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This issue is the second installment of a two-part series on evaluation and management of sexual assault in the emergency department (ED). Part I of the series covered initial ED care, physical exam, and evidence collection. This issue will cover laboratory analysis, pharmacotherapy, disposition, follow-up, documentation, and court testimony.

—The Editor

Evaluating and Treating Sexual Assault in the Emergency Department

Part II: Laboratory Analysis, Pharmacotherapy, Disposition, and Documentation

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Laboratory Analysis

Most rape kits require a blood sample from the victim for blood typing and DNA analysis. Rape kit protocol may require collection of blood in a purple top tube with EDTA powder. The tube is labeled with patient name, date and time of collection, and collector's initials. The tube then is placed in an envelope, sealed, labeled, initialed, and included in the kit. Alternatively, use of a filter paper (provided in the kit) for application of a few drops of the victim's blood may be employed.

Concern for possible exposure to sexually transmitted infections (STIs) should prompt provision of antibiotic

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prophylaxis in the ED and close follow-up care for testing. Traditional teaching has been to obtain blood samples for syphilis (RPR), hepatitis B, and HIV, and genital swabs for gonorrhea and Chlamydia during the initial ED evaluation. However, there remains some controversy regarding the use of screening tests for STIs after sexual assault. Some centers operate under a protocol of providing antibiotic prophylaxis without STI testing in the ED, and testing only on follow-up visits. Because the incubation period for common STIs may be several days, a positive STI test from the ED may document an exposure prior to the assault. Thus, many practitioners (particularly within SANE programs) omit routine screening, believing that positive ED test results may be used to vilify the victim in the courtroom. Urinalysis can be obtained for pregnancy testing and for toxicology analysis. Pregnancy testing is used to rule out a pre-existing pregnancy in women who will take estrogen-containing emergency contraception (EC). However, use of the product Plan B, which is a progestin-only form of EC, precludes the need for pregnancy testing.

Drug-facilitated rape, most commonly with gamma hydroxybutyrate (GHB) or flunitrazepam (Rohypnol), has received significant attention in the medical community, law enforcement, and lay public. The Drug Induced Rape Prevention and Punishment Act of 1996 is a federal statute that provides a penalty of up to 20 years in prison for the intent to commit a crime of violence against an individual by distribution of a controlled substance to him or her without his or her knowledge. Some states further amended that law to include Rohypnol, GHB, and ketamine.[1] If a drug-facilitated rape is suspected, or if specimens for toxicologic analysis are requested by police, urine and blood samples should be obtained after the patient consents. Most hospital drug screens do not detect the presence of GHB and Rohypnol, and these specimens need to be sent to special forensic labs to specifically test for these substances. In general, collect as much urine as possible, and sufficient blood for three gray top (fluoride) tubes. These specimens are labeled and sealed and usually not placed in the rape kit. Protocol may require delivery to a separate crime lab or other toxicology lab.

Finally, for those victims of sexual assault who have sustained bodily injury, other testing may be required, as dictated by clinical judgment and trauma management protocols.

Pharmacotherapy for Sexual Assault

Most medications provided to sexual assault victims are provided as prophylaxis against tetanus, STI, and pregnancy.

Tetanus. Victims who sustain tetanus-prone injuries should be provided tetanus prophylaxis using the same guidelines as other patients.

Sexually Transmitted Infections. Major STIs of concern to the sexual assault victim are gonorrhea, syphilis, Chlamydia, and trichimoniasis because of their relative high incidence. The Centers for Disease Control and Prevention (CDC) reports that 6-12% of adult victims contract gonorrhea after sexual assault.[2] In addition, 4-17% of victims acquire Chlamydia after assault.[3] Other STIs (i.e., trichimoniasis, syphilis, hepatitis, and HIV) also can be be contracted following sexual assault.

The decision to obtain genital or other specimens for STI diagnosis should be made on an individual basis. Laws in all 50 states strictly limit the evidentiary use of a survivor's prior sexual history, including evidence of previously acquired STIs, as part of an effort to undermine the credibility of the survivor's testimony. Cultures for *N. gonorrhea* and *C. trachomatis* should be obtained from any site of penetration or attempted penetration. FDA-approved nucleic acid amplification tests are more sensitive than culture testing. A positive test result should be confirmed by a second test. Enzyme immunoassay (EIA), non-amplified probes, and direct fluorescent antibody tests are not acceptable alternatives for culture because of unacceptably high false-negative rates. Nucleic acid amplification tests are not approved for use in pediatric patients and are not approved for use in non-urethral or non-vaginal/cervical sites. The CDC recommendations for STI prophylaxis in victims are listed in Table 1.[2] A common side effect of STI prophylaxis is nausea. An anti-emetic may be prescribed, or the patient may take some of the medications the next day.

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Table 1. Sexually Transmitted Infection Prophylaxis in Sexual Assault [2,4]

DISEASE	RECOMMENDED REGIMEN	ALTERNATIVE REGIMEN*
GONORRHEA		
	Ceftriaxone 125 mg IM in a single dose	Spectinomycin 2 g IM once Single dose quinolone** Single-dose cephalosporin†
CHLAMYDIA		
	Azithromycin 1 g orally in a single dose *OR* Doxycycline 100 mg po BID x 7 days	Erythromycin base 500 mg QID x 7 days Ofloxacin 300 mg BID x 7 days Levofloxacin 500 mg daily x 7 days
TRICHIMONIASIS		
	Metronidazole 2 g orally in a single dose	Metronidazole 500 mg BID x 7 days
HEPATITIS B		
	Hepatitis B Vaccine 1 cc IM initially, repeat in 1-2 and 4-6 months	None
HIV§		
	Regimen 1 Efavirenz 600 mg po at bedtime *PLUS* Lamuvudine/Zidovudine (Combivir 150/300 mg) one BID *OR* Emtricitabine/Tenofovir (Truvada 200/300 mg) one daily **Regimen 2** Lopinavir/Ritonavir (Kaletra 400/100 mg) 3 tablets daily *PLUS* Lamivudine/Zidovudine (Combivir 150/300 mg) one BID	See CDC website

* Alternative regimen is taken from the general CDC guidelines for treatment of sexually transmitted infections

** Options include: Ciprofloxacin 500 mg, Ofloxacin 400 mg, Levofloxacin 250 mg, Gatifloxacin 400 mg, Norfloxacin 800 mg, and Lomefloxacin 400 mg.

† Options include: Cefixime 400 mg po (may be unavailable from manufacturer), Ceftizoxime 500 mg IM, Cefoxitin 2 g IM plus probenecid 1 g orally, Cefotaxime 500 mg IM,

§ Either regimen can be used and is continued for 4 weeks.

Hepatitis B. Sexual transmission accounts for approximately 30-60% of the estimated 240,000 new hepatitis B virus infections in the United States.[2] Fully vaccinated patients do not require further therapy. If not vaccinated, then hepatitis B vaccine should be administered. Hepatitis immune globulin (HBIG) is not indicated. If vaccination status is unclear, obtain hepatitis serology and, if not immune, proceed with vaccination. Hepatitis B vaccination initiated in the ED requires medical follow-up at one and six months for completions of the series.

HIV. To date, the CDC reports three documented cases of HIV infection from sexual assault.[4-6] The average risk of HIV transmission per contact of unprotected receptive anal intercourse is approximately 1-5%. For unprotected insertive anal intercourse and receptive vaginal intercourse, the risk is approximately 0.1-1%. For unprotected insertive vaginal intercourse it is less than 0.1%. The risk of receptive oral transmission has not been quantified.[8-12] These data also can be quantified in the following manner: The per-act risk for HIV acquisition is 50 per 10,000 exposures for receptive anal intercourse; 10 per 10,000 exposures for receptive penile-vaginal intercourse; and 1 per 10,000 exposures for receptive oral intercourse.[13-16] Few studies have looked at HIV rates in

assailants.[4,17] The largest study, from Rhode Island, showed that 1% of males convicted of sexual assault were HIV-positive, compared to 3% of all prisoners, and 0.3% of males in the general population.[17]

Animal and human studies on post-exposure prophylaxis (PEP) have shown up to a 67% reduction in risk of HIV transmission in occupational exposures and perinatal transmission.[4,18] In 1999, the CDC-sponsored registry began assessing the availability of nonoccupational PEP nationwide in the United States. Of the 424 exposed patients reported, 92% were sexual exposures. Twenty-nine percent reported knowing the source was HIV-infected. Follow-up data were available on only 38% of patients, almost all of whom received PEP. Of those, 75% completed the initial regimen, 9% had the regimen modified, and 14% stopped early primarily because of side effects. One seroconversion was reported.[18] A national survey of emergency physicians and residents demonstrated that non-occupational PEP is recommended most frequently following sexual assault (35%), unintentional needlesticks (25%), and unprotected sex and shared injection drug use materials (less than 15%). Sixty-four percent felt it was feasible to provide PEP in the ED, although only 46% felt confident in prescribing appropriate drugs for PEP.[19] Another study of emergency physicians found that two-thirds had provided PEP, mostly for needlesticks. Forty-eight percent provided it following sexual assault. A majority of physicians said that they would provide it for adults and children assaulted by someone who was HIV-positive, had high HIV risk, or if the assailant was unknown.[20]

With regard to sexual assault victims, a 1998-1999 chart review from San Francisco General Hospital found that 57% of those seen had documentation of being offered PEP; 32% accepted. Of this group, only 38% completed a one-week follow-up visit and received the remainder of the medication.[21] A small program in Massachusetts reported on 83 sexual assault survivors, of which 34 were eligible and 15 began medications. Sixty-four percent completed their 28-day regimen.[22] In Vancouver, PEP is available for survivors of sexual assault. Acceptance has been reported at 28%, with 41% completing a follow-up 2-5 days later. Only 11% of those starting PEP completed the full course.[23] A study in Brazil examined the outcome of women treated within 72 hours after assault with a 28-day regimen of either two or three medications (depending on the presence of injury and location of the assault.) The study found that of the 180 women treated, none seroconverted, while 4 (2.7%) of the 145 untreated did seroconvert.[4] This study was not a randomized, controlled trial and the small sample size did not allow for statistical significance. Acceptance of PEP in North American and European cohorts is relatively low, although one French group did report a very high degree of acceptance.[18] In addition, completion of the medications and follow-up in both cohorts appear poor.[18]

The decision to provide HIV prophylaxis after sexual assault must take into account the likelihood of exposure to HIV, the interval between exposure and treatment with PEP, and the risks and benefits of treatment. Some states mandate offering and providing HIV PEP to all sexual assault survivors.

Indications for PEP include:

- repeated abuse;
- assault by multiple perpetrators;
- perpetrator known to be HIV-positive or to have HIV risk factors (i.e., IV drug abuse, crack cocaine use, or high-risk sexual practices);
- high HIV prevalence in the area;
- unprotected oral, vaginal, or anal penetration; and
- presence of mucosal lesions.

Other factors to consider include the presence of oral, vaginal, or anal trauma; the site of exposure to ejaculate; the viral load of the ejaculate (if known); the presence of STI or genital ulcer in assailant or survivor; likelihood of transmission from the assault; likelihood of patient compliance; and treatment availability (i.e., cost and medical expertise). Children may be at higher risk of HIV transmission due to their association with multiple assaults and greater risk for mucosal trauma.

The CDC guidelines for HIV testing include initial testing then repeat testing at 3 and 6 months. This testing regimen is recommended regardless of HIV PEP therapy. If HIV testing is not done at the time of the initial ED evaluation, the patient should be referred within 72 hours to his or her primary care physician or to voluntary testing and counseling centers to establish HIV status at the time of the assault.

Several two- and three-drug PEP regimens are available. Compelling animal data support the practice of a 28-day course of therapy regardless of the regimen used.[18] The regimen should be started within 72 hours of the exposure. The CDC recommendations for PEP are presented in Table 1.

If HIV PEP is given, it is recommended that a starter pack be provided and that the patient follow up within one week for evaluation of side effects and toxicity. At that time, the remainder of the medications can be prescribed. Common side effects include nausea (57%), fatigue (38%), and laboratory abnormalities (8%).[4] The patient needs to be informed of the toxic effects of the medications, the need for strict compliance with the regimen, the necessity for close follow-up, and the fact that the true efficacy of PEP is unknown. Baseline complete blood count, serum chemistries, and liver enzymes should be obtained and repeated during the course of treatment.

Pregnancy. The risk of pregnancy following sexual assault is approximately 5%.[24] Emergency contraception (EC) is the use of hormone pills to prevent pregnancy. In general, EC reduces the risk of pregnancy by 75%.[25] The regimen is a combination of ethinyl estradiol and levonorgesterol or levonorgesterol alone (Plan B emergency contraception works through multiple mechanisms that vary, based on the time of administration within the menstrual cycle.) It is felt that EC most likely blocks or delays ovulation. Other effects may include preventing fertilization, sperm incapacitation, and changes in lining of the uterus that prevent the implantation of a human embryo.[26-28] Medical experts agree that EC is not a medical abortion.[27] It has been shown the EC does not affect an already established preg-

nancy and is safe if it is used inadvertently in early pregnancy.[27] EC can be taken up to five days after unprotected intercourse.[29] Side effects of EC include nausea, vomiting, and irregular vaginal bleeding. Common EC regimens include Ovral (two pills in the ED and two in 12 hours), and Plan B (one pill in the ED and again in 12 hours, or both pills administered simultaneously). Plan B seems to be best tolerated by patients.[30] Other regimens using oral contraceptives can be used. Women should be advised to follow up for pregnancy testing, especially if their menses has not returned within 2-4 weeks from when it was expected.

The American College of Emergency Physicians' policy statement on the "Management of the Patient with the Complaint of Sexual Assault" states that a victim of sexual assault should be offered prophylaxis for pregnancy and that physicians and allied health practitioners who find this practice morally objectionable or who practice at hospitals that prohibit prophylaxis or contraception should offer to refer victims of sexual assault to another provider who can provide these services in a timely fashion.[31] A soon-to-be-published study in the *Annals of Emergency Medicine* found that many women have been unable to obtain ED from hospital EDs no matter what their circumstances.[32]

Disposition

The majority of sexual assault victims treated in the ED will be discharged home. Depending on protocols, following release from the ED, the victim may be taken to the police station for further interviews. Follow-up for patients is discussed below. For those patients with concomitant serious injury or severe psychological trauma, hospital admission may be warranted. A small percentage of victims may require operative intervention for an exam under anesthesia, intractable vaginal bleeding, injury repair, or foreign body removal. The exact incidence of genital injuries requiring operative repair is unknown but is thought to be relatively low. In the Slaughter et al study of 213 victims with genital injury, only one required surgical repair.[33] Another in postmenopausal women found a generally higher incidence of serious genital injury, with 25% requiring surgical intervention.[34] In patients with severe or intractable bleeding from a genital injury, the vagina can be packed with gauze rolls and immediate gynecologic consult obtained.

Follow-Up

Upon discharge from the ED, sexual assault victims should be provided instructions for follow-up. This follow-up may occur in a designated sexual assault follow-up clinic or with the patient's own primary care physician or gynecologist. Initial follow-up should occur approximately two weeks post-assault. At this visit, the victim should be evaluated for pregnancy, as necessary, and STIs. Repeat testing for STIs is not necessary if prophylaxis was provided, unless the patient has symptoms.[2] Results of all tests should be reviewed with the patient at this time as well. In addition, an examination may be performed to assess healing from injury or trauma.

Table 2. The Forensic Physical Exam in Sexual Assault

VITAL SIGNS

DATE AND TIME OF EXAMINATION

GENERAL PHYSICAL APPEARANCE

GENERAL DEMEANOR/BEHAVIOR/ORIENTATION

DESCRIPTION OF CLOTHING

COLLECTION OF CLOTHING AND UNDERPANTS (IF APPLICABLE)

CONDUCT GENERAL HEAD-TO-TOE PHYSICAL EXAMINATION

- Document/draw injuries (include location, size, shape—*be specific*)
- Use body maps/diagrams

ALTERNATIVE LIGHT SOURCE EXAMINATION (WOOD'S LAMP OR OTHER)

COLLECT DRY AND MOIST SECRETIONS, STAINS, AND FOREIGN MATERIALS

- Head hair combing
- Head hair pulled (if applicable)

COLLECT FINGERNAIL SCRAPINGS AND CLIPPINGS

EXAMINE ORAL CAVITY FOR INJURY AND SWAB

SWAB AREAS THE SUSPECT LICKED, KISSED, OR SUCKED

GENITAL EXAMINATION

- External genitalia
  - Swab area per protocol
  - Colposcopy and toluidine blue application
  - Document and describe injuries
- Speculum examination
  - Swab vagina and cervix per protocol
  - Document any injury
- Perineal exam
  - Swab area per protocol
  - Document injury
- Anal/Rectal exam
  - Swab area per protocol
  - Document injury
  - Consider use of anoscope, and/or colposcope, and toluidine blue

The CDC recommends follow-up serologic testing for syphilis and HIV at 6, 12, and 24 weeks post-assault if initial test results were negative and these infections are likely to be present in the assailant.[4] If hepatitis B vaccine was given, repeat vaccination should be given at 1-2 months and again 4-6 months after the first dose. If HIV prophylaxis was given, the patient should be provided enough medication until the next visit. The victim should be re-assessed 3-7 days after the initial visit to assess tolerance of medications. HIV antibody testing should be

repeated as outlined above. In addition, repeat complete blood count, chemistry panel, and liver enzymes should be checked during PEP treatment. Finally, the survivor should be encouraged to follow up at the local rape crisis center. The most significant sequelae after sexual assault are psychological, and these centers can screen for problems and provide care at little or no cost to patients.

Documentation

Accurate history and physical exam documentation is essential. (*See Table 2 for a review of the elements of the forensic physical exam in sexual assault, including evidence collection and documentation.*) Most jurisdictions and centers have standardized reporting forms for the medical evaluation of victims. Records should be clear, organized, legible, and complete. The date and time of examination should be documented. All history should be recorded in the victim's own words using quotation marks. The victim's affect should be documented in a descriptive, not subjective, manner. Three methods of documenting injury are recommended, including text description, diagrammatic illustration, and photography/colposcopy. All diagrams should be labeled. The location, size, shape, and color of any injury must be documented. Use of a measuring standard, like a photomacrograph, allows exact measurement. To effectively communicate genital injury site, the hours of the face of a clock are used as a locator. This avoids confusing terms and locators. Any laboratory and radiology test results, if performed, should be documented. Finally, any medications provided should be recorded.

Photodocumentation of general body and genital injuries is important. Options for photographs include Polaroid, 35-mm camera, digital camera, and the colposcope. The method selected should be based on cost, ease of operation, and admissibility in court. Digital photography allows the image to be reviewed at the time of examination and avoids the need for film processing. Digital images can be stored to a memory card or CD and later printed or shown in the courtroom directly from the computer. One major criticism of digital photography is the possibility of altering photos after they are taken. Therefore, all images should be downloaded to a password-protected, read-only format on CD-ROM (CD-R). This provides an electronic chain of evidence.

The first photograph taken should be an overview or full body shot that identifies the victim. Next, an orientation or medium-range shot is taken of an area of interest. Finally, proceed with a close-up of the area of interest. All close-up photos should be taken with and without a photo scale. The scale should be parallel with and in the same plane as the injury. In addition, consider contacting local law enforcement for a forensic photographer who can photodocument injuries (with the patient's consent), and maintain strict adherence to the chain of custody of these images.

The role of the clinician is not to determine if a sexual assault occurred but rather to document the events and exam findings, collect evidence, and provide medical treatment. Thus, any remarks that imply judgment or belief of the occurrence of the event should not be made in the chart.

Chain of Custody

Chain of custody refers to the procedure of handling and accounting for all specimens through each step of evidence processing. It starts with the initial collection of the evidence and continues all the way to the courtroom. Usually there is a standardized form or evidence collection label that documents the transfer of evidence from medical personnel to the police officer.

All evidence should be placed in separate envelopes, bags, or containers, then sealed and initialed. Evidence should be labeled with the victim's name, the date, examiner's name, and specimen source. The individual pieces of evidence then are packaged together, sealed, and initialed. It should be labeled in the same format. Rape kits provide all containers and materials needed as well as instructions to maintain the chain of custody.

The individual collecting the evidence should not let it out of his or her direct control unless it is turned over to the police officer or secured in an area accessible to only one responsible individual. The police officer taking the evidence should sign for it, and a receipt of the evidence should be left with the examiner. If the evidence is not taken by the police at the time of evaluation, it should be stored in a locked cabinet or refrigerator (refrigerator is preferred if biological specimens are included). The evidence can be picked up at a later time and that officer will sign for it. Maintaining the chain of custody will ensure the validity and admissibility of forensic evidence in court.

Testifying

Once the patient is discharged from the ED, the clinician's job is not over. The initial examiner may be asked to testify in court. The physician or nurse examiner in court can be asked to serve two roles. One, as a factual witness, involves providing direct knowledge of information surrounding the specific case by sharing the medical record. The other role, as an expert witness, involves providing the court with an interpretation of the information being discussed. Usually the prosecuting attorney will delineate the role required for the case and should prepare his witness accordingly. It is important to remember that as a factual witness, the emergency physician is not on the stand to state whether or not a rape occurred, but to report or interpret facts. Whether appearing in court as a factual or expert witness, all testimony in a criminal trial is subject to cross-examination by the defense attorney.

Special Considerations

Pre-hospital Providers. Care of the sexual assault victim often begins with pre-hospital providers, who should be trained in providing safety, security, and support to these patients. Because severe trauma in rape victims is rare, the physical needs of survivors often are limited.[35]

Most victims should be brought to a healthcare facility with the capabilities of providing a thorough forensic evaluation of

injuries and expert evidence collection.[36,37] These facilities are often outlined in pre-hospital triage protocols, or the EMS provider may be directed by the police to specific EDs. Pre-hospital care providers should focus on helping the victim maintain a sense of control and safety. It often is best to listen while saying little and to provide physical support and safety.[38] Victims should not be judged regardless of circumstance, appearance, lifestyle, race, gender, or socioeconomic status.

Efforts should be made to ensure the privacy and confidentiality of the victim's communication. With permission, a few limited questions that enable a focused assessment for injuries can be asked. Information about the perpetrator and/or details of the attack never should be solicited or questioned.

Physical assessment should focus on complaints or injuries. First-aid to wounds should be limited to preserving life and limb, as DNA or trace evidence may be lost. Because the patient/victim is essentially a portion of the crime scene, all efforts should be made to preserve evidence. Any modifications made to clothing by EMS workers should be documented in the chart. Any clothing that was removed or cut during evaluation should be saved, documented, and turned over to the hospital or law enforcement while maintaining chain of custody. Transport should not be delayed, but if time allows, the victim should be encouraged to bring a change of clothing.

Males. The NVAWS found there were 92,748 male rapes in the timeframe of 1995-1996. According to this data, it is estimated that 1 in 33 males will be sexually assaulted.[39] The lifetime prevalence of sexual assault in males attacking males is approximately 3.6%.[40] Because the Department of Justice's Uniform Crime Reports do not include the incidence of males being victimized, true prevalence will remain unknown.

Males can be sexually assaulted by other males or by females. The percentage of male rapes is most likely higher in metropolitan areas with significant gay communities.[40] Male rape is also seen among prisoners and other institutionalized populations. Because of fear, embarrassment, and stigma, males are less likely to report the rape to the police. However, a recent Department of Justice study showed that the difference in reporting rates between males and females was not statistically significant.[41] Male assaults include oral intercourse, rectal intercourse, or both. In a study of 27 male sexual assaults, researchers found that 10% of their total sexual assault population was male, and a high percentage of patients had documented physical and anogenital trauma.[40] The male patients presented an average of 13.5 hours following the attack, and the majority were assaulted by an unknown stranger or someone known fewer than 24 hours. In that study, the majority of men received prophylactic antibiotics against Chlamydia and gonorrhea, yet only 5 received HIV counseling, and 2 received HIV post-exposure prophylaxis. Sixty-three percent of men talked to the police while in the ED. Other studies have found similar assault characteristics and injuries.[42,43] One of these studies included a large percentage of incarcerated males.[42]

The history and physical exam should proceed in the same manner as with a female patient, obviously omitting gynecologic questions. The physical exam should focus on signs of trauma and should include a thorough assessment of the oral cavity, perineum, and rectum. Anoscopy and toluidine blue can be used to document anorectal injury. Male victims should be offered standard antibiotic prophylaxis against gonorrhea and Chlamydia as well as hepatitis B. Male victims also are at risk for developing hepatitis A if anal penetration occurred. However, prophylaxis is not recommended because the disease usually is self-limited. Based on the HIV status of the victim and assailant, as well as the type of sexual assault, HIV prophylaxis should be offered to most male sexual assault victims. Male victims should be offered the same follow-up as female victims and should be referred to rape crisis centers for counseling.

Elderly. The National Crime Victimization Survey (NCVS) (1997) estimates the incidence of rape in older adults at 10 per 100,000 per year, and estimates that those older than 50 years represent 3% of sexual assault victims.[44] Several other studies have shown that older sexual assault victims make up 2.2-4% of victims.[34,45,46] Part of the difficulty in understanding the true incidence of sexual abuse in elders is the underreporting by victims and the varying definitions in studies of this population.

Many older adult victims do not know their assailants.

Table 3. Sexual Assault Resources for Clinicians

- **National Sexual Violence Resource Center (NSVRC)**
  www.nsvrc.org
  1-877-739-3895
- **ACEP Policy Statement: Management of Patient with Complaint of Sexual Assault**
  http://www.acep.org/webportal/practiceresources/policystatements/ViolenceAbuse/ManagmentofthePatientwiththeComplaintofSexualAssault.htm
- **CDC Guidelines for STI and HIV prophylaxis**
  www.cdc.gov/mmwr/
  www.cdc.gov/std/treatment
- **National HIV/AIDS Clinicians' Consultation Center National Clinician's Post-Exposure Prophylaxis Hotline**
  www.ucsf.edu/hivcntr
- **SANE Development and Operation Guide, Office for Victims of Crime**
  www.sane-sart.com
  1-800-851-3420
- **Emergency Contraception**
  http://not-2-late.com
  1-888-Not-2-Late
- **Department of Justice**
  www.usdoj.gov
  www.ncjrs.org

Assailants may be total strangers, care givers, or significant others. Victims often are reluctant to disclose the assault secondary to their dependence on the perpetrator. Ramsey-Klausmik has shown that older victims of sexual assault in institutional settings often display subtle changes in behavior.[47,48] These include sleep disorders, irritability, mood swings, depression, aggressive/regressive behaviors, mistrust of others, disturbed peer interactions, and nightmares. These changes can mimic other medical problems. In older adult victims living outside an institutional setting, family members perpetrate the majority of abuse and violence. Evaluation, evidence collection, and treatment protocols remain the same for elderly victims as for other sexual assault victims. History taking may be difficult due to dementia and cognitive impairment. Debilitating physical conditions can make the examination and evidence collection difficult. It has been shown that elderly female victims sustain more injuries and that their injuries are more severe than those in premenopausal women.[34] Ramin found that injury was more severe in elderly victims and that 25% required surgical intervention.[34] The risk for greater injury is hypothesized as secondary to decreased estrogen levels and loss of tissue elasticity. These injuries also take longer to heal.

Vital to appropriate disposition of the elder patient in the ED is a safety plan to ensure that the victim of assault is not returned to an unsafe home or to the care of an assailant. Engage the assistance of hospital and local social services, as well as the patient's primary physician, to assist with placement of the patient in a safe environment.

Summary

Sexual assault survivors often present to the ED and count on clinicians to provide them with prompt care for physical injuries; empathy for the psychological trauma of the assault; advocacy in the form of evidence collection, accurate documentation, and court testimony; medical therapy to prevent disease and pregnancy; and appropriate referrals for ongoing medical and psychological therapy. The optimal response to a rape victim is provided with a team in place—with members who are confident in the knowledge of established protocols and roles, but experienced in providing victim-centered care. (*See Table 3 for a list of sexual assault resources for physicians.*) Compassionate medical care and advocacy of the victim has markedly improved in the past 40 years, and will do so in the future with continued research and the dedicated service of ED professionals.

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Physician CME Questions

181. Prophylaxis is given to rape victims against all of the following *except:*
    A. Chlamydia.
    B. gonorrhea.
    C. trichimoniasis.
    D. hepatitis B.
    E. herpes.

182. Which of the following is/are proper documentation techniques for rape evaluations?
    A. Written description
    B. Diagrams
    C. Photography
    D. Colposcopy
    E. All of the above

183. Which of the following statements regarding drug-facilitated rape testing is true?
    A. Most hospital drug screens can detect Rohypnol and GHB.
    B. Patient consent is not required for urine and blood samples if drug-facilitated rape is suspected.
    C. Blood and urine samples to detec Rohypnol and GHB usually need to be sent to a special forensic lab for testing.
    D. Specimens to detect for drugs such as Rohypnol and GHB are placed in the rape kit.

184. Which of the following is an acceptable method of testing for STIs?

In Future Issues: **Renal Stones**

Emergency Medicine Reports CME Objectives

To help physicians:

- quickly recognize or increase index of suspicion for specific conditions;
- understand the epidemiology, etiology, pathophysiology, and clinical features of the entity discussed;
- apply state-of-the-art diagnostic and therapeutic techniques (including the implications of pharmaceutical therapy discussed) to patients with the particular medical problems discussed;
- understand the differential diagnosis of the entity discussed;
- understand both likely and rare complications that may occur.

CME Instructions

Physicians participate in this continuing medical education program by reading the article, using the provided references for further research, and studying the questions at the end of the article. Participants should select what they believe to be the correct answers, then refer to the list of correct answers to evaluate their knowledge. To clarify confusion surrounding any questions answered incorrectly, please consult the source material. *After completing this activity, you must complete the evaluation form that will be provided at the end of the semester and return it in the reply envelope provided to receive a certificate of completion.* When your evaluation is received, a certificate will be mailed to you.

A. Enzyme immunoassay (EIA)
B. Culture
C. Non-amplified probes
D. Direct fluorescent antibody test

185. CDC guidelines require initial testing for HIV and then repeat testing at 3 and 6 months, regardless of HIV PEP therapy.
A. True
B. False

186. Which of the following statements is true of emergency contraception (EC)?
A. Medical experts agree that EC is not medical abortion.
B. It has been shown that EC does not affect an already established pregnancy.
C. EC can be taken up to five days after unprotected intercourse.
D. Women given EC should be advised to follow up for pregnancy testing, especially if menses has not returned within 2-4 weeks of when it was expected.
E. All of the above

187. Which of the following is not the role of the ED physician in evaluating sexual assault patients?
A. To document events and exam findings
B. To collect evidence
C. To determine whether a sexual assault occurred
D. To provide medical treatment

188. ED physicians should include in a patient's chart remarks about whether they believe sexual assault has occurred.
A. True
B. False

189. Which of the following is/are subtle signs displayed by elderly victims of sexual assault in institutional settings?
A. Sleep disorders
B. Disturbed peer interactions
C. Nightmares
D. Aggressive/regressive behaviors
E. All of the above

190. Which of the following statements is true regarding hepatitis B?
A. Sexual transmission accounts for more than 80% of new cases.
B. Fully vaccinated patients should receive a "booster shot."
C. Hepatitis serology can establish a patient's immune status.
D. Patients who are not immune require only one vaccination in the ED.

CME Answer Key

181. E	186. E
182. E	187. C
183. C	188. B
184. B	189. E
185. A	190. C

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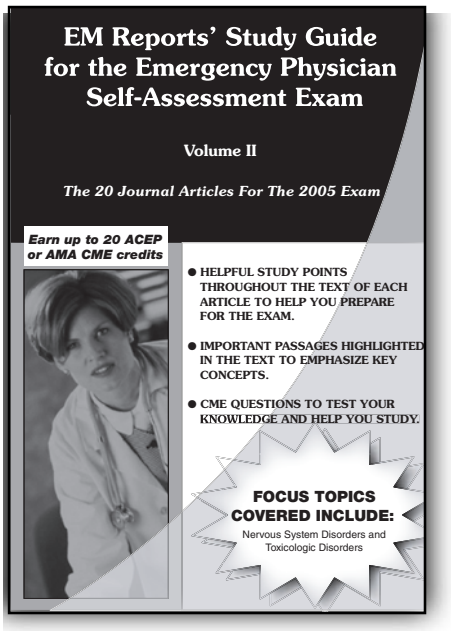

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Evaluating Sexual Assault, Part II

Sexually Transmitted Infection Prophylaxis in Sexual Assault

DISEASE	RECOMMENDED REGIMEN	ALTERNATIVE REGIMEN*
GONORRHEA		
	Ceftriaxone 125 mg IM in a single dose	Spectinomycin 2 g IM once Single dose quinolone** Single-dose cephalosporin†
CHLAMYDIA		
	Azithromycin 1 g orally in a single dose *OR* Doxycycline 100 mg po BID x 7 days	Erythromycin base 500 mg QID x 7 days Ofloxacin 300 mg BID x 7 days Levofloxacin 500 mg daily x 7 days
TRICHIMONIASIS		
	Metronidazole 2 g orally in a single dose	Metronidazole 500 mg BID x 7 days
HEPATITIS B		
	Hepatitis B Vaccine 1 cc IM initially, repeat in 1-2 and 4-6 months	None
HIV§		
	Regimen 1 Efavirenz 600 mg po at bedtime *PLUS* Lamuvudine/Zidovudine (Combivir 150/300 mg) one BID *OR* Emtricitabine/Tenofovir (Truvada 200/300 mg) one daily **Regimen 2** Lopinavir/Ritonavir (Kaletra 400/100 mg) 3 tablets daily *PLUS* Lamivudine/Zidovudine (Combivir 150/300 mg) one BID	See CDC website

* Alternative regimen is taken from the general CDC guidelines for treatment of sexually transmitted infections

** Options include: Ciprofloxacin 500 mg, Ofloxacin 400 mg, Levofloxacin 250 mg, Gatifloxacin 400 mg, Norfloxacin 800 mg, and Lomefloxacin 400 mg.

† Options include: Cefixime 400 mg po (may be unavailable from manufacturer), Ceftizoxime 500 mg IM, Cefoxitin 2 g IM plus probenecid 1 g orally, Cefotaxime 500 mg IM,

§ Either regimen can be used and is continued for 4 weeks.

The Forensic Physical Exam in Sexual Assault

VITAL SIGNS

DATE AND TIME OF EXAMINATION

GENERAL PHYSICAL APPEARANCE

GENERAL DEMEANOR/BEHAVIOR/ORIENTATION

DESCRIPTION OF CLOTHING

COLLECTION OF CLOTHING AND UNDERPANTS (IF APPLICABLE)

CONDUCT GENERAL HEAD-TO-TOE PHYSICAL EXAMINATION

- Document/draw injuries (include location, size, shape—*be specific*)
- Use body maps/diagrams

ALTERNATIVE LIGHT SOURCE EXAMINATION (WOOD'S LAMP OR OTHER)

COLLECT DRY AND MOIST SECRETIONS, STAINS, AND FOREIGN MATERIALS

- Head hair combing
- Head hair pulled (if applicable)

COLLECT FINGERNAIL SCRAPINGS AND CLIPPINGS

EXAMINE ORAL CAVITY FOR INJURY AND SWAB

SWAB AREAS THE SUSPECT LICKED, KISSED, OR SUCKED

GENITAL EXAMINATION

- External genitalia
  - Swab area per protocol
  - Colposcopy and toluidine blue application
  - Document and describe injuries
- Speculum examination
  - Swab vagina and cervix per protocol
  - Document any injury
- Perineal exam
  - Swab area per protocol
  - Document injury
- Anal/Rectal exam
  - Swab area per protocol
  - Document injury
  - Consider use of anoscope, and/or colposcope, and toluidine blue

Sexual Assault Resources for Clinicians

- **National Sexual Violence Resource Center (NSVRC)**
  www.nsvrc.org
  1-877-739-3895
- **ACEP Policy Statement: Management of Patient with Complaint of Sexual Assault**
  http://www.acep.org/webportal/practiceresources/policystatements/ViolenceAbuse/ManagmentofthePatientwiththeComplaintofSexualAssault.htm
- **CDC Guidelines for STI and HIV prophylaxis**
  www.cdc.gov/mmwr/
  www.cdc.gov/std/treatment
- **National HIV/AIDS Clinicians' Consultation Center National Clinician's Post-Exposure Prophylaxis Hotline**
  www.ucsf.edu/hivcntr
- **SANE Development and Operation Guide, Office for Victims of Crime**
  www.sane-sart.com
  1-800-851-3420
- **Emergency Contraception**
  http://not-2-late.com
  1-888-Not-2-Late
- **Department of Justice**
  www.usdoj.gov
  www.ncjrs.org

Supplement to *Emergency Medicine Reports*, September 5, 2005: Evaluating and Treating Sexual Assault in the Emergency Department. Part II: Laboratory Analysis, Pharmacotherapy, Disposition, and Documentation." *Author:* **Ralph J. Riviello, MD, FACEP,** Assistant Professor and Clinical Research Director, Department of Emergency Medicine, Jefferson Medical College, Philadelphia, PA; Medical Director, Sexual Assault Treatment Center, Thomas Jefferson University Hospital, Philadelphia, PA.

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Sept./Oct. 2005

Trauma complicates 6% to 7% of all pregnancies.[1] Emergency department (ED) physicians and nurses will find themselves frequently caring for pregnant women who have suffered a variety of traumatic injuries, ranging from minor to life-threatening. These cases will be complicated by a variety of issues, including pregnancy-associated physiologic changes, imaging/radiation risks, limitations in medication use, and fetal monitoring/tocometry. Emergency health care providers must be comfortable with the unique issues surrounding the evaluation and treatment of pregnant trauma patients and approach each pregnant woman in a systematic fashion.

— The Editor

Trauma in Pregnancy

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Epidemiology

Trauma is the leading cause of death among women of childbearing age. Trauma requiring hospitalization complicates 0.4% of pregnancies. Overall maternal morbidity and mortality after trauma are not increased by the gravid state; however, pregnancy alters the injury patterns.[2] Motor vehicle crashes are the leading cause of trauma in pregnancy, followed by physical violence and falls.[2-4] Maternal morbidity from trauma during pregnancy is related to an increased propensity to develop disseminated intravascular coagulation (DIC) due to placental factors, an increased rate of fracture complications, and increased abdominopelvic blood flow, leading to increased blood loss and development of retroperitoneal bleeding.[5] In addition, the presence or risk of preterm labor and the need for fetal monitoring are justifications for increased maternal hospitalization. Motor vehicle crashes have been identified as the most common cause of preterm labor requiring admission.[3]

Trauma is the most common cause of nonobstetric maternal death in pregnancy. (Maternal death is defined as death during pregnancy or within 42 to 90 days after delivery.[6-10]) In some areas of the United States, injuries are the most common cause of

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maternal death.[6] In recent studies comparing rates and causes of maternal death, the number of deaths from obstetric causes is decreasing.[7,8] In contrast, deaths from injuries (including unintentional and suicidal) account for more than half of nonobstetric deaths, and the number resulting from homicide is increasing.[9]

Fetal Morbidity and Mortality. Even mildly injured (Injury Severity Score [ISS] 1-8) pregnant women are at risk for placental abruption, and their fetuses are at risk for hypoxia, respiratory distress syndrome, and death.[11] Less commonly reported fetal injuries sustained in motor vehicle collisions include brain trauma and spinal fracture.[12,13] When the fetal head is engaged in the pelvis or maternal pelvic fractures are present, the likelihood of fetal skull and brain injuries is increased.[14] The fetus is at greatest risk of suffering injury or death during the time immediately following trauma. Rare case reports document severe intrauterine fetal neurologic injury undetected during trauma evaluation.[15]

Maternal death is the most common cause of trauma-associated fetal death. Following maternal trauma, fetal death rates have been reported between 4% and 61%, depending upon length of follow-up and injury severity.[16] Motor vehicle crashes are the predominant traumatic mechanism causing fetal death, distantly followed by penetrating trauma (caused by firearms) and falls. The prevalence of fetal injury and loss is difficult to determine, because of underreporting of these events in vital statistics reports and injury surveillance systems.[17]

Multiple studies have attempted to identify maternal factors predictive of poor fetal outcome. Fetal death has been associated with an increased maternal ISS and abnormal maternal physiology on presentation, including shock. Severe truncal injuries also have been associated with increased fetal loss.[2] In one large multi-institutional study, fetal deaths occurred in 50% of patients with an ISS more than 25.[18] Fetal loss also was associated with maternal shock (e.g., systolic blood pressure < 90) or a fetal heart rate less than 110 bpm. The most frequent fetal complication was premature labor; 5.9% of patients in this study delivered prematurely, 95% delivering viable neonates. Placental abruption occurred in 3.5% of patients and was associated with a 54% mortality. Other complications included premature rupture of membranes and uterine perforation or rupture. Overall, 72.3% of the 372 patients studied did not have fetal complications.[18] In another study, patients with placental abruption had a much lower ISS (< 2). In this population, placental abruption occurred in 6.8% of patients. An ISS of 4 was associated with fetal death.[19] Together, these studies illustrate that ISS alone should not be used to determine risk of placental abruption or fetal death; women with relatively minor injuries can sustain adverse pregnancy outcomes.

Physiology

The emergency care provider should be familiar with the physiologic changes of pregnancy (*Table 1*). These changes cause a pregnant woman's response to injury to be different from what is expected in a nongravid female. Trauma resuscitation of a pregnant female without consideration of these physiologic changes may contribute to high fetal death rates.[20]

Cardiovascular. Plasma volume is increased significantly during pregnancy. By the end of the first trimester, plasma volume has increased 40% to 50%.[21] Red blood cell mass also increases, but to a lesser degree, resulting in a dilutional anemia. This increased blood volume provides maternal protection against blood loss during delivery. However, an injured pregnant woman can lose up to 2000 mL of blood without developing any signs of hemodynamic instability.[21] Trauma care providers must be vigilant in their search for possible bleeding, even when the patient exhibits normal vital signs.

Blood pressure and heart rate also are affected by pregnancy. Baseline blood pressure decreases, secondary to progesterone-related vascular relaxation. During the second trimester, baseline systolic and diastolic blood pressures are lowered by 5 to 15 mmHg, making interpretation of blood pressure difficult in the presence of hemodynamic compromise. Baseline heart rate during pregnancy increases 15 bpm, complicating evaluation for occult hemorrhage. There are multiple case reports of pregnant women with presumably normal vital signs after trauma, who suffered significant internal injuries, including uterine rupture and placental abruption. Because of these factors, the care provider must have a high level of suspicion for injury.

Elevated blood pressure has different implications for pregnant and nonpregnant trauma patients, as it may be an indicator of pre-eclampsia and eclampsia. (The clinical triad that heralds eclampsia comprises seizures, elevated blood pressure, and proteinuria.) Pre-eclampsia also has been associated with transient blindness.[22] If a woman in the third trimester presents to the ED

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Table 1. Normal Physiologic Changes of Pregnancy Relevant to Trauma Care

PARAMETER	CHANGE	IMPLICATION
Maternal blood volume	Increased	Attenuated initial response to hemorrhage
Cardiac output	Increased	Increased metabolic demands
Uterine enlargement	Enlarged	Propensity for supine hypotension from aortocaval compression
Functional residual volume	Decreased	Hypoxemia from atelectasis more likely
Gastrointestinal motility	Decreased	Greater risk of aspiration
Minute ventilation	Increased	Compensated respiratory alkalosis, diminished buffering capacity

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with altered mental status after being involved in a motor vehicle collision or after being found after a presumed or witnessed seizure, eclampsia should be considered as a cause of the incident. Appropriate laboratory studies include complete blood count, blood urea nitrogen, creatinine, liver function tests, and a coagulation profile. Eclampsia is treated with a magnesium sulfate drip. Definitive treatment is delivery of the fetus, as placental factors contribute to the disease. An obstetrician should be involved in the decision-making process when managing a trauma patient with potential eclampsia.

Cardiac output increases 40% during pregnancy. During the third trimester (> 24 weeks), supine positioning of the patient will cause significant aortocaval compression, resulting in a 25% reduction in cardiac output and dropping systolic blood pressure by as much as 30 mmHg.[23] This condition can be alleviated by placing the patient in a left lateral tilt position, which can be accomplished by placing a towel, bag of saline, or wedge under the backboard or under the patient if she has no evidence of spinal injury.[21] Uterine blood flow at term approaches 600 mL per minute. Rapid exsangination can occur from uterine bleeding.[24]

Pulmonary. Respiratory changes in pregnancy also affect the patient's response to trauma. Minute ventilation increases due to increased tidal volume, resulting in a compensated respiratory alkalosis with increased excretion of bicarbonate. Pregnant patients tolerate acidosis poorly because they have little buffering reserve capacity. Functional residual volume also is decreased, increasing the patient's propensity to develop hypoxia. Atelectasis contributes to hypoxia in the supine pregnant patient as a result of increased abdominal girth. Because of these factors, after becoming apneic, a pregnant woman will become hypoxic more rapidly than a nonpregnant woman.

Pregnant patients are at increased risk of pulmonary embolism, because of changes in coagulation factors and venous stasis. In patients who report syncope, shortness of breath, or chest pain prior to the traumatic event, pulmonary embolism should be considered as a possible factor leading to the injury.

Other. Gastrointestinal motility is decreased by circulating progesterone.[24] Thus, many pregnant women have increased gastric reflux and are at an increased risk for aspiration.

Glomerular filtration rate and creatinine clearance are increased in pregnancy. These increases lower baseline serum creatinine levels (< 0.9 mg/dL) and blood urea nitrogen levels (<15 mg/dL), and modest increases may represent significantly impaired renal function.[20]

Pregnancy induces a hypercoagulable state by increased hepatic production of clotting factors, increasing maternal risk of thromboembolism.[24] An increase in the baseline level of fibrinogen in a pregnant patient is important when evaluating for the presence of DIC.[21]

Initial Management

Prehospital. Emergency medical services personnel are usually the first care providers who have contact with pregnant trauma patients. The most important initial factor in fetal outcome is the status of the mother; therefore, maternal resuscitation should come before attempts to assess the fetus. If the patient is of childbearing age but does not appear pregnant, she should be asked if she could be pregnant. If the estimated fetal age is more than 20 weeks, a hospital with a neonatal intensive care unit is preferred, but may not be available.[23] Fetal gestational age more than 20 weeks, may be estimated by a uterine fundal height between the umbilicus and xiphoid.[25] After the patient is placed on the backboard, the board should be placed in the left lateral decubitus position using blocks, towels, or a liter bag of saline. When supine, pregnant patients develop hypoxia easily and should receive supplemental oxygen. Two large-bore intravenous lines should be placed and aggressive crystalloid fluid resuscitation begun. En route to the trauma facility, all treatment should be guided by maternal status, not by suspected fetal distress.

Primary Survey. In the trauma center's receiving unit, initial management of the pregnant patient should focus on the maternal primary survey (evaluation of the airway, breathing, circulation, disability, and exposure or environment).[26] All women capable of childbearing should be tested for pregnancy. Supplemental oxygen should be given to achieve a hemoglobin saturation level greater than 90%.[1] If there is airway occlusion or danger of not protecting the airway adequately, rapid sequence intubation should be performed. Special considerations for intubation include physiologic and pharmacological issues. Induction and narcotic medications cross the placenta; paralytic agents are larger molecules and do not cross the placenta.[27] Although no consensus has been published regarding the selection of induction agents during pregnancy, etomidate and succinylcholine commonly are used. Success also has been reported without compli-

cations using ketamine and succinylcholine.[28] The individual performing the intubation must be prepared for rapid desaturation resulting from decreased functional reserve capacity, despite adequate preoxygenation. During the intubation attempt, the airway mucosa may be edematous and friable. Every attempt should be made to decrease aspiration risk by applying cricoid pressure and immediately placing a gastric tube, because of decreased gastric motility and increased aspiration risk. If a chest tube is required, it should be placed one to two interspaces higher than usual, owing to elevation of the diaphragm by the gravid uterus.[21] Prior to the circulatory evaluation, the patient should be placed in the left lateral decubitus position to prevent aortocaval compression, while maintaining appropriate spinal immobilization. Crystalloid (lactated Ringer's solution or normal saline) resuscitation should be given as a 3:1 blood loss replacement.[1]

Secondary Survey. The secondary survey should include evaluation of fetal heart rate. Fetal heart rate can be heard by Doppler at 10-14 weeks and with a conventional stethoscope at 20 weeks' gestation. A heart rate slower than 120 bpm or faster than 160 bpm should raise suspicion of fetal distress.[29] If the fetus is viable (> 23 weeks), continuous monitoring should begin at this time.[23]

In addition to the routine portions of the secondary trauma survey, several aspects of the physical examination apply specifically to pregnancy. First, in an unresponsive patient, or one from whom a history cannot be obtained, gestational age must be determined. The umbilicus marks the fundal height that correlates with 20 weeks' gestation. Gestational age beyond 20 weeks' can be estimated by measuring the distance in centimeters from the symphysis pubis to the uterine fundus. Next, the uterus itself should be palpated; it should be palpable but soft. Fetal parts may be palpable as small protusions but should not have discreet form. A firm uterus (with resistance like that of a basketball) is indicative of contraction or tetany. If a discreet uterus cannot be palpated in a woman known to be pregnant, uterine rupture should be considered, especially if individual fetal parts are palpable through the abdominal wall.

The perineal area should be assessed for leakage of fluid (clear or green stained with meconium), bleeding, prolapsed umbilical cord, or fetal parts. If there is leakage but it is not known whether the fluid is urine or amniotic fluid, amniotic fluid placed on a slide, allowed to dry, and then viewed by microscope will exhibit a classic ferning pattern. In addition, amniotic fluid placed on nitrazine paper will turn the paper blue.

Depending upon availability, optimally an obstetrician should perform the internal vaginal examination. In patients with vaginal bleeding, a speculum or bimanual examination should not be performed, because of the possibility of placenta previa (placenta covering the cervical os) and the risk of severe hemorrhage. The Apt test, described later in this article, should be considered to determine the source of any vaginal bleeding. In cases of fetal hemorrhage, exsanguination occurs rapidly, and the time from onset of fetal vaginal bleeding and fetal death is only 1 or 2 minutes. In patients without vaginal bleeding, a careful sterile speculum examination may be performed to assess cervical dilation, to identify or exclude internal trauma, and to look for fluid or amniotic membranes in the vaginal vault or for fetal presenting parts. A sterile bimanual examination should be avoided in preterm patients with leakage of fluid, because the procedure may increase the risk of fetal infectious complications.

Routine examination findings may be altered in pregnant trauma patients. Peritoneal signs may be absent in a pregnant woman despite significant intraperitoneal hemorrhage, owing to stretching of abdominal musculature making the peritoneum less sensitive to irritation.[30] In addition, many pregnant patients have low back pain caused by increased forces on the joints, which may present as paraspinal muscle spasm.[31]

History. The history of the trauma should be obtained simultaneously with the secondary survey. In addition to routine questions about the mechanism and cause of injury, loss of consciousness, location of pain, medical history, and allergies, questions specific to pregnancy should be asked. Information regarding gestation and parity should be obtained.

If the patient has delivered in the past, the mode of delivery (cesarean section or vaginal delivery) should be determined. In addition, any complications of pregnancy (current or previous) should be discussed. If the patient knows her Rh status and received RhoGAM (Ortho-Clinical Diagnostics) during the current pregnancy, this should be documented.

Laboratory Studies. Routine laboratory studies generally should be obtained, including complete blood count, basic metabolic panel, hepatic function studies, coagulation studies, toxicology screen, urinalysis, and type and screen.[25,32] In addition, the fetal DEX test, or Kleihauer-Betke test, should be considered. This quantitative test assesses for fetal blood cells in the maternal circulation. The results can be used to determine the required dose of RhoGAM. In addition, this test frequently is used to monitor patients for ongoing fetal-maternal hemorrhage during prolonged fetal monitoring after trauma.

If a patient is experiencing vaginal bleeding after trauma, it is important to determine whether the bleeding is fetal or maternal in origin. Total fetal blood circulation is very small; thus, if fetal blood is being lost, exsanguination can be rapid with minimal blood loss. Causes of fetal blood loss include umbilical cord avulsion and laceration of a vessel. Maternal vaginal bleeding can be secondary to placenta previa (placental tissue over the cervical os). A placental abruption can present with vaginal bleeding, but usually the blood is trapped behind the placenta. In either case, rapid diagnosis and definitive treatment are necessary to preserve fetal viability.

At the bedside, the Apt test can be performed to distinguish between maternal and fetal sources of vaginal bleeding. To perform this test, blood is placed on a 4 x 4-inch gauze and sodium hydroxide is applied. If the blood changes to dark brown, it is maternal blood, which oxidizes; blood that remains red is fetal.[33] In both cases, prompt obstetric evaluation is necessary.

Diagnostic Testing

Diagnostic testing in trauma patients routinely includes ultrasound evaluation, plain radiographs, and computed tomography (CT) imaging. Care providers must attempt to limit radiation in pregnant patients, and all patients who are able to give consent should be aware of radiation risks prior to undergoing any imaging. In addition, pregnancy may make the films from some of these modalities more difficult to interpret.

Ultrasound. Ultrasound is a valuable tool in the evaluation of nonpregnant and pregnant trauma patients. In emergency ultrasound guidelines published by the American College of Emergency Physicians,[34] evaluation of patients in the second and third trimesters focuses on detecting fetal cardiac activity. In the pregnant trauma patient, standard trauma ultrasound (focused assessment with sonography for trauma [FAST]) technique should be performed.[34] In addition, longitudinal and transverse views of the uterus should be obtained.[35] Uterine views should be used to establish fetal heart rate; to assess the placenta for abnormalities; and to look for gross structural fetal abnormalities, fetal movement, and the presence of amniotic fluid.

Ultrasound evaluation for free intraperitoneal fluid after blunt abdominal trauma is reportedly up to 90% sensitive in nonpregnant and pregnant patients alike, including patients in their third trimester.[5,37] One study advocates including an assessment for intrauterine pregnancy in the FAST study for all patients of childbearing age.[38] In the study population, identification of pregnancy on FAST scan significantly decreased radiation exposure in patients at more than 8 weeks' gestational age. Pregnancies of less than 8 weeks' gestation were not identified by the transabdominal FAST scan; a pregnancy test was required.[38] Bochicchio and colleagues suggested consideration of the rapid bedside urine pregnancy test in addition to serum pregnancy testing to have results before the patient is exposed to any radiation.[39]

Classically, placental abruption is visualized as a retroplacental hematoma (i.e., hypoechogenic area between the placenta and uterine wall) on ultrasound images. However, successful identification by ultrasound occurs in only 50% of trauma patients with placental abruption. Thus, an ultrasound study should not be used to exclude an abruption.[33,37]

Imaging/Radiation Risks. Radiation in pregnancy has three potentially harmful effects: 1) teratogenesis and cell death, 2) carcinogenesis, and 3) germ cell mutations or genetic effects.[40]

Cell death due to high doses of radiation is presumably an all-or-none phenomenon. Prior to implantation, at 2 to 4 weeks' gestation, it appears that cell death occurs universally. In contrast, a wide range of teratogenic effects of radiation has been documented. Human teratogenic risks of radiation include microcephaly, growth restriction, and mental retardation. During the organogenesis period (4-10 weeks' gestation), the fetus is at greatest risk of developing birth defects. The fetus is at greatest risk of radiation-induced mental retardation at 10 to 17 weeks' gestation, during the period of neurologic development. Radiation levels above 20 rads have been correlated with mental retardation in a dose-related fashion. After 17 weeks' gestation, there are very rare cases of radiation-induced effects.[37,40,41]

The risk of developing childhood leukemia is only mildly increased by fetal radiation exposure from 1 in 3000 in the general pediatric population to 1 in 2000 exposed children.[40] This risk is not related to radiation dose and has been associated with low doses of ionizing radiation. Ultrasound utilizes sound waves and has no documented adverse fetal effects. However, resolution limits usefulness in the trauma setting to evaluating for free fluid and fetal activity. CT scans expose patients to radiation, yet are considered safe below 5 cumulative rads.[40] In addition, contrast materials are not radioactive and therefore may be given during pregnancy.[41,42] Magnetic resonance imaging presents no known risks to the fetus but generally is not recommended in the first trimester.[40] In the future, it may become an important imaging modality in pregnant patients. Gadolinium crosses the placenta and should not be given.[41,43]

There is no increased risk of fetal anomalies, growth restriction, or spontaneous abortion with a radiation exposure of less than 5 rads (the maximal cumulative dose of ionizing radiation to which a pregnant woman should be exposed).[44] However, the Committee on Obstetric Practice of the American College of Obstetricians and Gynecologists states that any concern about fetal radiation exposure and risks should not alter the decision to obtain medically indicated maternal radiographic studies and that risks, although real, are not an indication for therapeutic abortion.[40]

Standard initial trauma radiographic studies usually expose patients to near-maximum total pregnancy radiation. Bochicchio and colleagues determined that a standard head, abdominal, and pelvic helical CT scan delivers approximately 4.5 rads.[39] In a study involving 3,976 women of childbearing age, the investigators documented that 114 (2.9%) were pregnant. Thirteen of the pregnancies were incidental, either unknown to the woman or known by the woman but unable to be conveyed to the trauma team. Fetal mortality in the incidental group was 77%. Newly diagnosed pregnancies ($N = 9$) were earlier in gestation (6.9 ± 4.2 weeks) than known pregnancies unable to be made known to the trauma team (20.5 ± 5.8 weeks). These women with newly diagnosed pregnancies received more than 5 rads of radiation and had 100% fetal mortality (three by induced abortion, six by spontaneous abortion).[39] This study raises the question whether immediate point-of-care testing (e.g., bedside urine human chorionic gondaotropin [hCG]) should be reinstituted in an attempt to decrease these fetal losses. However, the care provider must determine whether the medical indication for the test outweighs the significant potential for fetal loss. Of note, controversy exists regarding the 4.5 rads of radiation noted in the aforementioned study, and institutional variance may exist.[45]

Prior to counseling pregnant patients, the emergency physician should discuss radiation exposure with a radiation physicist at his or her institution. It is then important to be honest with patients and families about the risks associated with radiation. Trauma care providers should have figures available to quickly calculate an estimated fetal radiation exposure to explain those risks to the family.[46] Table 2 is provided as a radiation risk reference.

Table 2. Estimated Fetal Exposure for Various Diagnostic Imaging Methods

EXAMINATION TYPE	EST. FETAL DOSE PER EXAM (RADS)	NO. OF EXAMS REQ FOR A CUMULATIVE 5-RAD DOSE
Plain Films		
Skull	0.004	1250
Dental	0.0001	50000
Cervical spine	0.002	2500
Upper or lower extremity	0.001	5000
Chest (2 views)	0.00007	71429
Abdominal (multiple views)	0.245	20
Thoracic spine	0.009	555
Lumbosacral spine	0.359	13
Pelvis	0.040	125
Hip (single view)	0.213	23
CT scans (slice thickness, 10 mm)		
Head (10 slices)	<0.050	>100
Chest (10 slices)	<0.100	>50
Abdomen (10 slices)	2.600	1
Lumbar spine (multiple views)	3.500	1
Environmental (for comparison)		
Background radiation (cumulative doses over 9 months)	0.100	N/A

Modified from Toppenberg KS, et al. Safety of radiographic imaging during pregnancy. *Am Fam Phys* 1999;59:1813.

Fetal Monitoring/Tocometry

Intrapartum fetal heart rate (FHR) monitoring helps the physician identify acidosis, fetal tachycardia, hypoxia, and umbilical cord compression.[47] Fetal cardiotocographic monitoring for both FHR and contractions is recommended for at least 4 hours after trauma; after 4 hours of continuous monitoring without complications, outcomes among pregnant women are similar to those of uninjured control patients.[30,48] Some authors advocate up to 48 hours of continuous monitoring, based upon reports of placental abruption during that length of time after maternal injury. One study identified patients requiring at least 24 hours of monitoring by uterine irritability (at least 6 contractions per hour), abdominal or uterine tenderness, vaginal bleeding, hypovolemia, or nonreassuring fetal heart monitoring.[49] Obstetricians at specific institutions frequently have a standard length of monitoring if there are no notable complications.

Prior to the mid-third trimester, it is very difficult to obtain prolonged fetal heart rate tracings, although continuous monitoring is recommended beyond 20 weeks' gestation. To assess fetal well-being, a tocometer belt is applied to the gravid abdomen and the tracing is assessed for contractions or uterine irritability; intermittent fetal heart tones are documented. After blunt abdominal trauma, uterine irritability may signify placental abruption.[50,51]

In third-trimester pregnancies, fetal cardiac monitoring and tocometry constitute an established method of determining fetal well-being. A normal tracing shows FHR of 120 to 160 bpm with good variability (*Figure 1*). Fetal tracings that should cause concern include those indicating decreased variability in FHR corresponding with early fetal distress (*Figure 2*) or acidosis (*Figure 3*), or late decelerations caused by significant fetal distress such as abruption (*Figure 4*) or fetal bradycardia (FHR < 120 bpm).

Although a normal FHR tracing is associated with good fetal outcome, the reverse is not always true.[51,52] For the sake of this discussion, any FHR tracing abnormalities should be brought to the attention of the obstetrician immediately. Unfortunately, in one study, fewer than 15% of EDs had cardiotocographic equipment, yet 92% of emergency residents reportedly were taught the indicators of fetal distress.[53] This disparity may contribute to the finding that most teaching institutions do not begin continuous fetal monitoring within the first 30 to 60 minutes after presentation, which warrants concern because abruption usually occurs shortly after injury.[53]

Complications of Trauma During Pregnancy

Fetal injury can separated into two categories: direct fetal injury and indirect fetal injury caused by placental disruption, uterine injury, maternal shock, or preterm labor.

Prior to 12 weeks' gestation, the uterus is a pelvic organ and relatively protected from abdominal trauma. After the uterus becomes an abdominal organ, it is more susceptible to injury. In addition, increased uterine blood flow makes significant hemorrhage more likely. Some studies show a decreased incidence of injury to other abdominal organs because of the gravid uterus.

Placental Abruption. Placental abruption is the most common cause of fetal demise after blunt abdominal trauma. Placental abruption is the shearing of the placenta from the uterine implantation site. In trauma, this condition likely is secondary to continued forward propulsion of the uterus, with muscular elasticity, without placental adaptation to the change in location and form. Hemorrhage occurs into the new space between the uterus and placenta. As bleeding increases, the expansion can continue to shear the placenta from the uterine wall.

Placental abruption complicates up to 40% to 50% of cases of severe blunt abdominal trauma or major trauma and 1% to 5% of cases of minor trauma.[5,21,23,25,32] The incidence of abruption is not predicted by the speed or force of trauma. Similarly, injury severity scores do not correlate well with the likelihood of abruption.[19] Abruption frequently occurs soon after the trauma incident, but it can occur up to 48 hours after the initial trauma. One multicenter

Figure 1. Normal Fetal Heart Rate Variability

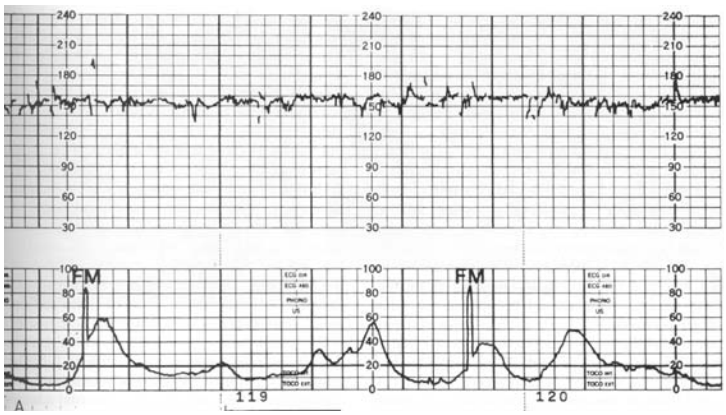

Figure 1. Example of normal fetal heart rate variability with accelerations greater than 15 bpm and longer than 15 seconds.

Reprinted with permission: Druzin ML, et al. Antepartum fetal evaluation. In: Gabbe SG, et al, eds. *Obstetrics: Normal and Problem Pregnancies*, 4th ed. New York:Churchill Livingstone;2002:325.

Figure 2. Fetal Movements

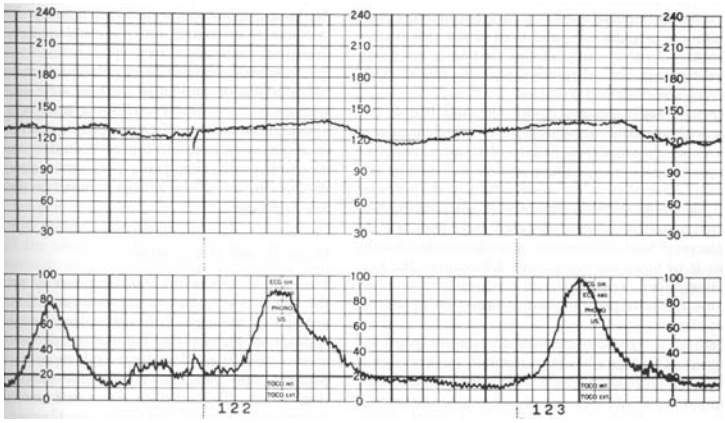

Figure 2. *Top*: Fetal movement (breaks in continuity of tracing) and no periodic changes. *Bottom:* Corresponding tocometer tracing.

Reprinted with permission: Benedetti TJ. Obstetric hemorrhage. In: Gabbe SG, et al, eds. *Obstetrics: Normal and Problem Pregnancies.* 4th ed. New York: Churchill Livingstone;2002:511.

study of admitted pregnant trauma patients reported a 3.5% incidence of abruption with resulting 54% mortality.[18] Disseminated intravascular coagulation occurs in up to 30% of patients with traumatic abruption.[53]

Evaluation for abruption includes a careful physical examination to identify the classic flat, board-like abdomen and vaginal bleeding. Vaginal bleeding caused by blood collecting in the potential space between the uterus and the placenta may or may not be present. Serial evaluations of fundal height may be performed at 15-minute intervals; a rising fundus correlates with concealed abruption.[14] As previously discussed, ultrasound has been utilized to identify and follow placental abruption; however, ultrasound should not be used to exclude the diagnosis.

Assessment of fetal well-being by cardiotocographic monitoring is the most sensitive test for abruption. In a previously mentioned multicenter study, cardiotocographic abnormalities (bradycardia or fetal distress) indicated abruption and led physicians to perform successful cesarean deliveries,[18] the definitive treatment for abruption with fetal distress. If the fetal status is reassuring on the cardiotocographic monitor, the patient can be monitored for a prolonged period and managed conservatively by the obstetrician.

Uterine Rupture. Uterine rupture, tearing of the uterine wall with release of the fetus into the abdominal cavity, occurs in less than 1% of pregnant trauma patients. However, due to the associated very poor maternal and fetal outcomes, uterine rupture is one of the most feared complications of trauma in the pregnant patient. Fetal mortality is 100%, and associated maternal mortality is 10%. The most common site of uterine rupture is the fundus, the superior portion of the uterus. Rupture is more common in patients with a history of previous cesarean delivery. Uterine rupture has been reported with lap belt use without shoulder restraint, airbag deployment, and pelvic fractures.[21,27] The mechanism of rupture in lap belt and air bag use likely is increased fundal pressure. The association between pelvic fractures and uterine rupture may be related to overall force of impact.

Penetrating Trauma. The position of the gravid uterus frequently prevents maternal visceral injury from penetrating abdominal trauma. The gravid uterus displaces the small bowel into the upper abdominal cavity, protecting it from direct abdominal trauma. However, the bladder is displaced out of the pelvis, increasing its susceptibility to injury. Injury patterns in penetrating trauma include direct fetal injury, placental injury or abruption, and uterine damage leading to preterm delivery. There are also case reports of uterine rupture caused by gunshot.[54] One study spanning 16 years of civil war in Lebanon showed maternal visceral injuries were present with entrance in the upper abdomen and back and absent if the entrance wound was below the fundus. However, half of cases with penetration below the fundus were associated with fetal demise.[55] Bullet wounds usually warrant surgical exploration. However, the management is controversial, and some advocate a conservative surgical approach to penetrating wounds, delaying laparotomy.[25,56]

Preterm Labor. In women who sustain severe trauma early in pregnancy, spontaneous abortions are almost universal. Interestingly, preterm labor or spontaneous abortion has been associated with trauma distant to the gravid uterus.[44] Trauma presumably results in the release of cytokines, which stimulate uterine contractions. Contractions developed in 28% of pregnant women with major blunt abdominal trauma in the series reported by Williams and colleagues.[57] Preterm labor leading to preterm delivery is actually very rare, accounting for less than 5% of fetal complications.[58]

If the fetus is viable, tocolysis should be discussed with the obstetrician but is not recommended until placental abruption has been excluded.[14] Even after abruption is excluded, routine med-

Figure 3. Acidosis and Decreased Fetal Heart Rate Variability

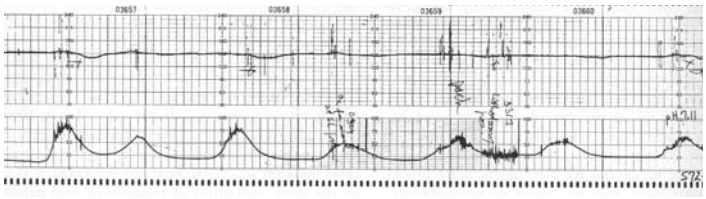

Figure 3. Acidosis with decreased fetal heart rate variability and late decelerations.

Reprinted with permission: Garite TJ. Intrapartum fetal evaluation. In: Gabbe SG, et al. eds. *Obstetrics: Normal and Problem Pregnancies.* 4th ed. New York: Churchill Livingstone;2002:404.

Figure 4. Late Decelerations

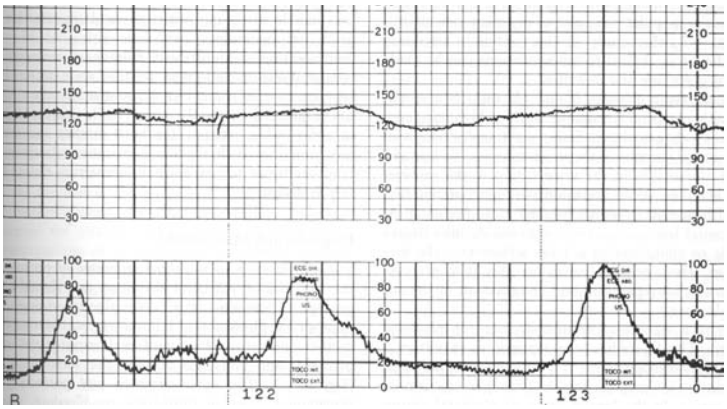

Figure 4. *Top*: Late decelerations with abruption. *Bottom:* Corresponding tocometer tracing.

Reprinted with permission: Benedetti TJ. Obstetric hemorrhage. In: Gabbe SG, et al. eds. *Obstetrics: Normal and Problem Pregnancies*. 4th ed. New York:Churchill Livingstone;2002:511.

ications used by obstetricians to treat preterm labor, including magnesium sulfate, terbutaline, and indomethacin, have side effects that may adversely affect the management of the pregnant trauma patient. Magnesium sulfate decreases respiratory effort and at high doses causes hypotension and arrhythmias. Beta-agonists (e.g., terbutaline) cause cardiac stimulation and even hypotension, confounding the evaluation of occult hemorrhage. Indomethacin may be contradicted in patients with head injury or occult bleeding because it affects platelet function.[23]

Fractures. Pelvic and acetabular fractures during pregnancy are associated with poorer outcomes than in nonpregnant patients.[60] Pregnancy predisposes the mother to significant retroperitoneal bleeding due to increased blood flow and severe hypovolemic shock.[1] Currently, there are different modes of managing pregnant patients with pelvic fractures including delayed fixation. Additional research likely will be completed in this area to determine the most successful route of treatment. Pelvic fractures are not an absolute contraindication to vaginal delivery.[1]

Disposition

Pregnant trauma patients without significant maternal injuries are not eligible for immediate discharge. Beyond 24 weeks' gestation, at least 4 hours of fetal monitoring is recommended. One study identified gestational age more than 35 weeks, assault, and pedestrian collision as risk factors associated with poor outcomes. Some centers monitor 24 hours, based upon persistently increased risk of fetal complications, including abruption beyond 6 hours, as previously discussed. One study advocates using the emergency observation unit for fetal monitoring if personnel are trained in interpretation of monitors and obstetrics staff is available for consultation.[61] In this case, care providers must be trained in interpretation of monitoring and have direct contact with an obstetrician. In academic centers, patients frequently are transferred to labor and delivery for prolonged monitoring if the acute trauma-related maternal issues have been addressed. If the patient requires ongoing trauma resuscitation unit care or trauma admission, there is variability in fetal monitoring practices. Depending upon gestational age and availability of obstetricians, patients may be monitored on the trauma floor by obstetrics nurses or followed by the trauma team on an obstetrics unit.

At the time of discharge after fetal monitoring or after maternal evaluation in the previable fetus, it is important to tailor the discharge instructions to the patient. Routine injury-specific discharge instructions should be given. In addition, the patient should follow up with her obstetrician as soon as possible. Patients should be instructed to return to the ED immediately if they experience any change in fetal activity, vaginal bleeding, abdominal pain or contractions, or leakage of fluid.

Special Considerations

Domestic Violence. Emergency care providers must have a high index of suspicion for domestic violence in pregnant trauma patients. Pregnancy is a significant risk factor for abuse, and studies have shown worsening patterns of abuse in pregnancy.[62] The 1985 National Family Violence Study reported 154 of 1000 pregnant women were assaulted by their partners in the first four months of pregnancy.[63,64] In addition, studies have established that the frequency of intentional injury sustained during pregnancy is increasing.[65] Studies have shown that direct interview questioning regarding abuse is the most effective way to identify that abuse is taking place.[66]

During pregnancy, the risk of homicide increases among battered women. A regional study by Krulewitch showed that maternal mortality resulting from violent death is underreported and thus goes underrecognized.[67] The gravid abdomen is one of the most common locations of partner-induced trauma. In addition, head and neck, breast, and genital injuries are common.[14,68]

Many studies have identified associations between domestic violence during pregnancy and adverse pregnancy outcomes. Adverse outcomes include placental abruption, spontaneous abortion, uterine rupture, preterm labor, hemorrhage, and low birth weight.[69] One study identified an association between com-

plications in pregnancy and physical violence, including partner-inflicted physical harm and being involved in a fight. The prevalence of physical violence in this study was 11.1%.[70] Overall, studies have shown inconsistent results regarding influence of violence on low birth weight and preterm birth.[71,72] These studies may be confounded by characteristics that commonly are associated with physical violence and with adverse pregnancy outcome, including young age, poverty, unmarried status, unwanted pregnancy, and substance abuse.[69] One study concluded that abuse was suspected or known prior to more than half of violent maternal deaths.[73] When eliciting a patient's history, it is important to remember the effect of domestic violence on pregnancy and ask questions regarding safety at home. Beyond the current pregnancy, abuse during pregnancy has been associated with future maternal homicide by the abusive partner.[74] The trauma care provider should be aware of appropriate documentation in suspected or alleged cases of abuse.[75]

Fetomaternal Hemorrhage and RhoGAM. All pregnant trauma patients should have a type and screen performed to determine their Rh antigen status, regardless of gestational age. Despite common beliefs that alloimmunization is rare in the early first trimester, even 38-day-old fetuses have detectable RhD antigen, and at 6 weeks Rh antigen is developed fully.[76] Minor trauma can be associated with significant fetomaternal hemorrhage. In one study, 28% of minor trauma cases, defined as a stable patient without need for surgery or admission and presenting with only contusions or superficial lacerations, experienced significant hemorrhage.[77] In trauma patients who are Rh negative, administration of 300 mg of RhoGAM (anti-D immunoglobulin) within 72 hours after onset of fetomaternal hemorrhage will prevent alloimmunization caused by up to 30 mL of Rh-positive fetal blood (15 mL of fetal cells). It has been established that anti-D immunoglobulin should be given to all Rh-negative patients with abdominal trauma.[78]

The Kleihauer-Betke test is used to quantify fetomaternal hemorrhage greater than 0.5 mL. The test has little utility in the acute trauma setting, because maternal fetal hemorrhage volume as low as 0.15 mL has elicited an antigen response; thus, all Rh-negative patients should be considered RhoGAM candidates, even if their Kleihauer-Betke test result is zero. The test can be used by the obstetrician to follow hemorrhage and to determine if additional doses of RhoGAM are indicated.

Medications. Acetaminophen is the only class A medication (i.e., determined safe in pregnant humans by controlled studies). All other medications used in pregnancy are class B (i.e., presumed to be safe, no evidence of risk) or class C (i.e., risk cannot be ruled out). Most medications used in the trauma setting are class B and C medications. Acute trauma-related pain usually is managed with opiates, which cross the placenta freely. Because the fetus absorbs opiates, decreased fetal heart rate variability and decreased fetal movements may be noted. These effects may confound evaluation of fetal well-being. Tetanus immunization is safe during pregnancy.[79]

Antibiotic use in the immediate trauma setting is frequently necessary for the management of open wounds or fractures. A first-generation cephalosporin often is used in this setting. Briggs and colleagues suggested that teratogenicity can be associated with cefaclor, cephalexin, and cephadrine but not with other cephalosporins.[80] Other antibiotics considered safe for use in pregnancy should be administered whenever possible. These include older penicillins (e.g., ampicillin and amoxicillin) and macrolides (e.g., erythromycin). Sulfonamides have no documented teratogenic effects;[81] however, they should not be used in the third trimester because of the increased risk of neonatal kernicterus. Antibiotics not recommended for use during pregnancy include the aminoglycosides and tetracyclines.[24] An update on the use of antibiotics during pregnancy was published by Niebyl.[82]

The use of acid-suppressing drugs (e.g., cimetidine, omeprazole, and ranitidine) is considered safe during pregnancy.[83]

Antiemetic agents safe for use during pregnancy include diphenhydramine (antihistamine) and phenothiazines such as promethazine, prochlorperazine, and thorazine.[84] Ondansetron has not been evaluated for safety.

In the hypotensive pregnant trauma patient, aggressive crystalloid fluid resuscitation and blood transfusion are the mainstays of therapy. Vasopressors reduce uterine blood flow and should be avoided if possible. If shock is unresponsive to volume resuscitation, ephedrine or dopamine should be considered. Ephedrine classically is used in nontrauma laboring or cesarean-section patients for hypotension without associated uteroplacental insufficiency and with possible increased uterine blood flow during contractions.[85,86] Low-dose dopamine (up to 5 mcg/kg/min) also has limited effect on placental blood flow, but dopamine at doses greater than 10 mcg/kg/min has been shown to decrease placental blood flow.[86]

Cardiac Arrest and Perimortem Cesarean Section. Cardiac arrest is complicated if the fetus is viable because there are two patients to consider during resuscitative efforts. Advanced cardiac life support should be performed; however, the effectiveness of cardiopulmonary resuscitation (CPR) is limited significantly by the physiologic changes of pregnancy, including decreased stroke volume while in the supine position. CPR also is limited significantly by the required left lateral positioning of the pregnant patient. Uterine evacuation has been shown to increase cardiac output by approximately 60%.[87] Emergent cesarean delivery of a viable fetus (> 23 weeks' gestation) should be performed after 4 minutes of unsuccessful maternal cardiac resuscitation. CPR should not be stopped to perform the cesarean delivery. The fetus should be delivered within 5 minutes of maternal resuscitation for optimal maternal and neonatal survival rates. There are case reports of delivery of viable infants after delayed perimortem delivery, but the most consistent infant survival rate (up to 70%) relies upon delivery within the first 5 minutes after arrest.[88]

The procedure may be completed within 5 minutes with a large scalpel and hemostats for clamping the umbilical cord. Sterile technique and draping generally are not used because they increase time to delivery. A vertical incision is made from the epigastric region to the symphysis pubis, following the darkened linea nigra. When the uterus has been exposed, a midline vertical uterine incision is initiated at the fundus with the scalpel and

completed with blunt-tipped scissors (e.g., bandage scissors), extending to the bladder reflection. If an anterior placenta is encountered, it should be incised. If the fetus is in the vertex (head-down) position, the operator's hand is placed into the cavity and under the fetal head, drawing it caudad out from the pelvis and through the uterine incision; the body will follow. Then, the umbilical cord should be double clamped and cut and the neonate handed to the team assigned to neonatal resuscitation. At this point, it is important to reassess the mother's vital signs. Delivery usually improves the response to resuscitative efforts significantly.[89]

Conclusion

The management of the pregnant trauma patient is a difficult and complex task and requires coordination between a variety of health care providers, including those in the prehospital, ED, trauma, operating room, and labor and delivery areas.

Several basic principles are paramount in the care of these patients. The first is the concentration of initial evaluation and treatment on maternal injuries; maternal death is the most common cause of trauma-associated fetal death.

The second principle is the importance of involvement of obstetricians and labor and delivery personnel in the care of these patients. This factor is especially important when the stage of fetal viability has been reached.

Finally, domestic violence reaches across our society and is increasing. The pregnant patient is especially at risk, and all health care workers need to be aware and ready to assist the victims of domestic violence and their unborn children.

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CE/CME Objectives

Upon completing this program, the participants will be able to:

a.) discuss conditions that should increase suspicion for traumatic injuries;
b.) describe the various modalities used to identify different traumatic conditions;
c.) cite methods of quickly stabilizing and managing patients; and
d.) identify possible complications that may occur with traumatic injuries.

CE/CME Instructions

Physicians and nurses participate in this continuing medical education/continuing education program by reading the article, using the provided references for further research, and studying the questions at the end of the article. Participants should select what they believe to be the correct answers, then refer to the list of correct answers to test their knowledge. To clarify confusion surrounding any questions answered incorrectly, please consult the source material. **After completing this activity, you must complete the evaluation form provided and return it in the reply envelope provided in order to receive a certificate of completion.** When your evaluation is received, a certificate will be mailed to you.

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CE/CME Questions

1. What is the most common cause of trauma-associated fetal death?
   A. Fetal brain trauma
   B. Fetal spinal fracture
   C. Maternal death

2. Patients in the third trimester of pregnancy should be transported to the hospital in the left lateral tilt position. The benefit of this position is:
   A. Improved functional residual capacity
   B. Increased comfort for the patient
   C. Prevention of aortocaval compression

3. Examination of a pregnant patient's abdomen reveals a fundal height at the level of the umbilicus. What is the estimated gestational age?
   A. 16 weeks
   B. 20 weeks
   C. 24 weeks

4. Serial examinations of fundal height performed on a pregnant patient reveal a rising fundus. This finding indicates which of the following conditions?
   A. Concealed placental abruption
   B. Placenta previa
   C. Preterm labor

5. Which complication of traumatic injury in the pregnant patient is associated with 100% fetal mortality?
   A. Placental abruption
   B. Placenta previa
   C. Uterine rupture

6. The most effective way to identify that a pregnant woman is a victim of domestic violence is:
   A. Direct interview questioning
   B. Fetal monitoring
   C. Physical examination

7. A pregnant patient with abdominal trauma should be given RhoGAM if:
   A. she is Rh negative and in any stage of pregnancy.
   B. she is Rh negative and in the second trimester or later.
   C. she is Rh negative and in the third trimester.

8. Which of the following regarding placental abruption is true?
   A. It is not associated with minor trauma.
   B. It never occurs more than 6 hours after trauma.
   C. It is the most common cause of fetal demise after blunt abdominal trauma.

9. The goal during postmortem cesarean section is to deliver the fetus within how many minutes after maternal arrest?
   A. 5 minutes
   B. 10 minutes
   C. 15 minutes

10. In a pregnant patient with vaginal bleeding, what test can determine if the blood is fetal or maternal in origin?
    A. Apt test
    B. Ferning test
    C. Fetal DEX test

Answers 1. C; 2. C; 3. B; 4. A; 5. C; 6. A; 7. A; 8. C; 9. A; 10. A

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