

Fall 2014

Reading

CEPCE

Professional Development:
Pregnancy Related Emergencies

This self study package was compiled by Chris Andersson and the clinical CEPCP staff.

Introduction

It was the first day of the season's black ice. After several months of not having to worry about traction and stopping distances there was suddenly ice on the roads. Predictably cars were careening out of control and bumping into each other like a catchment-area wide smash-up derby. Luckily the accidents so far had all been minor fender-benders. Lots of paperwork but no patient transports so far.

"4241 call for a code 4."

"Go ahead." Clearly it wasn't over yet.

"Please proceed code 4 to King Street and Spencer Avenue. There are reports of an MVC at that location. Two vehicles. Unknown injuries...", this was becoming way too routine, we thought, until the dispatcher added the dreadful ending to the call information. "...one of the passengers is a female, pregnant...", she paused, we held our breaths, "...unknown injuries. Proceed code four. Fire and 10-2s have been tiered."

As the ambulance wheels were spinning across the slick surface our mental wheels were doing the same. How far along was the pregnancy? Would there be injuries? The fetus is pretty well protected in there... isn't it? Oh, and there is something with the vital signs. They go up during pregnancy...or is it down? What if there is vaginal bleeding? The silent contemplation was ended by my partner. With his eyes on the road, one hand on the siren control and the other on the wheel he declared "Well, this will be one patient we are NOT signing off." I could not have agreed more.

It is probably safe to say that a pregnant patient ranks right up there with a pediatric patient when it comes to invoking anxiety in paramedics. There are lots of special considerations that should be taken into account and although most of the pregnant patients that are transported are not in critical condition, it is important to know what to look for, ask about and recognize when caring for a



pregnant patient. This can be a daunting task considering all the complications and special considerations that apply during the nine months of pregnancy.

We will try to tease it all out in this reading package. By dividing the period of pregnancy into the well known trimesters, and then looking at which special consideration and risks exist in those trimesters the topic can be made quite manageable.

First Trimester Emergencies

Each trimester lasts approximately 13 weeks (or three months) (Bledsoe 2006). During the first trimester the egg is fertilized in the ovary and then travels down to the uterus where it attaches and begins to grow, forming a placenta and fetus. During the beginning few weeks it is unlikely that the mother is even aware of the pregnancy which adds a layer of difficulty to the EMS assessment. I would argue that the two most common lies told to paramedics are “Two beers.” and “No, there is no way I could be pregnant.”

Most of the non-traumatic, (we will cover trauma later in this reading package) pregnancy-related symptoms that paramedics will be called for, will be abdominal pain and/or vaginal bleeding. There are a few possible causes for these symptoms in the first trimester. The best case scenario is that it is simply some bleeding as a result of the implantation process. This type of bleeding happens in as many as one out of four pregnancies and is not life-threatening (Snell 2009).

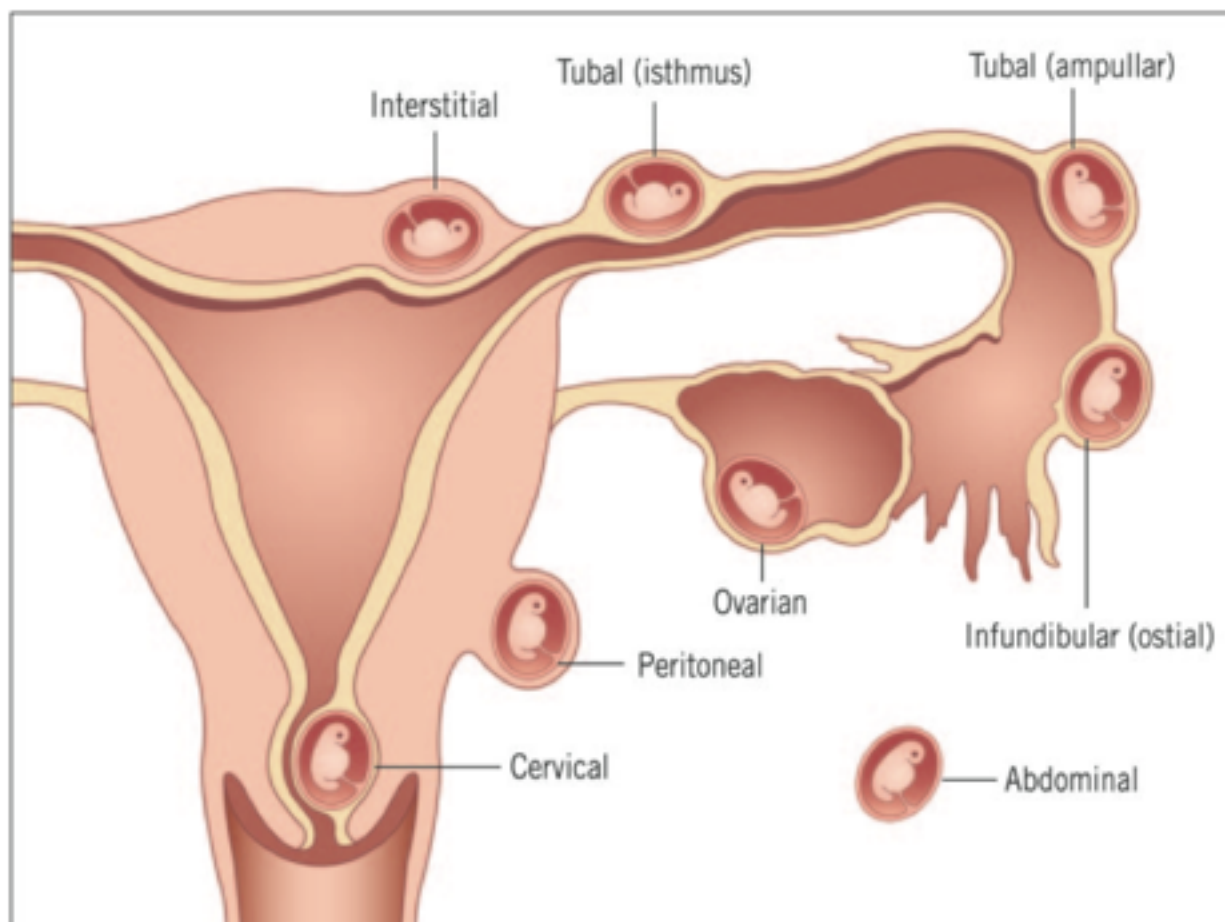
However, there are three other causes that should be ruled out; spontaneous abortion, ectopic pregnancy, and gestational trophoblastic disease (GTD) (Snell 2009). Gestational trophoblastic disease is sometimes referred to as a ‘molar pregnancy’ and is

unlikely to result in any *immediate* life-threat (Soper 2006). It is essentially a growth that should turn into the placenta but instead just turns into a growth on the uterine wall (Soper 2006). Some are, or turn into, cancers but luckily many are benign (Soper 2006).

Spontaneous abortions at this stage are also rarely life-threatening. Most spontaneous abortions happen between week 12-14 (Snell 2009). As you may recall, each trimester is 13 weeks so a spontaneous abortion is most likely towards the end of the first trimester or the beginning of the second. They may be emotionally upsetting to the mother. A supportive trip to the ER to ensure that there are no other issues going on is prudent.

That leaves the ectopic pregnancy, a condition which is most definitely life-threatening and often missed! Ectopic pregnancy is the most common life-threatening emergency in early pregnancy (Murray, Baakdah et al. 2005). In fact it is the leading cause of maternal death in Canada and makes up 4 percent of the approximate 20 annual pregnancy related deaths in Canada (Murray, Baakdah et al. 2005). As many as 19 percent of deaths from ectopic pregnancies are considered preventable, so recognition is huge (Anderson, Hogan et al. 2004).

An ectopic pregnancy is usually diagnosed anywhere between 4 to 10 weeks after the last normal menstrual period (LNMP) (Lozeau and Potter 2005, Murray, Baakdah et al. 2005, Bledsoe 2006). It occurs when the implantation of the fertilized egg occurs outside of the uterus where the fetus normally grows along with the placenta. *Outside* in this case does not mean on the outside of the uterus (although it happens in very rare cases) but rather on the path from the ovary to the uterus. Normally



Types of ectopic pregnancies.
(Seeber and Barnhart 2006).

fertilization occurs in the ovaries and then the fertilized egg is moved down the fallopian tubes to the uterus.

However, in some cases the fertilized egg gets stuck or decides that it has travelled far enough and implants before reaching the uterus. This may not cause any detectable problems for a few weeks but the fertilized egg grows quickly and eventually runs out of space in the narrow fallopian tube. The fallopian tube distends a little bit but eventually ruptures unless the implantation is removed in time. Once ruptured it bleeds into the abdominal space, and can quickly cause life-threatening internal hemorrhage.

In order to describe the signs and symptoms associated with an ectopic

pregnancy let's consider the textbook version and then also discuss some very annoying exceptions to the textbook presentation that makes these cases easy to miss.

Let's imagine a tubal implantation that is gradually growing larger (refer to the illustration). I think we have all had an... ahem...irritation of a hollow organ. It is easy to imagine the crampy, poorly localized pain that ensues (Murray, Baakdah et al. 2005, Seeber and Barnhart 2006). At this point there is no bleeding since nothing has ruptured yet. Once the fallopian tube ruptures we can expect the pain to change dramatically to a more severe, sharp, peritonitis-like pain associated with guarding and rigidity

(Lozeau and Potter 2005, Seeber and Barnhart 2006). The ruptured fallopian tube will begin to bleed and depending on the location and type of rupture it can bleed into the fallopian tube, blood which will flow into the uterus and eventually present as vaginal bleeding. The ruptured fallopian tube may also bleed outwards, into the abdominal space which will not present as vaginal bleeding but is just as life-threatening. The take home point is that there may or may not be vaginal bleeding (Lozeau and Potter 2005).

Since the internal bleeding associated with a ruptured ectopic pregnancy is often quite severe, the typical signs and symptoms of shock, hypotension and tachycardia, may also be present (Lozeau and Potter 2005, Seeber and Barnhart 2006). Do NOT get too comfortable if your patient does not have these hallmark signs though. Patients with a ruptured ectopic pregnancy often fail to show the normal vital signs abnormalities that one would expect with volume loss (Hick, Rodgers et al. 2001). This is thought to be caused by vagus stimulation which may 'put the breaks' on the normal tachycardia response (Hick, Rodgers et al. 2001).

This might be the point in this article where you start getting a bit frustrated since I have basically said that a typical ectopic is one that present with a patient who may or may not know that she is pregnant and may or may

not have pain and may or may not have bleeding and if there is hypovolemia this might not even be detectable by usual means! Who said medicine is black or white? It is always a series of clues that helps you lean in one direction or the other. Ready for some more clues?

Lets say that you have a patient with a fairly typical ectopic presentation. She has abdominal pain, vaginal bleeding and is in the first trimester. The chances that your patient is having an ectopic pregnancy is 39 percent based on those signs and symptoms alone (Lozeau and Potter 2005). Clearly this patient needs to be taken to the ER in a hurry but you can refine your working assessment even more by exploring if the patient has any risk factors.

Have a look at the list of risk factors and try to commit most of them to memory. At least remember that any condition that has the potential to damage the fallopian tube has the potential to cause the fertilized egg to get hung up in its travel to the uterus. If there are any risk factors present your 39 percent increases to 54 percent. Maybe speed

things up a bit more!

In summary it is safe to say that any pain or bleeding in a female of childbearing age with a late period needs to be transported to the hospital for further investigation. However, more details may help you determine the cause of the bleeding and provide the receiving staff with invaluable information. Some questions that should be

Risk Factors for Ectopic Pregnancy

- Previous tubal surgery
- Previous ectopic pregnancy
- Patient exposed to DES* in utero
- History of pelvic inflammatory disease
- History of infertility
- History of chlamydial or gonococcal cervicitis
- Tubal abnormality
- Tubal ligation
- Current IUD use

(Murray, Baakdah et al. 2005)

* DES exposure

Diethylstilbestrol is a synthetic estrogen that was widely prescribed, specifically to pregnant women, from 1938 to 1971 in US and Canada (as late as 1980 in some other countries). During this time as many as 4 million women, in the US alone, were given this drug during their pregnancy for its purported effect of decreasing complications such as miscarriages.

In a cruel twist of fate the drug was actually poisoning the fetus without any of the positive effects that were claimed. Later research found that persons that were exposed to DES in utero have a higher risk of certain types of cancer. Females often have structural abnormalities of their reproductive organs. Ectopic pregnancy is just one of the potential complications of an overzealous drug industry and an era where way too much hope was placed in magical pills that could solve the world's problems.



explored includes when the onset of bleeding occurred; the amount, colour, and consistency of the blood and the clots in the blood; what was associated with the onset (e.g., sexual activity, lifting, vomiting, etc.); and whether pain, cramping, or discomfort is associated with the bleeding (Snell 2009).

In order to define the severity of vaginal bleeding consider this handy rule of thumb; light bleeding is lighter than a period, moderate bleeding is similar to a period, and heavy bleeding is heavier than a period (Snell 2009).

Second and Third Trimester Emergencies

As discussed previously the most common cause for vaginal bleeding at the beginning of the second trimester is a spontaneous abortion. Although often very emotionally devastating for the mother it is rarely a life-threatening event. However, bleeding in the second half of the pregnancy (later in the second trimester and into the third) should be taken very seriously as it can be life threatening to both the mother and the fetus. The good news is that bleeding this late in the pregnancy is relatively rare, occurring only in about 1 percent of pregnancies.

Hypovolemia is the biggest threat to the mom at this stage. Hence, a main focus of

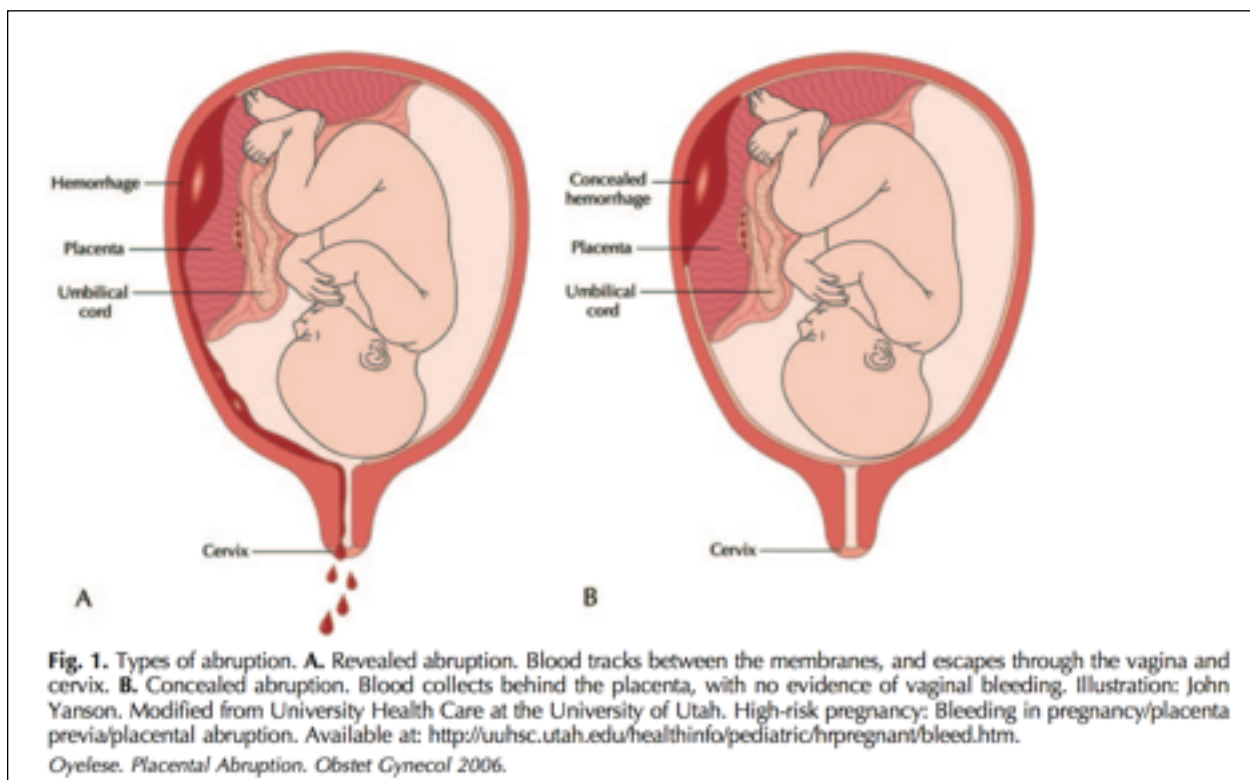
assessments is directed towards accurately estimating blood loss and looking for signs and symptoms of hypovolemia. The challenge with this seemingly routine task is that we must take into account the normal physiological changes that occur at this stage of the pregnancy. During the second half of pregnancy we can expect the heart rate to be 5-20 beats per minute faster than normal. The blood pressure drops to 5-15 mmHg lower than normal in the second trimester and then gradually rises to normal levels towards the end of the pregnancy. You may have noticed that these vital sign abnormalities in a non-pregnant patient would lead you to suspect hypovolemia. This is good news, at least the physiological changes of pregnancy won't 'mask' hypovolemia.

The two most common causes of bleeding in the second half of pregnancy are placental abruption and placenta previa (Koifman, Levy et al. 2008). In fact, in one

large study covering over 175,000 pregnancies all of the cases of vaginal bleeding that occurred in the second half of the pregnancy were attributed to either placental abruption (63.5%) or placenta previa (36.5%)(Koifman, Levy et al. 2008).

Placental abruption is essentially when the placenta peels off the uterine wall before it is time to do so (Oyelese and Smulian 2006). Recall that the placenta is very vascular and serves as the interface between the mother and the developing fetus. When separation occurs bleeding also occurs. The bleeding may leak between the layers into the uterus and consequently through the cervix and present as vaginal bleeding, or it may get trapped between the layers and be 'concealed' (Oyelese and Smulian 2006).

The effects of bleeding from a placental abruption vary widely. Sometimes there is no negative consequences at all. On the other hand of the spectrum is the potential



death of the fetus and/or mother (Oyelese and Ananth 2006). The two main mechanisms of harm may be self-evident; the fetus may be starved of oxygen and nutrients as the connection to the mother is lost, or there may be significant blood loss for both the fetus and/or the mother from the bleeding (Oyelese and Ananth 2006). Consequently the degree of damage is dependent on the degree of separation and the gestational age of the fetus at the time of separation (Oyelese and Ananth 2006).

If the gestational age is advanced enough then the decision will probably be to deliver through emergency c-section. Unfortunately most of the cases of placental abruption occur between 24-26 weeks gestation which is on the lower cusp of viability (Oyelese and Ananth 2006). Neonates delivered early due to a placental abruption have a much higher incidence of long term complications (Oyelese and Ananth 2006). Luckily the dilemma of whether to deliver via c-section or not is up to the hospital and mom, not you!

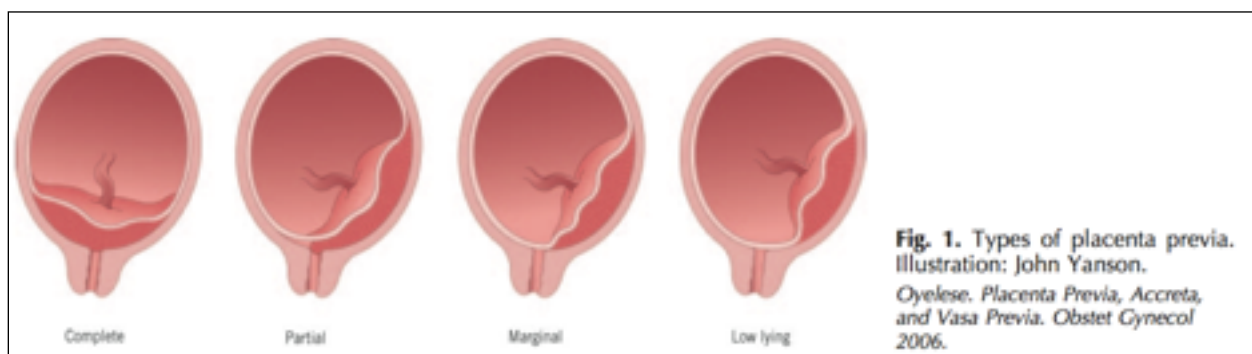
The question that is probably burning in your mind now is what should we be looking for, and asking about, to help nail down the working assessment of placental abruption and tell it apart from placenta previa. The classic presentation of placental abruption is painful vaginal bleeding at the

end of the second or beginning of the third trimester (Oyelese and Ananth 2006). But, (there is always a but) only one or none of these symptoms may be present (Oyelese and Ananth 2006). Often the uterus will be tender and hard on palpation. If the abruption is posterior then backache might be the only symptom (Oyelese and Ananth 2006).

If you suspect a placental abruption the most important thing is to recognize it for the emergency that it truly is. There is no time to waste on scene. Immediate transport with an early update to the receiving hospital is key. IV access (if available) can be established en-route. Please do not be stingy with the oxygen. Appreciate that an SpO₂ reading on mom tells you nothing about the oxygenation status of the fetus. Play it safe and use a non-rebreather mask set to 15 litres per minute.

Another important role we can play is getting an accurate estimation of the amount of blood loss. Even though the amount correlates poorly to the degree of abruption it is invaluable to the receiving staff to get a clear idea of how much blood, fluid volume and clotting factors need to be replaced (Oyelese and Ananth 2006).

Placenta previa is simply when the placenta implants low in the uterus, sometimes even covering the cervix.. Worst case scenario is a placenta that covers the cervix when contractions begin and the baby



busts through it to get out. Obviously such an event would lead to bleeding and a fetus without blood flow for a long period of time.

Luckily there is often some warning before such disasters occur. During gestation the tissue around the cervical opening is normally quite thick (over 1.5 inches) And the cervix is tightly closed and sealed with a mucous plug. Late in the third trimester there are usually some small contractions and the thickness of the tissues around the cervix is reduced to prepare for delivery. These changes may cause some separation of the placenta that has implanted in the area with resultant bleeding (Oyelese and Smulian 2006). The bleeding itself may cause some further contractions and some further bleeding (Oyelese and Smulian 2006). The classic presentation of placenta previa is painless bleeding late in the second or early in the third trimester (Oyelese and Smulian 2006). The good news is that this bit of bleeding is usually not life threatening, but for a patient who has not had any pre-natal care to catch the precarious position of the placenta it may cause them to seek medical help which will identify the position of the placenta (Oyelese and Smulian 2006).

A complication that frequently goes along with placenta previa is something called placenta accreta (Oyelese and Smulian 2006). Placenta accreta is when the placenta grows into the uterine wall and surrounding tissues (Oyelese and Smulian 2006). This can lead to serious complications and bleeding since the placenta will not separate cleanly from the uterine wall (Oyelese and Smulian 2006). The average blood loss during a delivery with placenta accreta is 3,000 - 5,000 mL, aggressive fluid and blood replacement is critical for survival (Oyelese and Smulian

2006). Luckily, with today's ultrasound technology it is possible to detect the position and condition of placental growth during the pregnancy and prepare accordingly.

As you may have already noticed, there is no definitive way to determine what is causing vaginal bleeding and/or pain in the second half of pregnancy but it is potentially being caused by something that can threaten the life of the fetus and/or mother so ensure rapid transport is part of your plan!

Trauma

When dealing with a pregnant trauma patient it is again useful to determine what trimester the patient is in to help narrow the focus on potential injuries. For example, in the first trimester the fetus and uterus do not protrude past the protective pelvic girdle, hence is fairly resistant to direct trauma (Chames and Pearlman 2008). At this stage in the pregnancy the biggest threat to the fetus is lack of perfusion due to the mother becoming hypovolemic (Mattox and Goetzl 2005). It is important to note that this continues to be a threat throughout the pregnancy.

There are a couple of things to be aware of when assessing for hypovolemia. A developing fetus needs a lot of blood flow. The vessels that feed the uterus are forced to run 'wide open' during pregnancy to supply the demand (Chames and Pearlman 2008). If the mother is injured and is bleeding, the vessels will constrict to shunt blood flow to vital organs. Since the fetus needs full flow, any vasoconstriction can be life-threatening for the fetus (Chames and Pearlman 2008).

To make things even more complicated the usual signs and symptoms of hypovolemia may be missing. The maternal blood volume increases by 40-50% by the end of the first

trimester, and into the second trimester, to make sure it can supply the uterus' demand. If needed, the blood vessels will simply constrict and shut this part down to preserve the mothers life. With that extra volume not circulating to the fetus, mom can compensate quite well. This means that there may not be any vital sign abnormalities until 1.5 - 2 litres of blood has been lost, at that stage the blood flow to the fetus is already severely compromised (Shah and Kilcline 2003).

As the pregnancy continues, the fetus and the uterus grows and becomes more susceptible to direct injury from blunt trauma. The fetus itself continues to be quite well protected by the thick uterus and the amniotic fluid filled sac (Chames and Pearlman 2008). So luckily, direct injury to the fetus continues to be rare. However, in addition to maternal hypovolemia, as previously discussed, an even more sneaky injury can occur at this stage. We have already discussed spontaneous placental abruption. Likewise blunt trauma can also cause the placenta to separate from the uterine wall. The placenta is stiffer than the uterus. You can think of it as a scab growing on your leg. If you pinch the skin on either side of the scab it tends to peel the scab off. Similarly, shearing forces on the uterus can cause the placenta to peel off (Shah and Kilcline 2003).

Unfortunately the mechanism of injury will not help you rule out a traumatic abruption. Traumatic placental abruption occurs in approximately 6% of pregnant trauma patients but it is not strongly related to the severity of trauma (Chames and Pearlman 2008).

Ok, so the mechanism won't help in ruling it out. Then the assessment must do the trick. Not really. As with a spontaneous abruption, pain and vaginal bleeding are the

big warning signs but they are not always present. One study found that less than half of patients with a traumatic abruption had vaginal bleeding (Shah and Kilcline 2003). The most common symptom is regular uterine contraction which is present in the vast majority of cases (Shah and Kilcline 2003).

Another, more devastating but rarer, blunt trauma injury in pregnancy is uterine rupture. Uterine rupture occurs most often in patients who have had a cesarian section in the past (Shah and Kilcline 2003). It normally occurs as a result of significant blunt trauma. Mortality of the fetus is close to 100% and the mother will succumb to her injuries about 10% of the time (Shah and Kilcline 2003).

The signs of a uterine rupture is a tender uterus that might be irregular in shape, sometimes even with palpable fetal parts (Shah and Kilcline 2003). If the uterus is not scarred from a previous cesarian section then the uterus is more likely to rupture at the back which often also injures the bladder (Shah and Kilcline 2003). This type of rupture may present as blood and meconium in the urine (Shah and Kilcline 2003). Vaginal bleeding may or may not be present.

So far we have discussed the potential consequences of blunt trauma, how about penetrating trauma? As sad as it may be, pregnant individuals do get stabbed and shot too. Gunshot wounds to the abdomen are not surprisingly often devastating to the fetus. Seven out of 10 fetuses are injured when the mother is shot in the abdomen and over half of them will die (Mattox and Goetzl 2005). Stab wounds are less devastating and carry a lower mortality rate (Shah and Kilcline 2003, Mattox and Goetzl 2005).

One thing to keep in mind when caring for a pregnant stabbing victim is that

the bowels get displaced upwards in later stages of pregnancy and upper abdominal wounds can lead to very complicated bowel injuries (Mattox and Goetzel 2005).

So at this point you are probably wondering what good all this knowledge will be when you actually arrive on that chaotic trauma scene and find a pregnant patient. Lets get down to business and get you prepared to deal with it like a seasoned master!

First of all, do a proper rapid trauma survey, like you always do when you suspect trauma. There is no point stressing over pregnancy related stuff if your patient is bleeding externally or not breathing. Take care of the basics first. Make sure that your patient is breathing adequately and assist breathing if required or apply oxygen with a non-rebreather. Do not even think of applying a nasal cannula. Pregnant patients have diluted blood, they are anemic (Shah and Kilcline 2003). Anemic patients can be hypoxic with excellent sats. Remember; if a patient has one hemoglobin left in their system and it is fully saturated with oxygen, they will have a saturation level of 100%. During pregnancy, oxygen demands are high and the fetus is very sensitive to drops in oxygen levels. There is no

way of rationalizing a nasal cannula (or no oxygen!!) for a pregnant trauma patient. Period.

Second to the hypoxia concern, all of the pregnancy related injuries that are immediately life-threatening are due to bleeding and hypovolemia. This is where determining the trimester comes in. Know the normal growth pattern (see below) so that you can estimate the trimester even for an unconscious patient. Palpate the uterus for tenderness and contractions (Chames and Pearlman 2008).

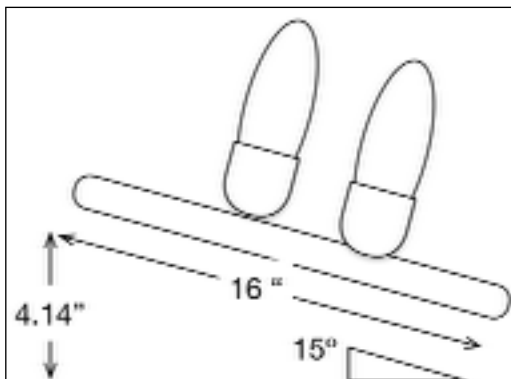
The absence of abdominal tenderness and guarding does not rule out intra-abdominal bleeding. The gradual growth and stretching of the abdominal tissues tend to desensitize them and pain may not be present even with significant bleeding (Shah and Kilcline 2003).

Beyond 20 weeks gestation the uterus has grown to a point where it may compress the vena cava and impede blood return from the lower body when the patient is supine (Shah and Kilcline 2003). This impediment can be significant, reducing cardiac output by as much as a third (Shah and Kilcline 2003).

Gestational age and uterine location. (Mattox and Goetzel 2005)

Gestational Age, Wks	Location of Top of Uterus
8	Just above pubis
12	Halfway between pubis and umbilicus
16	Two-thirds of way between pubis and umbilicus
20	At umbilicus
26	Just above umbilicus
32	Halfway between umbilicus and xyphoid
36	Three-fourths of way between umbilicus and xyphoid
40	Near xyphoid

Luckily this has an easy fix; simply tilt the backboard (or the patient if they are not on a backboard) 15 degrees to the left. You don't carry a protractor in your vehicle? Who said math is only for calculating drug doses? A standard backboard is about 16 inches wide. To get a 15 degree angle, basic trigonometry will tell you to raise the backboard by 4.14 inches...maybe make it 4.5 to be on the safe



side. Also, rather than trying to remember which side to lift, just remember to tilt the patient towards you as you sit on the bench (or sliding jump seat).

If, for some odd reason, tilting the backboard just isn't an option, you can manually shift the uterus to the left (Chames and Pearlman 2008).

Conclusion

So there you have it, you are now on the way to the hospital with your patient. The rapid trauma survey is done. The patient has oxygen on, running through a non-rebreather. You have stuck a folded sheet (4.5 inches thick) under the far side of the backboard. You have assessed the uterine height, tenderness and checked for contractions. You are looking at the vital signs with a critical eye, knowing the normal physiological changes you can expect. You have instructed your partner to give the hospital a heads-up since you know some expertise may need to be summoned for your arrival.

Suddenly you wonder why you expected this to be so much more stressful and overwhelming. Sure there are a few more considerations and there are two lives instead of one in your care. But with knowledge and preparation it really is a very manageable call.

Bibliography

Anderson, F. W., et al. (2004). "Sudden death: ectopic pregnancy mortality." Obstetrics & Gynecology 103(6): 1218-1223.

Bledsoe, B. P., S. Robert; Cherry, A. Richard (2006). Paramedic Care Principles & Practice. Upper Saddle River, New Jersey, Pearson Education.

Chames, M. C. and M. D. Pearlman (2008). "Trauma during pregnancy: outcomes and clinical management." Clinical obstetrics and gynecology 51(2): 398-408.

Hick, J. L., et al. (2001). "Vital signs fail to correlate with hemoperitoneum from ruptured ectopic pregnancy." The American Journal of Emergency Medicine 19(6): 488-491.

Koifman, A., et al. (2008). "The clinical significance of bleeding during the second trimester of pregnancy." Archives of gynecology and obstetrics 278(1): 47-51.

Lozeau, A.-M. and B. Potter (2005). "Diagnosis and management of ectopic pregnancy." Am Fam Physician 72(9): 1707-1714.

Mattox, K. L. and L. Goetzel (2005). "Trauma in pregnancy." Critical care medicine 33(10): S385-S389.

Murray, H., et al. (2005). "Diagnosis and treatment of ectopic pregnancy." Canadian Medical Association Journal 173(8): 905-912.

Oyelese, Y. and C. V. Ananth (2006). "Placental abruption." Obstetrics & Gynecology 108(4): 1005-1016.

Oyelese, Y. and J. C. Smulian (2006). "Placenta previa, placenta accreta, and vasa previa." Obstetrics & Gynecology 107(4): 927-941.

- Seeber, B. E. and K. T. Barnhart (2006). "Suspected ectopic pregnancy." Obstetrics & Gynecology 107(2, Part 1): 399-413.
- Shah, A. J. and B. A. Kilcline (2003). "Trauma in pregnancy." Emergency Medicine Clinics of North America 21(3): 615-629.
- Snell, B. (2009). "Assessment and management of bleeding in the first trimester of pregnancy." Journal of Midwifery & Women's Health 54(6): 483-491.
- Soper, J. T. (2006). "Gestational trophoblastic disease." Obstetrics & Gynecology 108(1): 176-187.