THE PROBLEMS FOR THE ANESTHETIST WHEN EXTREME RELAXATION IS NEEDED FOR THE PATIENT WITH TOXEMIA OF PREGNANCY *

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Received for publication April 30, 1949

MUCH has been said of the susceptibility of the pre-eclamptic and eclamptic patient to the various anesthetic agents (1, 2, 3, 4, 5). It is generally agreed that local block should be the method of choice. We wish to report 2 fatalities on the delivery table in patients who had the diagnosis of "moderately severe toxemia of pregnancy" for which general anesthesia was used.

Case 1.—A colored prima gravida, age 17, not seen in the prenatal clinic was admitted to the hospital with edema 3 +, albumin 4 + and blood pressure of 170 mm. systolic and 130 mm. diastolic. She had been cared for by a local physician until four weeks before admission. Three weeks before admission there was pedal edema, headache, and scotomas. Membranes were ruptured before admission. From the size of the uterus she appeared to be at term; the cervix was effaced, and there was 2 cm. dilatation. As determined by auscultation and percussion the lungs were normal. Except for a cardiac rate of 110, no abnormalities were found in the heart. Treatment consisted of paraldehyde and 20 per cent glucose by intravenous administration. She was fed a high protein diet. The treatment was complicated by repeated periods of vomiting so that feeding by stomach tube had to be abandoned and changed to parenteral administration. After twelve hours, blood pressure was 140 mm. systolic and 110 mm. diastolic, the albumin in the urine one +. She was drowsy but not more so than might have been expected from the sedative agent. Irregular contractions started about thirty hours after admission. As the contractions continued to be irregular and ineffective a number 6 bag was introduced into the cervix, 350 cc. of water was put into the bag and a pound weight attached. At 6:50 p.m. the bag presented at the vulva; a sterile vaginal examination revealed the the cervix dilated to 7 cm., the presenting part just below the level of the ischial spines. The decision of the obstetrical department was to deliver her by podalic version rather than by a high and difficult forceps plus Dührssen incisions of the cervix. Because of the need for a flaccid uterus for intrauterine manipulations, ether by the open drop method was selected. Atropine sulfate, 0.4 mg., was injected at 7 p.m. Anesthesia was started at 7:10 p.m. Induction was stormy owing to excess secretions largely of the "frothy" type. It was necessary to interrupt the induction several times to aspirate secretions. At 7:27 p.m. version was attempted. The uterus was not sufficiently relaxed. Attempts

* Read before the Joint Meeting of The American Society of Anesthesiologists, Inc. and the Southeastern Section of Anesthesiology, Washington, D. C., April 7, 1949.

were made to increase the depth of anesthesia. At 7:30 p.m. while intrauterine manipulations continued, the respirations suddenly becoming gasping and the blood pressure fell rapidly; a feeble cardiac impulse could be heard over the apex of the heart forty-five seconds to a minute later. All efforts at resuscitation failed. A dead baby was delivered about one minute after cardiac impulse ceased. Postmortem examination was not carried out. The following note was made by the Chairman of the Department of Obstetrics. "The patient after a long period of observation had not made the progress in labor that should have been expected with good pains. With membranes ruptured and the head at 0 station, although in TOT, the cervix should have shown some effects as a result of uterine contractions in that it should have been thinned out and softened. It seemed most advisable that this uterus should have been emptied as soon as possible because the toxic condition seemed to be becoming more acute and alarming; therefore, to accomplish this end and in light of the above statement a cesarean section would have been the better method of delivery.

"The patient's pulse and blood pressure did not indicate any special predisposition to circulatory failure. Ether was given for seventeen minutes and at the end of this time the pulse was still satisfactory in volume and rate. During this time the anesthetist reported that frequent suction of secretions from the upper air passages had to be performed. Before the operative delivery could be accomplished, the patient stopped breathing and the heart action disappeared simultaneously. The probable cause of death could be considered as follows, without either point taking preference over the other: (1) cardiovascular failure owing to toxemia; (2) pulmonary failure owing to toxemia that was further intensified by ether anesthesia."

Case 2.—A colored multigravida, age 28, had been seen in the prenatal clinic. Three weeks before admission the patient had been advised to eat a salt free diet and had been put on oral administration of magnesium sulfate because of rise in blood pressure and rapid gain in weight. She was admitted to the hospital because of increase in pedal edema, frontal headaches and continued rise in blood pressure. The blood pressure on admission was 180 mm. systolic and 120 mm. diastolic; there was albumin 2 + in the urine and swelling of the ankles. In so far as could be determined by percussion and auscultation the heart and lungs were normal. Treatment consisted of "phenobarbital," salt free high protein diet, intravenous infusions of 10 per cent glucose, and intramuscular injections of 10 per cent magnesium sulfate. As the patient was at term and the cervix effaced, medical induction of labor was started on the third day after admission by the use of castor oil and quinine. Irregular contractions started ten hours later. After twenty-four hours of irregular and ineffective contractions the labor seemed to be at a standstill. At 5:30 p.m. atropine sulfate, 0.3 mg., was administered. At 6 p.m. a "sterile vaginal" examination was done using nitrous oxide-oxygen anesthesia. There had been no progress in labor for several hours. Podalic version was selected as the method of delivery. Anesthesia was continued, using carbon dioxide absorption technic, adding ether to the mixture and increasing the oxygen. At 6:30 p.m. intrauterine manipulations were attempted; the uterus was reported as still firmly contracted. Before deepening the level of anesthesia an endotracheal tube was inserted to insure a better airway and to provide a means for suction. Intrauterine manipulations were again undertaken. Respirations became gasping and the blood pressure and pulse were unobtainable. The gasping respirations continued for another thirty to forty-five seconds. Respirations ceased and all efforts at resuscitation were un-

successful. A dead baby was delivered after death of the mother. There was no postmortem examination.

There are, in our opinion, four possible errors in the management of these 2 patients which caused death: (1) improper selection of the agent; (2) misconduct of the anesthesia irrespective of the agent used; (3) improper selection of the method of delivery, and (4) too deep a level of anesthesia in the toxemic patient.

The Agent Selected.—Ether was selected as the anesthetic agent because of the depth of anesthesia needed to relax the uterus. Third plane of third stage is necessary to obtain smooth muscle relaxation (6). Not only does a uterus with good muscle tone make intrauterine manipulations difficult but it adds to the danger that it may be ruptured. No other inhalational agent except chloroform will produce as complete relaxation at the same depth. It is not recommended that cyclopropane be used to produce third plane anesthesia because the danger of cardiac irregularity is increased with the blood level of the agent necessary to produce third plane. The relaxation obtained by this agent is not as great at the same level of anesthesia as with ether. Possibly, induction with cyclopropane supplemented by addition of ether would have produced adequate relaxation with less disturbance to the patient's physiology. Chloroform has no advantage over ether and many disadvantages, although it was used in the "Stroganoff" treatment of eclampsia. Spinal and caudal anesthesia are characterized by increased tone of the uterus (7). Conceivably, if the spinal block were at the level of the fifth or sixth thoracic segment the uterus would relax. The toxemic patient, as we will try to show, is hardly the subject for so high a level of sympathetic block and so much loss of muscular tone. In addition, it may not be possible to recover the tone of the uterus rapidly after the delivery. Increase in blood loss might follow. All essayists agree that local anesthesia is at all times the method of choice in the delivery of the pre-eclamptic or eclamptic patient. Local anesthesia is used at our clinic whenever possible; it is obvious that it is completely inappropriate for intrauterine manipulations. Ether is frowned on by most obstetricians for the toxemic patient. The objections listed are the dangers of remote ill effects. Ether is not the agent of choice in the presence of damage to the liver and kidneys. Pulmonary edema is common as part of the generalized edema; ether may increase the danger of postoperative respiratory complications. But why should this agent predispose to sudden death? The pharmacologic effect of ether which may be significant is the increase in hemoconcentration and viscosity of the blood (1). Since one of the findings in toxemia is increased viscosity of the blood, there may be stagnation and slowing of the circulation before anesthesia is induced. Ether may produce enough additional stagnation to cause severe anoxia.

The Management of the Anesthesia.—The management of anesthesia may be at fault and the fatal results may have no relation to the agent. Case 1 may be considered to be in this category. Air used to vaporize the ether offers a minimal amount of oxygen when there is already stagnant anoxia and possibly anoxic anoxia owing to pulmonary edema. Although no rales had been heard in the lungs when the patient was examined before induction, there appeared to be edema evidenced by the frothy secretions during induction. Not sufficient time was allowed to elapse after the use of a drying agent. It is more difficult to place Case 2 in this category. We tried to correct the mistake made in Case 1 by using a high oxygen mixture and insuring a good airway.

The Management of the Delivery.—It is beyond my province to discuss the judgment used in selecting the method of delivery. Dieckman (1) stated that the mortality is higher if routine cesarean section is used for toxemic patients than if the majority of the deliveries are by the vaginal route. He stated that accouchement forcé and version have no place in delivery for the toxemic patient. If the delivery is prolonged owing to inadequate dilatation of the cervix or delay in descent of the presenting part, Dührssen incisions of the cervix and forceps delivery are recommended. The opinion at our clinic is not in agreement with this dictum; they believe that podalic version is less traumatic than a difficult mid or high forceps. Is the level of anesthesia then the sole reason for avoiding this method of delivery? Is it imperative that we avoid at all cost the necessity for third plane anesthesia? If we admit the inability of insuring any reasonable safety for these patients, then the number of cesarean sections will increase and it is unlikely that the mortality rate will improve. There are reports of death resulting from the trauma of forceful dilatation of the cervix (1). Reflexes may be produced by intrauterine manipulations which tend to induce circulatory failure. Failure to secure sufficient relaxation of the uterus in both procedures may be the cause of these reflexes. We may have erred not because the level of anesthesia was too deep but because it was not deep enough.

The Level of Anesthesia.—Why should these patients be unusually unable to tolerate even the upper levels of third plane? Guedel (6) stated that owing to loss of tone of the blood vessels, fifteen minutes in plane three produces more shock than two hours in plane one. In neither patient was the level at plane three for more than one or two minutes. We may hypothesize that since some stagnant anoxia and anoxic anoxia already were present, even so early a loss of tone of the blood vessels reduced the oxygen to vital centers below the level necessary to support life. Gasping respiration indicates failure of the respiratory center owing to anoxia; gasping continues for a short period because of stimulation of the chemoreceptors (8).

Pathology in the Toxemia of Pregnancy.—It is only appropriate here to consider the pathologic condition as it may affect the conduct of anesthesia. The underlying cause of toxemia appearing late in pregnancy has not been determined. Some theories as to the cause are: (1) entrance of toxic substances into the maternal circulation from the placenta (2); (2) entrance into the maternal circulation of material from the products of gestation which produce embolic phenomena (2); (3) hormonal imbalance (9); (4) disturbance in enzyme activity (10), and (5) disturbance in circulation owing to the increased demand for blood volume in the uterus to supply the fetus with adequate oxygen (11). Whatever the underlying factor, the characteristic changes indicate profound disturbance in peripheral circulation. There is generalized vasospasm (12) especially of the cutaneous vessels, the renal arterioles and probably of the splanchnic arterioles. There is increased capillary permeability. Beker (11) stated that two forms of the disease should be recognized. In one form abnormal resistance is offered to circulation through the uterus, in the other there is deficient adaptation of the general circulation to the requirements of the uterus in pregnancy and delivery. Dieckman (1) reported 29 deaths in toxemic patients with postmortem examinations in 24. Of these 29 patients the cause of death was listed as follows: 9, shock; 3, shock following manual dilatation of the cervix; 6, shock and pulmonary edema; 5, cerebral hemorrhage; 1, peritonitis; 1, respiratory paralysis; 1, ruptured uterus; 1, pyelonephritis; and 2, acute yellow atrophy of the liver. Of the 29, 15 are listed as death caused by circulatory failure. We find a situation in which it appears that the vasomotor system is enduring constant strain. In large areas of the body continuous angiospasm is necessary to maintain adequate blood supply to brain, heart and lungs and at the same time increased blood supply to the uterus. Slowing of circulation owing to increased viscosity and increased peripheral resistance adds to the strain. It is not unlikely that although a patient may have a systolic pressure of 200 mm. of mercury, she hovers on the brink of circulatory failure. Failure of the angiospasm in the periphery, splanchnic area and kidneys may reduce the blood supply of the brain to so low a level that inadequate oxygen is supplied to the vital centers in the medulla.

It appears that the anesthesia for the toxemic patient ought not be carried to third plane of third stage. This may be impossible to avoid. If so, I believe that we improved our management in Case 2, even though the ultimate results were not better. If it becomes necessary, it seems that there is no agent or method that could be substituted with greater safety and produce the results needed. If the patient can so readily be put into circulatory failure, spinal or caudal anesthesia would not be a safer method. Ether vaporized by oxygen and administered through a well preserved airway seems to be the best we can offer at this time to produce a well relaxed uterus prior to podalic version and extraction where preeclampsia or eclampsia are complicating factors.

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THE AMERICAN SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY

The Spring Meeting will be held at the Hotel Shelburne, Lexington Avenue and 37th Street in New York City, on Monday,

March 27, 1950, at 8:30 P.M.

The speaker and subject of the scientific meeting will be:

"Dental Anesthesia Today," by Dr. Alfred A. Ackerman, Newark, N. J.

"Use of Ethyl Chloride for Children," by Dr. Neville A. Booth, Boston, Mass.

"Motion Picture of Office Intravenous Anesthesia Technic," by Dr. Myer Solomon, Williamsport, Pa.

Dinner at Hotel 6:30 P.M.

DR. M. HILLEL FELDMAN,
Executive Secretary