
Case Report

Management of Maternal Vegetative State During Pregnancy

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A pregnant patient with irreversible anoxic brain damage was maintained by life-support measures from 14 weeks' gestation until delivery of a healthy male infant at 34 weeks. Because two patients (the mother and the fetus), as well as the surviving family members, will be affected by decisions about life support, each case should be assessed individually.

Life-support measures have been used to maintain the dying patient in the third trimester of pregnancy until a gestational age compatible with survival of the fetus has been achieved. The techniques used to maintain uteroplacental blood flow and maternal oxygenation and nutrition may be extended, when appropriate, to the first half of pregnancy. We describe the management of a pregnant patient with irreversible anoxic brain damage from the beginning of the second trimester until delivery at 34 weeks' gestation.

REPORT OF CASE

At 14 weeks' gestation, a 28-year-old woman (gravida 3, para 2) suddenly collapsed at home. A neighbor telephoned for assistance, and the rescue squad arrived within approximately 15 to 20 minutes. Cardiopulmonary resuscitation was begun when they arrived.

On admission to a local hospital, the patient was in ventricular fibrillation. Her pupils were in midposition and fixed. Normal sinus rhythm was restored after multiple attempts at defibrillation. Epinephrine, bicarbonate, and lidocaine were administered. Persistent ventricular tachycardia was controlled with continuous intravenous infusion of lidocaine (4 ml/min) and procainamide hydrochloride (2 ml/min). The development of pulmonary edema and progressive hypoxia necessitated intubation and mechanical ventilation with use of positive end-expiratory pressure. Dobutamine hydrochloride was

administered intravenously (10 µg/kg per min) to correct hypotension. This dosage was gradually tapered, and administration was discontinued 72 hours after admission. During that time, the patient's blood pressure ranged from 80/40 to 132/68 mm Hg. A Swan-Ganz catheter was inserted the morning after admission, at which time the pulmonary artery pressure was 20/10 mm Hg and the cardiac output was 5.2 liters/min. After the patient's condition stabilized, the catheter was removed on the seventh hospital day.

The patient was initially flaccid. Soon after hospitalization, however, she had decerebrate posturing, myoclonus, and repeated tonic-clonic seizures that were abolished by administration of phenobarbital. Subsequently, the patient's pupillary, ciliospinal, and doll's eye reflexes returned.

The patient's history included mitral valve prolapse that had been diagnosed by auscultation 9 years before admission. Echocardiography performed at 29 weeks' gestation disclosed only mild systolic bowing of the mitral leaflets during some cardiac cycles. An electrocardiogram showed a regular sinus rhythm with a rate of 84 beats/min and occasional premature ventricular contractions. Cardiac auscultation at that time revealed no murmurs or clicks.

Serial electroencephalograms were recorded, the first of which showed a pronounced generalized dysrhythmia. Subsequent electroencephalographic tracings revealed the development of generalized, low-amplitude slow waves without an identifiable rhythm.

Because of the patient's initially unstable condition and the tentative diagnosis of cardiovascular collapse,

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neither a computed tomographic scan nor a spinal tap was performed at the time of admission.

At 28 weeks' gestation, the patient was transferred to a tertiary medical center for fetal surveillance and delivery. The following is an abbreviated list of the patient's medical problems during her 20 weeks of hospitalization before delivery.

Neurologic Status.—A chronic vegetative state is defined as the subacute or chronic condition that sometimes emerges after severe brain injury and consists of a return of wakefulness accompanied by an apparent total lack of cognitive function.¹ In this patient, chewing, swallowing, random eye movements, and nonpurposeful motor action were reinstated, along with the capacity to maintain adequate respiratory function and blood pressure. Myoclonic and generalized seizures abated after several weeks; thus, anticonvulsant therapy was discontinued.

Pulmonary Status.—After intubation and oxygenation with 55% FiO₂, the Po₂ was 94 mm Hg and the oxygen saturation was 98%. On the morning after admission, a roentgenogram of the chest revealed an infiltrate in the left upper lobe, most likely caused by aspiration. The patient was adequately oxygenated (50% FiO₂; total volume 650 ml). Therapy with penicillin and gentamicin was begun for aspiration pneumonia. Evidence of progressive hypoxemia 48 hours after admission prompted the addition of 7 cm of positive end-expiratory pressure to the ventilatory support. Her cardiac output was unaffected. Because a coagulase-positive *Staphylococcus* was cultured from a sputum specimen, oxacillin was added to the antibiotic coverage. On the fifth day after admission, use of positive end-expiratory pressure was discontinued because of improvement in her pulmonary status. During the next morning, however, extubation was unsuccessful, and the patient's respiratory status gradually deteriorated. She remained intubated on a T-piece and was given 40% oxygen.

Two weeks after admission, the respiratory status of the patient deteriorated again. On two occasions, bronchoscopy was necessary for removal of thick secretions that occluded the left lower lobe bronchus. After she had had recurrent atelectasis, pneumonia, and unpredictable episodes of hypoxia, a tracheostomy was performed on the 16th hospital day. During the third week in the hospital, the patient's respiratory status stabilized. She remained intubated on a T-piece, and 40% oxygen was administered. Auscultation was performed daily, and chest roentgenography was done when it was clinically indicated. Antibiotics were administered intermittently for recurrent pneumonia.

Nutritional Status.—Feedings were initially administered via a nasogastric tube. Five weeks after admission, the patient's medical condition stabilized. Because it was apparent that she would remain in a chronic vegetative state, a gastrostomy tube was inserted and gavage feedings were initiated with Ensure (125 ml/h; 3,000 calories/day). This daily regimen consisted of 111 g of protein, 111 g of fat, and 435 g of carbohydrate. Because of persistent emesis, Ensure Plus was substituted for Ensure, and the rate of administration was decreased to 75 ml/h (2,700 calories/day). Consequently, supplemental peripheral alimentation was provided with 500 ml of 10% dextrose in water (200 calories) and 500 ml of Travasol (170 calories).

The caloric intake was adjusted on the basis of the demands placed on the mother by her febrile episodes and the other crises that might have affected her metabolic requirements. Maternal weight gain during her hospitalization totaled 8.2 kg.

Cardiac Status.—On the third day after admission, an electrocardiogram revealed a regular sinus rhythm. Frequent premature ventricular contractions, episodes of bigeminy and trigeminy, multifocal premature ventricular contractions, and occasional occurrences of ventricular tachycardia were controlled with lidocaine, procainamide, propranolol, and, finally, quinidine. The quinidine was administered until 10 days before delivery.

Temperature Regulation.—Apart from one elevation to 40°C during the 20th week of gestation, the patient's temperature did not exceed 38°C until 27½ weeks' gestation, at which time it was 38.4°C. During the next 6 weeks, her temperature vacillated considerably (between 37.5 and 39.5°C). With each increase in temperature, acetaminophen suppositories and a cooling blanket were used in an effort to reduce maternal metabolic requirements and to minimize the stress on the fetus. The pulmonary status was carefully assessed to determine whether atelectasis or pneumonia was present; repeated blood cultures were obtained when indicated. Antibiotics (penicillin, gentamicin, oxacillin, and amikacin sulfate) were administered when appropriate.

Fetal Monitoring.—Biophysical profile scoring was used for antepartum fetal surveillance in the intensive care unit.² With this technique, the intrauterine environment is evaluated by means of real-time ultrasonography. Fetal movement, fetal breathing movements, fetal tone, and amniotic fluid volume are assessed individually, and a composite score is recorded. As more of these factors become abnormal (absence of fetal movement, tone, and breathing; oligohydramnios), the severity of fetal com-

promise and the perinatal mortality increase. Fetal growth was also assessed by serial ultrasound examinations.

The rate of survival of the fetus at 34 weeks' gestation is more than 95%. Amniocentesis was performed at this gestational age to assess the maturity of the fetal lungs. When the concentration of lecithin in the amniotic fluid is 2 to 3 times the concentration of sphingomyelin, the likelihood of the development of respiratory distress in the neonate is virtually excluded (false-positive result, 3% or less). Because the lecithin to sphingomyelin ratio was 5.4/1, we thought that the neonate's course would be more manageable than the further attempted maintenance of the patient's pregnancy. Because of the patient's unstable condition and the early gestational age, delivery was by primary cesarean section, and general anesthesia was used. The 2,320-g male infant had Apgar scores of 8 and 9 at 1 and 5 minutes, respectively. The infant had an uncomplicated hospital course and was dismissed on the sixth day of life. Development through his first 21 months was normal.

The patient continued in a vegetative state for 1 month after the delivery and then died of septicemia and diffuse bronchopneumonia. At autopsy, a moderately severe floppy mitral valve and mild focal myocardial ischemia were found. Evaluation of the brain revealed diffuse anoxic encephalopathy; the involvement was accentuated in the cerebral cortical arterial border zones and minimal in the brainstem and cerebellum.

DISCUSSION

This case typifies the classic clinical picture of sudden cardiac arrest and rapid loss of consciousness. In this patient, the relationship between the valvular abnormality and the precipitation of the ventricular dysrhythmia is unknown. Whatever the cause of such a collapse, cessation of respiration invariably follows. If resuscitative measures are not instituted within approximately 4 minutes after the precipitating event, function of the central nervous system is likely to be impaired even if resuscitation is successful.

Experimental evidence seems to indicate that the fetus is more resistant to an acute asphyxial incident than is the adult. This resistance probably results from redistribution of blood flow to vital organs, anaerobic metabolism, and decreased fetal oxygen consumption.^{3,4}

Because of technologic improvements in cardiopulmonary resuscitation and patient stabilization and maintenance, trauma centers throughout the United States may see an increasing number of pregnant women who are brain dead or in a chronic vegetative state. Distinguishing these two conditions is critical. If a patient

fulfills the Harvard criteria for brain death (unresponsivity, no movements or breathing, no reflexes, and a flat electroencephalographic tracing), the physician can reasonably anticipate prolonging somatic life for only up to 2 weeks.⁵ To improve the specificity of the diagnosis of brain death, the participants in the Collaborative Study of Cerebral Death⁵ proposed an expanded list of criteria. With use of these guidelines, the sensitivity for predicting somatic death has remained at 100%, but maintenance of essential bodily functions has been extended for up to 3 months before somatic death has occurred. Hence, depending on the criteria used for brain death, in utero fetal survival is possible for days to months.⁶ If, however, a patient is in a chronic vegetative state, in which cerebral function is lost but specific vital functions such as respiration and blood pressure regulation are retained, somatic survival can be maintained for a prolonged period.^{7,8} In this situation, the patient is not "dead," and continuation of life-support systems becomes an ethical, moral, and societal issue even after delivery of the infant.

Dillon and associates⁹ outlined a plan of management for pregnancy that has been complicated by maternal brain death: (1) at less than 24 weeks' gestation, no extraordinary measures of intervention should be pursued for either the mother or the fetus; (2) at 24 to 27 weeks' gestation, maternal life-support measures should be used in an attempt to improve fetal salvage; delivery should be by cesarean section when maternal viability can no longer be maintained or fetal distress occurs; and (3) after 28 weeks' gestation, delivery by cesarean section should be performed as soon as possible. We concur with Dillon and colleagues⁹ that after a gestational age of 26 weeks, consideration of the fetus should take precedence if the maternal condition is considered hopeless. We take issue, however, with two of their recommendations.

First, although we agree that "attempts to prolong maternal life in the face of brain death are expensive, frustrating, and ultimately futile,"⁹ the delivery of a 28-week-old fetus merely substitutes, from the fetal standpoint, one intensive care unit for another. Indeed, if the mother's condition is stable, as in the chronic vegetative state, the intrauterine environment could well be safer than an incubator for maturation and development. At our institution, the survival rate for a 28-week-old neonate is approximately 80%. We believe, however, that the neonatal morbidity is excessive for preterm delivery at this gestational age. In terms of duration of hospitalization alone, Pomerance and associates¹⁰ reported that, at their institution, infants who weighed less than 1,000 g remained an average of 89 days (range, 51 to 194 days). Although the decision about the optimal

time for delivery may be dictated by the maternal condition, elective delivery might best be performed at a gestational age of 32 to 34 weeks.

Second, a cutoff of 24 weeks' gestation before which extraordinary measures for the fetus should not be undertaken is arbitrary. Maternal maintenance from an earlier gestational age was provided in our case and in a case reported by Sampson and Petersen⁷ in 1979.

In summary, the maternal condition and fetal status should be accurately assessed before a plan of management is developed. Occasionally, determining the condition of the mother may take several days to weeks. During this period of evaluation, maternal care should be provided with a goal toward fetal survival. A thorough ultrasound examination should be performed to assess gestational age and to exclude any gross congenital abnormalities. Once the appropriate investigations have been completed, the medical team must make a decision about the likelihood of maternal survival and, barring this, fetal survival if maternal life support is to be continued for a specific period.

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