

## MASTER CLASS

## Trauma in Pregnancy



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High-risk obstetrics by its very nature involves a wide spectrum of diseases and events that complicate pregnancies and preclude or prevent their normal progression. Sometimes, high-risk obstetrics involves physical trauma that is inflicted externally upon an otherwise normal pregnancy.

Physical trauma is, in fact, one of the leading causes of morbidity and mortality during pregnancy. It has been estimated that physical trauma complicates approximately 1 in every 12 pregnancies—a staggering figure and one that we may not fully appreciate or think about often enough.

According to the American College of Obstetricians and Gynecologists, approximately two-thirds of all trauma

during pregnancy in industrialized nations results from motor vehicle crashes.

Women not only are more likely to be involved in automobile accidents than are male drivers; they also are increasingly more likely to be victims of violence. In 1994, women were about six times more likely than men to be victims of violence—a significant increase from more than a decade before, when women were half as likely as men to be victims of violence.

Trauma in pregnant women has to be dealt with by a variety of specialists. Very often, these patients will present to emergency departments or urgent care centers, and will have to be seen by emergency physicians, surgeons, or general practitioners. This is a challenging situation and one that presents unusual challenges for obstetric staff.

Especially as the number of patients with traumatic injuries and complications increases, it is important that we review some of the key types of presentations and com-

plications of trauma in pregnancy, and discuss how we may best develop therapeutic algorithms for dealing with them.

It is in this light that we have invited Dr. Hugh E. Mighty, chairman of the department of obstetrics, gynecology, and reproductive sciences at the University of Maryland, Baltimore, to discuss the management of seriously injured pregnant women.

Dr. Mighty is not only a maternal-fetal medicine specialist, but is certified in critical care medicine as well. We are pleased to welcome him as an expert on trauma in pregnancy and as this month's guest professor on the subject. ■

DR. REECE, who specializes in maternal-fetal medicine, is vice president for medical affairs, University of Maryland, and the John Z. and Akiko K. Bowers Distinguished Professor and dean, School of Medicine, Baltimore. He is the medical editor of this column.

## Be Prepared to Manage Severely Injured Pregnant Women

Trauma is a leading cause of morbidity and mortality in women of childbearing age. It accounts for approximately 2.5% of hospital admissions among women in this age group, and occurs in at least 6%-7% of pregnant women, a significant number considering the annual birth rate in the United States of approximately 4.4 million.

Patients are bearing children at older ages and are more active than the obstetric populations of generations ago. They are in the workplace, out on the roads, and exposed to common causes of trauma, such as motor vehicle accidents and falls.

It is helpful to know the numbers and be aware of the significance of the problem. Trauma in pregnancy is significantly more frequent, for instance, than the genetic problems we encounter and screen for in our practices.

As ob.gyns., we are bound to be called to treat trauma in pregnancy at some point, and it is important that we be prepared to optimally manage the seriously injured pregnant woman as either a primary manager or as an advisor or consultant, whatever the situation and phase of evaluation and treatment demand.

## The Causes

The vast majority of women who experience trauma (95%-96%) suffer injuries from blunt, rather than penetrating, types of trauma. Most of these injuries, in turn, are a result of motor vehicle accidents.

Motor vehicle accidents are the leading cause of death in women aged 12-51 years and the leading cause of trauma in women of childbearing age, accounting for well over half of the major injuries experienced by pregnant women.

Falls are the second most common cause of blunt trauma.

Although relatively infrequent, penetrating trauma—often caused by gunshot wounds—is still a reality. Penetrating trauma

leads to significant injury to the fetus more often than to the mother, because the mother's abdominal organs are shielded by the gravid uterus.

As ob.gyns., we can help our patients decrease injury in motor vehicle accidents by urging them to use seat belts. When worn correctly—with the lap belt fitting under the belly and close to the hips, and the shoulder belt resting between the breasts and over the shoulder—seat belts with shoulder restraints can definitively

reduce the risk of death and injury for both the mother and fetus.

It is also important to remember that domestic or interpersonal violence may be more frequent during pregnancy than at other times. Such abuse is a less evident cause of blunt trauma, but a very real one. The incidence of interpersonal violence can be as high as 14%-20% in pregnant teenagers, and probably averages about 10%-11% in pregnant women overall.

When taking care of women who report injuries from falls and other events that do not correlate with the overall history or physical exam, we must—in a private and safe environment—address the possibility of partner abuse. We should also remind ourselves that women who are physically abused have a higher incidence of infection, low maternal weight gain, maternal alcohol and drug abuse, and low-birth-weight babies.

## Physiologic Changes

Ob.gyns. will sometimes serve as consultants or advisors in managing trauma during pregnancy, and at other times will serve as primary managers. In any case, optimal evaluation and management require both teamwork (an integrated effort of multiple specialties) and a central role for the ob.gyn., whose understanding of the physiologic changes of pregnancy is vital to management decisions.

Key changes that occur secondary to

pregnancy most often alter the patient's cardiovascular, hematologic, respiratory, urinary, gastrointestinal, and endocrine systems.

Cardiac output increases during pregnancy by 1-1.5 L/min, with a dramatic increase in the percentage of cardiac output that goes to the uterus. By week 36, the uterus receives up to 600 mL/min of blood—which represents about a tenth of the mother's cardiac output—compared with 60 mL/min in the nonpregnant state. Consequently, trauma to the uterus can result in significant hemorrhage and shock.

Blood volume increases by 45%-50% during pregnancy, and can be instrumental in concealing signs of shock from hypovolemia. Along with this, however, the amount of all clotting factors also increases, which predisposes the pregnant

carbonate (a compensated respiratory alkalosis). The decreased residual volumes render the pregnant patient more susceptible to alveolar collapse and respiratory compromise.

Under these circumstances, it may be prudent to consider early intubation of the pregnant patient with respiratory compromise in order to preserve the exchange of gases across the fetoplacental unit.

Renal blood flow is increased in pregnancy, with a concomitant increase in creatinine clearance and a tendency to more rapidly clear drugs that are renal dependent.

Standard lab values must be seen in the context of the changes in maternal physiology. For example, blood gas values in pregnancy may reveal lower CO<sub>2</sub> values, and hematocrits may be lower secondary to the hemodilution seen in blood volume expansion.

During evaluation or resuscitation, it is important for ob.gyns. to remind the team of the mass of the gravid uterus and its ability—when the woman is in the supine position—to compromise the return of blood flow to the heart by compressing the vena cava.

Beyond the second trimester, the

patient should be tilted to the left by approximately 35 degrees, and when a full-body tilt is not possible, left lateral displacement of the uterus must be maintained. When spinal injury is suspected, care must be taken to keep the spine and neck aligned during tilting.

## Questions About Imaging

The obstetrician often will be asked whether the imaging needed to diagnose

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BY HUGH E.  
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COURTESY DR. HUGH MIGHTY

Motor vehicle accidents are the leading cause of trauma and death in women of childbearing age.

patient to embolic risks as well as coagulopathy from disseminated intravascular coagulation (DIC).

The respiratory system adapts for its role of oxygen delivery to the fetus. Tidal volume increases, with an overall increase in minute ventilation. Changes that result from this adaptation are a lowering of the maternal CO<sub>2</sub> level and a decrease in alveolar residual volume. This can further result in a respiratory alkalotic state, which is corrected with a renal decrease in bi-



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various injuries is safe for the fetus. Doses of radiation used during trauma care and evaluation—for example, CT scans of the pelvis or chest, and chest x-rays—are usually in the range of less than 250 mGy, which is considered to be the intermediate range of exposure and reasonably safe for the fetus.

Whenever possible, the pelvis of a pregnant woman should be shielded, especially in the first trimester. It is important to know, however, that much of today's imaging equipment is faster than previous technology and therefore delivers much lower radiation exposure with more information in a single pass. Additionally, MRI has been shown to be a safe modality in pregnancy.

The bottom line is that imaging studies that are needed for the care of the critically injured patient should not be withheld because she may be pregnant.

### Primary Assessment

On initial presentation, all efforts for the pregnant trauma patient must first be directed toward stabilizing the mother and maintaining oxygen delivery, with the ABCs (airway, breathing, and circulation) of trauma care being the first priority.

Women who are pregnant have a reduced ability to compensate for respiratory compromise. Maintaining a patent airway is critical for both maternal and fetal oxygenation, and this very well may require early intubation. We must make sure that the patient is moving oxygen in, with oxygen saturation levels better than 90%.

The fetus's oxygen uptake depends directly on oxygen delivery via uterine blood flow, so circulation—both to the mother's vital organs and to the uterus—is also key. Because of shunting and vasospasm, significant uterine blood flow compromise may exist even with normal-appearing blood pressure. Thus, it is important to control any significant bleeding and pursue vigorous volume replacement.

Only after the ABCs are addressed—and readdressed for effectiveness—can we turn

our attention elsewhere. If we were to add a "D" to the trauma protocol, it would stand for "disability" and would involve a rapid neurologic evaluation to assess for any neurologic injury. It is worth considering that neurologic impairment in late pregnancy may be secondary to an eclamptic seizure that may have led to the trauma event.

Other often critical components of trauma injuries, such as fractures and intraperitoneal hemorrhage, are usually evaluated almost simultaneously by the trauma team.

Patients with pelvic fractures (common in motor vehicle accidents) are at risk of having retroperitoneal hemorrhage, which is not always obvious and requires careful diagnosis. A pelvic exam can reveal signs of lower pelvic fracture and possible vaginal lacerations from protruding bone fragments.

### The Secondary Survey

Once we have stabilized the mother and evaluated her for other critical signs of trauma, we can turn our attention to fetal assessment. First, we should assess gestational age, either by taking a history if someone close to the mother is present, or through ultrasonography.

Ultrasonography is an important tool at this point for assessing several factors in short order. In addition to assessing the viability of the fetus, we can evaluate the intrauterine fluid volume and the placental location. (The question of viability, of course, depends on the level of neonatal intensive care services available).

A low amount of amniotic fluid should lead us to suspect rupture of the amniotic membranes or, in some cases, uterine rupture secondary to trauma. Although with expert hands it is possible to detect relatively small placental abruptions, abruptions are usually apparent only with larger separations.

Ultrasonography can also be used in de-



One situation in which the ob.gyn. becomes the primary provider is when delivery is necessary.

termining intra-abdominal free fluid which is consistent with intraperitoneal hemorrhage.

When the woman is severely injured and needs surgery and if delivery of the fetus is unnecessary, we should focus on monitoring the fetus in the operating room. We can do so with an ultrasound probe or a fetal Doppler encased in a sterile sleeve.

After surgery—or when the woman does not need surgery and is considered stable enough to undergo observation—continuous monitoring of the viable fetus, with a longer-term view, should be done using external monitoring of fetal heart rate and uterine monitoring for signs of preterm labor. Frequent uterine contractions should be followed closely, and cervical dilatation should be evaluated.

The ob.gyn. becomes the primary provider when a viable fetus shows signs of fetal compromise that necessitate delivery, or when uterine rupture occurs, in which case urgent intervention is necessary for the mother.

Many studies have attempted to address

the question of how long trauma patients should be monitored, and many guidelines have been proposed. In general, we can conclude that 12 hours of observation is adequate for stable patients who are not contracting and have reassuring fetal tracings and no signs of bleeding.

On the other hand, patients who are contracting, who have a nonreassuring fetal tracing, or who have had any form of vaginal bleeding should be observed for a minimum of 24 hours. The more severe the injury to the mother, the more likely there is to be an injury to the fetus, and the higher the risk that a placental abruption or other serious complication may surface.

If a patient is discharged after observation, regardless of the severity of trauma, she must be given precautions regarding any changes in fetal movement or the development of abdominal pain, vaginal bleeding, or fluid loss. Any one of these changes should prompt her to return for evaluation immediately.

The Kleihauer-Betke test may be useful in evaluating the degree of fetal-maternal hemorrhage and the amount of Rh immune globulin that may be needed in the Rh-negative mother. In general, Rh-negative mothers who are involved in trauma should be given a single dose of Rh immune globulin unless it is known that the fetus is Rh negative.

Cardiac arrest is sometimes the tragic outcome for a posttrauma victim. Maternal resuscitation should be undertaken immediately. If maternal resuscitation is not thought likely to be effective, and the fetus is considered viable, the best outcome for fetal survival occurs if delivery can be accomplished within approximately 5 minutes from arrest. Beyond this time, there is diminishing return for fetal survival.

Organized, rapid assessment and intervention hold the key to the best outcomes for the pregnant patient involved in a trauma. Following the rules of trauma resuscitation (those ABCs) provides the best chance of successful treatment of the mother, which in turn provides the best chance of a favorable fetal outcome. ■

## Team Is Vital for Gravidas With Congenital Aortic Stenosis

BY BRUCE JANCIN  
Denver Bureau

BARCELONA — Complications occurred in nearly three-quarters of completed pregnancies in the largest-ever reported patient series involving women with congenital aortic stenosis, Dr. Sing-Chien Yap said at the joint congress of the European Society of Cardiology and the World Heart Federation.

Cardiac complications were common but for the most part nonsevere and readily manageable.

However, there were also high rates of general medical, obstetric, and neonatal complications. This underscores the merits of a team approach to management of pregnancy in adults with con-

genital aortic stenosis, with involvement of a cardiologist, neonatologist, and obstetrician, stressed Dr. Yap, a cardiologist at Erasmus University, Rotterdam, the Netherlands.

He reported on 48 women with congenital aortic stenosis who collectively had 70 completed pregnancies, defined as being of more than 20 weeks' duration. The women were part of the larger ZAHARA study, a Dutch nationwide retrospective study investigating pregnancy outcomes in women with all forms of congenital heart disease.

ZAHARA was undertaken with funding from the Netherlands Heart Foundation because treatment advances have resulted in far more women with congenital heart disease surviving

into their childbearing years than was historically the case. Few data exist on the risk factors for and nature and frequency of pregnancy complications in these women, Dr. Yap explained.

Thirty-five of the women had valvular aortic stenosis, 11 had subvalvular disease, and the remainder had supra- or aortic stenosis. Prepregnancy, 9 had severe aortic stenosis as defined by a valvular gradient in excess of 64 mm Hg, 17 had moderate aortic stenosis with a gradient of 36-44 mm Hg, and the rest had mild aortic stenosis. Mean gradients were unchanged after pregnancy.

The most common cardiac complication of pregnancy was deterioration in New York Heart Association functional class. It occurred during 19 of 70 pregnan-

cies and persisted for longer than 1 year postpartum in 3. Heart failure occurred in two patients, both with severe aortic stenosis. Angina occurred in two patients. Four patients developed arrhythmias, mainly supraventricular arrhythmias treated with  $\beta$ -blockers.

Seventeen women required hospitalization for general pregnancy disorders, most of which were hypertension related. There were six cases of isolated pregnancy-induced hypertension, three of preeclampsia, and one of eclampsia. Three women were hospitalized for dyspnea. One woman experienced a transient ischemic attack despite being on warfarin for atrial fibrillation.

Eight women had elective cesarean deliveries, and 11 had emergency cesarean sections.

There were three cases of placental abruption and two of postpartum hemorrhage.

Mean pregnancy duration was 38.2 weeks. Eleven babies were born small for gestational age. There were 10 preterm deliveries. One neonate died as a consequence of prematurity. Two children were born with congenital heart disease.

Most of these complications occurred at significantly higher rates than in the general Dutch pregnant population. Complication rates were highest in women with severe aortic stenosis.

Because of the limitations inherent in a retrospective study, the investigators have launched a prospective nationwide study of pregnancy in congenital heart disease, according to Dr. Yap. ■