A case study: Arteriovenous malformation—pregnancy and delivery

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An arteriovenous malformation (AVM) is a grave, although not common, neurological disorder. The author recounts a case that looks at the anesthetic management of a pregnant patient with an arteriovenous malformation.

A cerebrovascular accident is an uncommon but formidable complication of pregnancy. Estimates of the frequency of subarachnoid hemorrhage in pregnancy range from one to five per 10,000 pregnancies. Eclampsia is the most frequent antecedent, followed by aneurysmal rupture, of which 37 proven cases are reported. Even more uncommon is cerebral bleeding from a rupture of an arteriovenous malformation (AVM). Ten documented instances of this condition associated with pregnancy have been recorded.

In the case report described here, a patient with a history of AVM delivered a healthy baby boy by cesarean section under epidural anesthesia.

Case report

The mother’s history. A 26-year-old caucasian, gravida-1, para-0, of 38 weeks gestation was admitted to labor and delivery after spontaneous rupture of membranes. Active labor had not been established. A 16-gauge IV intracath was started in the patient’s left arm prior to her admission to the obstetrical suite.

Her perinatal history and previous medical history were unremarkable except for an abrupt onset of leftsided weakness and loss of peripheral vision in her left eye at eight weeks gestation. At that time a computerized axial tomography (CAT-scan) was performed which showed an intracranial bleed resulting from an AVM (Figure 1). An ar-

![Figure 1](image-url)
eteriogram was not performed. A neurosurgery consultant recommended no treatment for the subarachnoid bleeding, unless her symptoms persisted or worsened during the course of her pregnancy. The patient continued her pregnancy uneventfully until two weeks prior to admission when she complained of a “splitting headache.” This headache was relieved by two Tylenol® tablets, and there was no further progression of her neurological deficits. No change in her neurological examination was noted upon her admission to the obstetrical suite.

The Plan. After consultation with the neurosurgery and neurology services, an obstetrical decision was made to perform a cesarean section for delivery. Anesthetically, it was determined that delivery by cesarean section in this patient could be managed best by administering a slow, carefully executed, and well planned continuous lumbar epidural anesthetic. Continuous lumbar epidural anesthesia, it was felt, would provide the patient with the least hemodynamically altering anesthetic. Maintaining cardiovascular stability to avoid wide swings in blood pressure was the primary goal in order to avoid the possibility of AVM oozing or rupture and possible disaster. An attempt was made to maintain the blood pressure at the “normal” preanesthesia levels or slightly lower. If hypotension (a blood pressure below 20% of normal or a systolic of less than 100 torr) manifested itself, preparations had been made to treat it with ephedrine sulfate in small doses (5 mg) intravenously in an attempt to avoid an “overshoot” resulting in hypertension. If hypertension posed a problem, a nitroprusside solution was available immediately for low dose infusion (0.1-0.5 mg/kg/min) for treatment.

Special monitoring would involve direct intraarterial pressure measurement, so as to insure minute-to-minute assessment and control of blood pressure.

The procedure. After an Allen’s test proved adequate ulnar artery circulation, a 20-gauge intracath was used to cannulate the right radial artery. The transduced pressure then was compared to cuff pressure, which was within 5 mm Hg systolic. O₂ via facemask was placed, and an ECG lead II was monitored. Volume preloading was accomplished with 1000 ml of lactated Ringer’s solution. Assuming the left lateral decubitus position, an epidural cannulation using the loss of resistance technique was performed at the L3-L4 vertebral interspace without incidence. After a 3 ml test dose of 0.5% bupivacaine (Marcaine®) and five minutes, an epidural catheter easily was threaded 2 cm cephalad. The epidural needle was removed, and the catheter taped in place. The patient was positioned for cesarean section with a right hip roll and left table tilt to avoid aortocaval compression. Twenty-two ml of 0.5% bupivacaine was titrated in 5 ml increments to a T4 dermatone level. The patient’s blood pressure ranged between 150/90 and 127/60 perioperatively (admission=145/88). The perioperative period was unremarkable. A baby boy was delivered with Apgars 9 and 9 at one and five minutes respectively. Postoperatively the arterial pressure was monitored directly for 12 hours when the arterial cannula became dysfunctional and was discontinued. Analgesia was provided by incremental doses of 0.25% bupivacaine for 24 hours, when the epidural catheter was removed intact.

Mother and baby were discharged four days later after an unremarkable hospital stay. The patient is to be followed by the neurosurgery department, and an angiogram is scheduled to determine the extent of her intracranial AVM and surgical resection.

Pathophysiology

An AVM consists of a tangled mass of blood vessels in which arterial blood is shunted directly into veins, which become tremendously dilated. Subarachnoid hemorrhage results from rupture at an arteriovenous junction. Since the mortality rate in the early stages of rupture is considerable—24% within the first 24 hours, 27% within the first 48 hours, and 42% within the first week—prompt diagnosis and treatment is essential. Add to this the life of the unborn fetus, and the gravity of the situation is doubled.

The cooperative study at the University of Iowa by Lockesley in 1966 of 6,368 cases of subarachnoid hemorrhage indicated that the cause was arteriovenous malformation in 6% or 353 cases. Sixty-three percent of first bleeding episodes from arteriovenous malformation occurred in women between 20 and 49 years of age. This age bracket encompasses a large portion of the childbearing years.

Identification of arteriovenous malformation before it ruptures and results in a subarachnoid hemorrhage is especially important. Lockesley discovered only two symptoms with an incidence of at least 90%; headache and dizziness, both of which are so commonplace and nonspecific—especially in the parturient—as to be of little diagnostic value. However, neurosurgeons have become aware of the so-called “warning leak,” which is characterized
by small premature bleeds that may cause only temporary headache or other symptoms such as orbital pain, diplopia, or motor/sensory disturbances. Recognition of these early warning signs is important to begin appropriate treatment early and bring about a more favorable outcome.

The patient developed the most common symptom, headache, at eight weeks gestation accompanied by other symptoms, including left-sided weakness and loss of peripheral vision in the left eye. These symptoms prompted the patient to seek medical aid which resulted in neurological and neurosurgical consultation and the discovery of an AVM. These symptoms lasted throughout the pregnancy with only minor resolution.

The differential diagnosis is easiest when the patient’s history is known. However, it can be significantly more complicated when the patient is found in a comatose state and is unable to provide the necessary diagnostic information. A thorough physical examination and judicious use of all diagnostic tests, along with careful questioning of family members or friends, are essential. Skull radiographs in a patient with an AVM malformation may show a unilateral increase in vascular markings. The computerized axial tomograph (CAT-scan) is undoubtedly the diagnostic tool in any case of intracranial hemorrhage. In an intracranial hemorrhage, a CAT-scan will reveal the location of the blood clot as an area of increased density. Our patient’s CAT-scan revealed such an area in the left medial occipital lobe (Figure 2).

A patient with an AVM who never becomes pregnant has a relatively low risk—10%—of sustaining a subarachnoid hemorrhage; however, if that woman does become pregnant the chances of hemorrhage at some time during her pregnancy increase to 87%. The peak periods for subarachnoid hemorrhage from AVM tend to occur at times of the greatest rate of change in the cardiac output: early in labor, during labor and delivery, and immediately post delivery.

During the first trimester of pregnancy, cardiac output is elevated approximately 30 to 40%. During labor, cardiac output rises 15% during the latent phase and 45% during the expulsive phase, compared with pre-labor values. In addition, each uterine contraction increases the cardiac output an additional 10 to 25%. Immediately after delivery, the cardiac output can be an average of 50% above pre-labor values. With such a large increase in cardiac output during these phases, it can be appreciated why these are the most dangerous periods for rupture and hemorrhage. Another interesting aspect concerns the endocrine changes of pregnancy. It is thought that these changes may stimulate the growth of an AVM and that this may weaken the vessel wall, leading to subsequent rupture and hemorrhage. The obstetrical decision whether to allow the parturient to labor and deliver by the vaginal route or to avoid the active labor phases and perform a cesarean section in delivery is controversial at this time.

Dunn and Raskind believe that patients with treated or untreated AVM should be allowed to deliver vaginally, preferably with continuous regional anesthesia. This is supported by Amias, who studied 52 patients with intracranial hemorrhage of whom 40 were pregnant and 12 recently delivered. No lesions bled during labor, but in three cases hemorrhage occurred within 24 hours of delivery. The authors concluded that “the mode of delivery need not be unduly influenced by the cerebral lesion, the incidence of bleeding during labor is rare, cesarean section carries no demonstrable advantage for mother or child over controlled vaginal delivery, even when the lesion has not been surgically obliterated, and that forceps delivery under sedation and regional anesthesia is the method of choice.”

On the other side of the therapy mode lies cesarean section. Robinson, et al studied 152 women under 45 years of age in whom an AVM or an aneurysm had been demonstrated either by
angiography or at autopsy. Of 24 patients with an AVM, 42 hemorrhages occurred, with 13 taking place during pregnancy, labor, or in the early puerperium. They conclude that “in patients with an arteriovenous malformation, delivery by elective lower cesarean section at 38 weeks is the safest method.”

Factors that may influence the type of delivery are:
1. Treatment of the lesion (conservative versus operative).
2. Maturity of the pregnancy at the time of onset.

Amias et al. showed a bias in favor of cesarean section in 30 cases when neurological management was conservative. The relationship between onset of symptoms and the time of delivery determines the method of delivery of choice. When the lesion is presented late in pregnancy, the cesarean method was preferred, whereas the vaginal route was favored in patients with symptoms occurring no later than eight weeks before labor.

Finally, many authors advise against the routine use of oxytocics in these patients. “The amount of oxytocin administered for most obstetrical purposes is usually insufficient to produce marked alterations of blood pressure.” However, when very large doses are administered in the treatment of uterine atony, a marked fall in arterial pressure may occur with a resultant need to treat it, an overshoot of hypertension, and a subarachnoid bleed or ooze. The use of ergot alkaloids namely Methylergonovine Maleate, to treat resistant uterine atony may be fraught with the dangers of hypertension and the possibility of a subarachnoid bleed. All this is seen most dramatically when the treatment of hypotension with a vasopressor becomes necessary. Therefore, an acute awareness of this interaction is extremely important, especially in patients with an AVM.

Summary
A case study was presented of a 26-year-old female who had a subarachnoid hemorrhage at 8 weeks gestation, secondary to a history of AVM which was noted on a CAT-scan. She presented at 38 weeks gestation with a spontaneous rupture of membranes.

A review of subarachnoid hemorrhage related to an arteriovenous malformation and pregnancy was presented, along with the anesthetic obstetrical implications.

The patient did extremely well in undergoing a cesarean section that utilized a carefully conducted continuous lumbar epidural anesthetic with invasive monitoring. Therefore, labor need hold no insurmountable hazards for the patient with an arteriovenous malformation. A useful guide is to apply safeguards similar to those used in the management of a patient with cardiac disease. If the labor, delivery, and anesthetic are conducted properly and carefully, the risk of further intracranial bleeding can be minimized.

REFERENCES

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