room should contain a gas machine equipped with the standard gases such as oxygen, nitrous oxide and cyclopropane and a precision vaporizer for the administration of ether or halothane, should uterine relaxation be required. Emergency drugs for intravenous use, laryngoscopes, oral airways, endotracheal tubes, for both mother and baby, should be at hand. A source of oxygen, a suction device, a delivery table which can be adjusted quickly to place the patient either in Trendelenburg or Fowler position, a heated bassinet and infant mechanical ventilator are standard equipment.

In addition, a compact mobile anesthesia trolley which includes a device for intermittent positive pressure respiration (*e.g.*, Ambu or Pulmonator) as well as resuscitative drugs and airways, should be available. The anesthesiologist should take this equipment into the labor room before he performs regional anesthesia in order to treat cardiovascular or central nervous system complications.

A bronchoscope, sterile tracheostomy and cardiac resuscitation trays, monitoring devices such as stethoscopes, sphygmomanometers, and a cardioscope as well as a pacemaker and defibrillator should be handy. The maintenance and storage of supplies and equipment should be the responsibility of a specifically designated person.

Anesthesia Records

An obstetric anesthesia record such as that designed by the Maternal Welfare Committee of the American Society of Anesthesiologists is useful, since it incorporates the essential obstetric and neonatal history. Preferably, the record should have two carbon copies. One copy should become part of the mother's chart, while another should accompany the infant to the nursery. The pediatrician is thereby made aware of the condition of the infant at birth, and of any special treatment given. The original is kept by the anesthesiologist and may be

used for statistical, didactic or investigational purposes.

Economics

When an obstetric anesthesia service is organized a fee schedule is dictated by certain basic principles: (1) Patients should be billed on a fee-for-service basis by the anesthesiologist, if this is the prevailing medical practice. (2) Cost must not be the determining factor in the choice of anesthesia. (3) The precise fee for anesthesia for vaginal delivery or cesarean section will vary in different medical centers depending upon regional medical costs. Essentially, the fee should be at once reasonable and adequate for services rendered. If the volume of cases alone is insufficient to support an adequate staff, the hospital conceivably may have to subsidize the program.

Teaching Program

In hospitals with residency training programs, an interested and preferably a specially trained staff anesthesiologist should be assigned exclusively to the obstetric unit to teach obstetric anesthesia. At the present time, 24 per cent of teaching hospitals in the United States follow this practice.²³ Aside from providing liaison and communication on a permanent basis with the obstetrician, pediatrician, and nursing service, the staff anesthesiologist is responsible for the instruction of residents and medical students where present.

RESIDENTS IN ANESTHESIA

An anesthesia resident should rotate on a full-time basis through the obstetric anesthesia service for a period of at least two months, preferably at the end of his first year of training when he is well versed in basic anesthetic techniques and resuscitation. The Maternal Welfare Committee of the American Society of Anesthesiologists recommends that under qualified supervision, he administer during his residency training 150 to 200 anesthetics for vaginal delivery. If this is not possible in the parent institution, formal affiliations should be arranged with approved hospitals where standards are maintained and where these goals can be achieved. Presently in the United States only 30 per cent of the residents trained are offered these recommended requirements.²³

While assigned to obstetrics, the resident should attend obstetric rounds, both maternal and neonatal, morbidity and mortality conferences, as well as his own departmental meetings. A reading list of textbooks and journal articles dealing with obstetric anesthesia should be available. A profitable teaching exercise is to review each morning the cases of the previous 24 hours. These case discussions together with the literature review form the basis for didactic teaching in the program.

RESIDENTS IN OBSTETRICS

Obstetricians are responsible for obstetric anesthesia in 23 per cent of hospitals in the United States.³ Because of the immense patient load and relative shortage of qualified anesthesiologists, participation by obstetricians in anesthetic care is at present necessary and likely to persist. Anesthetic techniques most frequently used are paracervical, pudendal, spinal or epidural anesthesia.

Obstetric residents, therefore, should receive experience in these techniques under the supervision of an anesthesiologist. Equally important is instruction in maternal resuscitation, for complications such as arterial hypotension or convulsions. This goal can be accomplished by providing the resident with two or three months of instruction and experience in general surgical anesthesia. He will learn the management of the upper airway, endotracheal intubation, intermittent positive pressure respiration and the pharmacology of anesthetic drugs and vasopressors. Obviously, this short period will not produce a qualified anesthesiologist: it will, however, stress the limitations while giving the resident confidence in resuscitation and in the techniques to be used in practice.

RESIDENTS IN PEDIATRICS

The staff anesthesiologist assigned to obstetrics should offer seminars, on a regular basis, to teach pediatricians the facets of newborn resuscitation. In addition, he should make daily rounds in the nursery with pediatric residents and participate in neonatal death conferences.

MEDICAL STUDENTS

During the clinical years students should receive didactic lectures in obstetric anesthesia and infant resuscitation. While in the delivery suite they should observe and administer anesthesia under direct supervision as well as receive practical instruction in newborn resuscitation.

NURSES IN THE DELIVERY ROOM

Delivery room nurses often participate in the observation of vital signs during regional block anesthesia and in resuscitation of the newborn. Consequently, seminars should be organized by the staff anesthesiologist, to instruct nurses in the duties they may be asked to perform.

Research Program

An obstetric anesthesia service directed and participated in by anesthesiologists has the unique opportunity to carry out an investigational program. The attitude should be that every case, in essence, is a clinical experiment in the observations that are made. Evaluation of accepted and new anesthetic techniques, effects of drugs on mother and infant, and placental transfer studies, just to mention a few, are areas that can be explored. Many aspects of maternal and neonatal physiology deserve further investigation. Cooperation and participation by obstetricians are necessary to perform the clinical and basic research in this field. Cooperation is achieved most readily in obstetric units wherein the anesthesiologist participates primarily in patient care.

Liaison

The ultimate success of an obstetric anesthesia service will depend in large part on the rapport between anesthesiologist and obstetrician. Both must enter the partnership wholeheartedly and with mutual understanding and respect for each other's problems. Papper⁵ has observed that a major impediment to good care is the breakdown in intellectual communication between anesthesiologist and obstetrician, in the care of a given patient, despite apparent agreement away from the delivery room. "Fortunately, it is becoming more common . . . for each to attempt to educate the

other at periodic intervals so that an effective, mutually trusting working relationship develops. It is necessary that frequent exchange of information occur to weave these two specialties closer together in the care of the patient."

Summary

Around-the-clock obstetric anesthesia care will provide benefits for mother, infant, obstetrician, pediatrician and anesthesiologist. This report has considered the nature of the organization necessary to provide optimal anesthesia care. Unfortunately, due primarily to the shortage of qualified anesthesiologists, the ideal solution to obstetric anesthesia care will remain beyond the resources of most communities in this country for many years to come. Possible alternative methods to cope with this unfortunate situation are described. These include training in anesthesia for residents in obstetrics and gynecology and the establishment of obstetric anesthesia training centers throughout the country, both for obstetricians and anesthesiologists.

The author wishes to acknowledge with appreciation the valuable assistance of Doctor Frank Moya in the preparation of this paper.

References

1. Hellman, L. M.: Paraobstetric personnel, *Amer. J. Obstet. Gynec.* **83**: 503, 1962.
2. Cull, W. A.: Twenty-four-hour obstetric anesthesia coverage, *J.A.M.A.* **172**: 416, 1960.
3. Phillips, O. C., and Frazier, T. M.: Obstetric anesthetic care in the United States, *Obstet. Gynec.* **19**: 796, 1962.
4. Lindstrom, C., and Moore, D. C.: Trends in obstetrical anesthesia following the acceptance of a twenty-four hour physician anesthesia service, *West. J. Surg.* **65**: 63, 1957.
5. Papper, E. M.: The organization of an anesthesiology service for obstetrics, *Bull. Sloane Hosp. Wom.* **6**: 39, 1960.
6. Bonica, J. J., and Mix, G. H.: Twenty-four hour medical anesthesia coverage for obstetric patients, *J.A.M.A.* **159**: 551, 1955.
7. Moore, D. C., and Bridenbaugh, L. D.: Is it practical for medical anesthesiologists to supply a twenty-four hour obstetrical service?, *West. J. Surg.* **63**: 382, 1955.
8. Rutherford, R. N., Moore, D. C., Dare, J., and Rose, P. A.: Coordinated obstetric care, *Obstet. Gynec.* **8**: 581, 1956.
9. Cull, W. A., and Hingson, R. A.: Dedication, education and organization in the round-the-clock staffing of a modern obstetrical

- analgesia and anesthesia service, *Bull. Mat. Welf.* 4: 17, 1957.
10. Nelson, A. T., Phillips, O. C., and Savage, J. E.: Obstetric anesthesia care. Full-time coverage in a private hospital, *Obstet. Gynec.* 13: 426, 1959.
 11. Phillips, O. C., Frazier, T. M., and Davis, G. H.: Factors in obstetric mortality, *Amer. J. Obstet. Gynec.* 87: 71, 1963.
 12. Rose, D. J., Bader, M. E., Bader, R. A., and Braunwald, E.: Catheterization studies of cardiac hemodynamics in normal pregnant women with reference to left ventricular work, *Amer. J. Obstet. Gynec.* 72: 233, 1956.
 13. McLennan, C. E., and Thouin, L. G.: Blood volume in pregnancy; critical review and preliminary report of results with new technique, *Amer. J. Obstet. Gynec.* 55: 189, 1948.
 14. McNair, R. D., and Jaynes, R. V.: Alterations in liver function during normal pregnancy, *Amer. J. Obstet. Gynec.* 80: 500, 1960.
 15. Rubin, A., Russo, N., and Goucher, D.: The effect of pregnancy upon pulmonary function in normal women, *Amer. J. Obstet. Gynec.* 72: 963, 1956.
 16. De Alvarez, R. R.: Renal glomerulotubular mechanisms during normal pregnancy. I. Glomerular filtration rate, renal plasma flow, and creatinine clearance, *Amer. J. Obstet. Gynec.* 75: 931, 1958.
 17. Shnider, S. M.: Serum cholinesterase activity during pregnancy, labor and the puerperium, *ANESTHESIOLOGY* 26: 335, 1965.
 18. Bannister, W. K., and Sattilaro, A. J.: Vomiting and aspiration during anesthesia, *ANESTHESIOLOGY* 23: 251, 1962.
 19. Green, N. M.: *Physiology of Spinal Anesthesia*, Baltimore, The Williams and Wilkins Co., 1958, pp. 83, 172.
 20. Howard, B. K., Goodson, J. H., and Mengert, W. F.: Supine hypotensive syndrome in late pregnancy, *Obstet. Gynec.* 1: 371, 1953.
 21. Kennedy, R. L., Friedman, D. L., Katchka, D. M., Selmans, S., and Smith, R. N.: Hypotension during obstetrical anesthesia, *ANESTHESIOLOGY* 20: 153, 1959.
 22. Moya, F., and Smith, B.: Spinal anesthesia for cesarian section, *J.A.M.A.* 179: 609, 1962.
 23. Shnider, S. M.: Obstetric anesthesia training in the United States, *Amer. J. Obstet. Gynec.*, submitted for publication.
 24. Sheely, L. L., and Urbach, K. F.: Pre-anesthetic evaluation of patients on a small obstetrical service, *J.A.M.A.* 180: 490, 1962.

HYPOTHERMIA Ventricular diastolic distensibility is diminished as temperature is lowered, as evidenced by a progressive change in ventricular diastolic pressure-volume relations. This is the primary ventricular response to hypothermia as observed in the isolated preparation. In the whole animal preparation, the response is biphasic; with the onset of hypothermia an increase in diastolic distensibility is observed, which is followed by the expected diminution in distensibility. The initial distensibility increase seen in the whole animal but not the isolated preparation may be explained by an increase in circulating catecholamines evinced by adrenal medullary response to a cold stress. (*Remensnyder, J. P., and Austen, W. G.: Diastolic Pressure-Volume Relationships of the Left Ventricle During Hypothermia, J. Thor. Cardio. Surg.* 49: 339 (Feb.) 1965.)

EPIDURAL ANESTHESIA Respiratory function under epidural anesthesia was investigated in three groups according to whether analgesia was at the third, sixth or seventh thoracic level. On spirometry, the vital capacity and the expiratory reserve volume were significantly increased in sixth-thoracic-level group as compared with third-thoracic-level group. The pneumotachogram and the nitrogen clearance curve showed marked expiratory disturbance in the latter group even when the tidal volume or the minute volume was well maintained. Electromyographic patterns revealed that this was caused by muscle blockade of the lower intercostal and abdominal muscles. Measurement of uterine contracting force by the balloon method showed that saddle block caused more profound reduction of the force than high epidural analgesia. (*Nishimura, N., and others: Clinical Studies on Epidural Anaesthesia (Japanese) Jap. J. Anesth.* 13: 399 (1964.)