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others suffered hemiparesis, aphasia, or weakness. Although not statistically significant, there appeared to be a trend toward more adverse outcomes in women who suffered intracerebral hemorrhage vs. cerebral infarction.

Neuroimaging studies should be performed in any patient with symptoms that may be consistent with stroke. CT is widely available and may be very useful in confirming the diagnosis; however, a negative CT should not rule out further testing in the face of suspicious symptoms and/or physical examination findings. In our series, the initial CT was negative in 3 of 20 patients, with subsequent MRI or MRI angiography required to accurately diagnose stroke and elucidate its features.

Four-vessel traditional angiography, echocardiography, and lumbar puncture are other diagnostic modalities.

## How to Weigh Stroke History, Pregnancy

With enhanced diagnosis and management of stroke, more patients are recovering well. These patients will increasingly seek advice about the risks of subsequent pregnancy.

We recently conducted a review of 35 pregnancies in 23 women with a history of stroke, including 9 pregnancies in 4 women whose previous stroke had occurred during pregnancy or the postpartum period (*Am. J. Obstet. Gynecol.* 2004;190:1331-4).

Their risk factors for the prior stroke included thrombophilias, sickle cell disease, cardiac malformations, hypertension, oral contraceptive use, cerebral arteriovenous malformations, head trauma, meningitis, endocarditis, and idiopathic etiologies.

Anticoagulation was prescribed in two pregnancies in patients who had a reported history of pregnancy/postpartum stroke. Our findings were reassuring.

There were no recurrent thrombotic episodes during pregnancy or the postpartum period, although one patient required admission to the ICU for uncontrolled hypertension.

This result aligns with findings from another study (*Neurology* 2000;55:269-74), which found a 1% recurrence rate. The chance of recurrence in patients with thrombophilia is likely higher, perhaps 20%.

It makes sense to prescribe anticoagulation for women at risk of thromboembolic stroke, either low-dose aspirin plus prophylactic doses of unfractionated heparin, or low-molecular-weight heparin.

All women with a history of stroke deserve close monitoring during pregnancy, delivery, and the postpartum period.

Of course, appropriate consultation is an integral part of stroke management, and may include a maternal-fetal medicine specialist as well as neurologists, neurosurgeons, radiologists, anesthesiologists, and later, rehabilitation specialists, social workers, and physical and occupational therapists.

Treatment hinges on protecting salvageable brain tissue; stabilizing the patient and preventing further complications such as aspiration; controlling blood pressure and other physiologic factors; and initiating physical rehabilitation.

As evidenced in our series, young patients have a great capacity for recovery in many cases.

My overall recommendation for stroke management is to admit the patient to labor and delivery, perform a thorough maternal and fetal evaluation, and use a multidisciplinary approach to care throughout.

Order antihypertensive medication if the systolic blood pressure is 160 mm Hg or greater, the diastolic blood pressure is 110 mm Hg or greater, or if the mean arterial pressure is 125 mm Hg or greater. Antiepileptic, antiemetic, and anticoagulation medications should be administered as needed.

Neither medications nor surgery should be withheld because of pregnancy.

Deliver the patient in cases of maternal instability or nonreassuring fetal status; labor or rupture of membranes; or gestational age greater than 34 weeks.

### When Intervention Is Necessary

At a gestational age of less than 24 weeks, intervention should be guided by the woman's diagnosis and condition.

Between 24 and 32 weeks' gestation, administer steroids for fetal lung maturity and conduct daily reassessments of the maternal and fetal condition with a planned delivery at 34 weeks, or term delivery if circumstances warrant.

Between 33 and 34 weeks, steroids should be administered and the baby delivered.

The nature of the stroke will determine the best course of medical and surgical management for the cerebrovascular event.

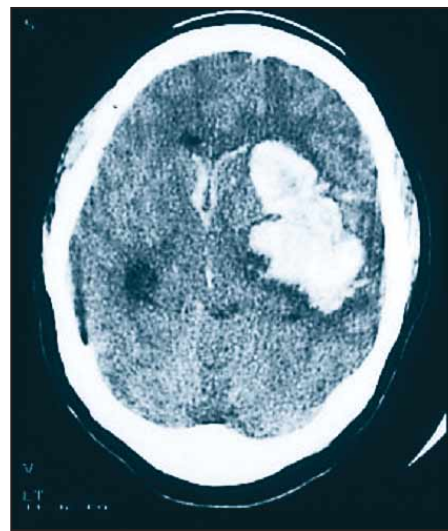
When anticoagulation is needed, keep in mind that warfarin crosses the placenta and has been linked to teratogenicity in the first trimester and bleeding complications in the third trimester. Heparin has been associated with thrombocytopenia, osteoporosis, and bleeding disorders, although it does not cross the placenta. After vaginal delivery, I recommend withholding anticoagulation for 6 hours. I recommend withholding anticoagulation for 12 hours following C-section.

When infection is implicated in stroke, antibiotics should be administered along with anticoagulation.

Low-dose aspirin may be sufficient to treat patients with a single episode of transient ischemic attack.

Hypertensive encephalopathy requires intensive management during labor and for 48 hours post partum. Response to antihy-

Even though occurrence is rare, it calls for prompt diagnosis and direct state-of-the-art treatment of cerebrovascular disorders in this special population.



This CT shows the brain of a pregnant woman who had a hemorrhagic stroke.



This MRI shows the brain of a pregnant woman who had an ischemic stroke.

pertensive therapy confirms the diagnosis. Volume contraction may be present, evidenced by a sharp drop in diastolic blood pressure and a rise in heart rate on standing from the supine position. Normal saline infusion for 24-48 hours may be considered to achieve volume expansion, decrease the

activity of the renin-angiotensin-aldosterone axis, and maintain better blood pressure control. Careful attention should be paid to volume status, blood pressure urinary output, electrocardiographic readings, and

mental status. Antepartum patients should have continuous fetal monitoring.

Eclampsia is treated with supportive care, including oxygenation; minimization of aspiration and future injuries; and lowering of blood pressure. Magnesium sulfate is used for the prevention of eclamptic seizures, although seizures may persist in 10% of patients. The medication should be maintained throughout labor and for 24 hours post partum.

Disturbances in the fetal heart rate are commonly seen after an eclamptic seizure, although resolution usually occurs within 5-10 minutes. Proceed to cesarean delivery only for obstetric indications, as vaginal delivery is preferred following a seizure.

Labor can be induced with oxytocin or prostaglandins.

Carefully monitor the patient's overall fluid status. These patients may have pro-

found hemoconcentration, which necessitates close hemodynamic monitoring when epidural anesthesia is used and after severe blood loss. Acute blood loss can be a serious complication in hypovolemic patients. Limit fluids to prevent pulmonary edema secondary to capillary leakage.

Thrombolytic therapy with intraarterial re-

combinant tissue plasminogen activator has been used to treat ischemic stroke in pregnancy. This treatment must be administered within a window of 6 hours or less to be effective.

### Course of Treatment

Patients who receive a diagnosis of arteriovenous malformation or aneurysm before hemorrhage should be referred for surgical embolization or clipping, as it is believed that patients with AVM may be at increased risk of bleeding during pregnancy. Patients with AVMs are also prone to bleed during delivery.

Once an intracerebral hemorrhage has occurred, the extent of the bleeding will determine the course of treatment. If the brain stem is compromised, surgical decompression is necessary. Surgery may also be necessary if the bleed is subarachnoid in origin; however, surgery itself may damage overlying normal brain tissue, and surgical morbidity is high.

If the bleeding and the patient are stable, surgery can be avoided. Blood pressure should be well controlled and seizures prevented. Steroids have not proven beneficial.

In summary, I would encourage obstetricians to become well versed in the symptoms of stroke and to have a low threshold for clinical suspicion of such symptoms, which may mimic common complaints of pregnancy.

A rapid diagnosis and close consultation with an interdisciplinary team of colleagues may maximize outcome in patients suffering one of the most feared and serious complications of pregnancy. ■

## DATA WATCH

### Rising Cost of Hospital Stay for Acute Cerebrovascular Disease



Source: Agency for Healthcare Research and Quality