Acute Sexual Assault and Evidence Collection in the DNA Era

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here were an estimated 67000 substantiated cases of
sexual abuse in 2009. Many of these cases present for
care in the emergency department (ED). Therefore, the
emergency physician must be able to diagnose and treat
sexual assault, generate a report to child protective services and/
or law enforcement, and refer for appropriate follow-up.

ILLUSTRATIVE CASE

A 16-year-old adolescent girl presents to the ED with a history of acute sexual assault by a stranger 3 hours ago. In the social
work interview, the patient reports that she was staying over at a
friend’s house and that she and her friend left to attend a party.
While there, she drank 2 or 3 beers. She later went to use the
bathroom, and a teenage boy at the party, whom she did not
know, grabbed her, pushed her down, and pulled off her pants.
She disclosed that the boy’s penis went into her vagina with
ejaculation. Afterward, she left the party and called her mother.
She reports some scant vaginal bleeding but no other symptoms.
She denies consensual sexual activity. The general physical
examination is normal. Examination with colposcopy by a
pediatric sexual assault nurse examiner (P-SANE) reveals an
acute hymenal transection (Figure 1) that is photo documented.
Forensic evidence is collected. Sexually transmitted infection
screening and prophylaxis, and when a report to child protective services and law enforcement is appropriate. A case of acute sexual assault will be used to illustrate pertinent points.

Abstract:
Approximately 70000 reports of sexual abuse in children and adolescents are substantiated each year. Many of these cases present to the emergency department for assessment. Knowledge of which cases require emergent evaluation is essential. This article will provide a description of the steps in the assessment of acute sexual assault in children and adolescents including components of the patient interview, proper interpretation of physical examination findings, indications for sexually transmitted infection screening, and prophylaxis as well as forensic evidence collection, assessment of a drug-facilitated sexual assault, and when a report to child protective services and law enforcement is appropriate. A case of acute sexual assault will be used to illustrate pertinent points.

Keywords:
acute sexual assault; forensic evidence collection; sexually transmitted infection screening and prophylaxis, children, adolescent

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reports the case to law enforcement. The patient is given a mental health referral and advised to follow-up with the primary care provider in 2 weeks.

**BACKGROUND**

Sexual abuse is the involvement of children or adolescents in sexual activities that they do not fully comprehend, to which they are unable to give informed consent or that violate societal taboos. Sexual abuse encompasses a spectrum of activities including exhibitionism, fondling, genital viewing, production of pornography, oral-genital contact, insertion of objects, or vaginal/anal penetration. Sexual assault is any sexual act performed on a person without consent. The use or threat of force may be involved, or the person may not be able to give consent because of age, mental or physical capacity, or impairment with substances. These definitions overlap, and the terms are often used interchangeably. The age of consent for sexual contact varies by state as do reporting requirements to child protective agencies, law enforcement, and parents; therefore, medical providers should be aware of the laws in their state.

**PATIENT ASSESSMENT**

Not all children and adolescents who report a sexual assault require an emergent medical examination. An ED assessment should be considered in patients who report an assault within the preceding 72 hours, who have anogenital or other urgent symptoms, who may be unsafe, or who have other emergent concerns. It is important to recognize that a disclosure of sexual abuse is often a crisis for the patient or family. Therefore, in patients who are not seen acutely for a medical examination, providing referrals for appropriate support as well as a timely report to child protective services (CPS) should be considered. The development of child advocacy centers, which use multidisciplinary teams composed of forensic interviewers, mental health professionals, members of CPS, law enforcement staff, legal advocates, and child abuse pediatricians, is extremely helpful in sorting out the complex issues involved in sexual abuse cases. Patients who do not meet criteria for an ED evaluation may be referred for evaluation at a child advocacy center if available.

The purpose of the medical evaluation is to document what happened, perform the patient's physical examination, collect forensic evidence, and provide patients with appropriate follow-up. The first step is an interview of the patient. This may be performed by a physician, nurse, social worker, or a member of law enforcement, or a caseworker from CPS. Specific questions regarding the details of the assault for the purpose of medical diagnosis and treatment are the first step. However, this should not replace a forensic interview by a trained professional. The history should include time, place, circumstances, others present, threats, or bribes. Vulvar, vaginal, anal, or oral contact should be documented. Older children may be aware of whether ejaculation occurred. The patient should be asked if he/she has bathed or urinated since the assault. A menstrual and contraceptive history should be obtained from adolescent girls. The patient should be asked about any pain or injuries occurring at the time of the assault. The patient's medical, developmental, and social history should also be documented. The next step is the physical examination that should be performed with a supportive caretaker in the room if possible. In contrast to the pattern in younger children, sexual assault during adolescence is more likely to involve vaginal intercourse with either a stranger or acquaintance. Regardless of the age of the victim, if the child or adolescent victim presents to the ED within 72 hours of the incident, a forensic evidence collection kit is likely a necessary ED intervention. Many EDs have P-SANEs who can assist with the history taking, physical examination, and forensic evidence collection. The patient's general appearance and emotional state should be documented. Clothing worn at the time of the incident and any debris observed on the patient should be collected. A general physical examination with description of any injuries should then be completed. Photo documentation with a size and color standard is suggested. Body surfaces with dried stains should be swabbed and retained as evidence. A Bluemaxx BM500 lamp (Sirche Finger Print Laboratories, Raleigh, NC) may detect areas of semen by fluorescence.
scrapings should be obtained. Head-hair combings and a head-hair standard are included in many evidence kits. An anogenital examination, noting any injuries or signs of STIs, should be performed. The pubic hair in an adolescent should be combed to collect any debris. The genital structures, with specific attention to the hymen and posterior fourchette, should be examined. Extensive hymenal and perineal trauma may be observed, although the absence of injuries does not eliminate the possibility of acute sexual assault. The genitals can be visualized in the frog-leg or knee-chest position, and any abnormal hymenal discharge, bleeding, or foreign bodies should be documented. Any lack of certainty on potential abnormal findings in the frog-leg position should be confirmed in the knee-chest position. The hymen in adolescents should be examined for transections by running a saline-moistened cotton-tipped applicator around the edges or by introducing a Foley catheter into the vagina, inflating the bladder, and applying gentle traction to the Foley to enable the hymenal edges to be fully visualized. In cases where vaginal bleeding is seen, the source of bleeding should be identified, and an examination under sedation or anesthesia may be necessary. Vaginal swabs from the evidence collection kit should be obtained for semen detection or DNA analysis. In the pubertal patient, a wet mount to look for trichomonas and clue cells should be done, and a swab should be sent for trichomonas culture or equivalent testing technique. Any genital or anal discharge should be swabbed and sent for additional STI screening. Although there is debate about whether baseline STI tests could be used inappropriately by courts, medical assessment is improved by knowing whether infection is present even if it is not possible to know whether it is preexisting or the result of the current assault.

Adolescent patients may not require a speculum examination because of changes in the recommendations for Papanicolaou test screening and the use of urine and/or vaginal nucleic acid amplification tests (NAATs) to screen for Chlamydia trachomatis and Neisseria gonorrhoeae. If there are symptoms, such as vaginal bleeding from a suspected vaginal laceration, an examination can be done with a small Huffman speculum. Samples from the vaginal fornices and the cervix can be obtained as forensic evidence.

The perianal area should be inspected, and oral swabs should be obtained if orogenital contact is disclosed. Presumptive treatment for children who have been sexually abused is not recommended by the CDC because NAATs are not US Food and Drug Administration cleared for anal specimens in children and adolescent assault patients. However, many hospitals only provide chlamydia and gonorrhea NAATs for extragenital sites. A throat swab should be tested for N gonorrhoeae if orogenital contact is disclosed. Oral swabs should also be obtained for forensic analysis if oral-genital contact is suspected. Serologic tests for syphilis, human immunodeficiency virus (HIV), hepatitis B, and hepatitis C should be obtained if the patient discloses genital-genital or anogenital contact.

The STI screening can be individualized in prepubertal children. If obtained, samples for N gonorrhoeae are taken from the vagina, anus, and throat, and samples for C trachomatis, from the vagina and anus. Swabs of genital ulcers should be sent for viral culture and herpes simplex virus polymerase chain reaction assay.

A urine or serum pregnancy test should be done to detect a preexisting pregnancy in adolescent girls. Emergency contraception with levonorgestrel 1.5 mg should be offered to the adolescent girl who was raped within the last 120 hours. A sensitive pregnancy test should be done 2 to 3 weeks after the assault, regardless of whether emergency contraception was given. A urine sample for toxicology should be considered if there are concerns for drug-facilitated sexual assault (DFSA). If the patient's level of consciousness was impaired during the assault, a thorough and complete specimen collection for forensic analysis and STI screening should be obtained from the vagina, anus, and mouth.

For the adolescent victim of acute assault, prophylactic antibiotics should be given because of the higher prevalence rate of STIs and to prevent sequelae, such as pelvic inflammatory disease. Treatment of gonorrhea and chlamydial infection should follow Centers for Disease Control and Prevention (CDC) guidelines. In the asymptomatic prepubertal child, antibiotic treatment is usually prescribed only if a positive STI screening test is found. Presumptive treatment for children who have been sexually abused is not recommended by the CDC because of low STI prevalence and less risk of ascending infection, and regular follow-up of children is felt to be better ensured. Tetanus toxoid is given according to standard guidelines following acute injuries. Human immunodeficiency virus prophylaxis should be individualized, and regimens should be prescribed per CDC recommendations. Hepatitis B vaccine should be administered to victims of sexual assault at the time of the initial examination if they have not been previously vaccinated. Additional doses of vaccine should be given 1 to 2 and 4 to 6 months after the first dose.
At the conclusion of the examination, it is important to discuss the findings with the patient and caregivers. Patients are often anxious over the possible loss of virginity and reproductive potential and are relieved when they learn that their examination is normal. If there is an injury, it is helpful to remind patients that most trauma heals well.

The medical record should be as detailed as possible because it may be subpoenaed years later. When possible, the patient’s exact words in response to questions should be documented. A clear explanation of the significance of the physical examination findings should be included as well as recommendations for medical or mental health follow-up. All cases of suspected sexual abuse or assault in children and adolescents must be reported to law enforcement and/or CPS. It is important to understand the specific state statutes regarding reporting requirements.

The patient should be seen for follow-up approximately 2 to 3 weeks after the acute evaluation to assess healing of injuries, check results of STI screening tests, and ensure linkage to mental health services. If prophylactic antibiotics are given, follow-up testing does not need to be obtained unless there are symptoms; otherwise, testing for *N. gonorrhoeae* and *C. trachomatis* should be performed at the follow-up visit. Repeat testing for syphilis, hepatitis B, hepatitis C, and HIV can be obtained at 6 weeks, 3 months, and 6 months after the short-term assault. Sexual abuse has been associated with several mental health problems, such as anxiety and depression, as well as health risk behaviors and diseases in later adulthood. For these reasons, linkage to mental health treatment after sexual abuse is essential. Trauma-focused cognitive behavioral therapy has been shown to be an effective treatment.

### NORMAL AND ABNORMAL ANOGENITAL FINDINGS IN CHILDREN AND ADOLESCENTS

The use of the colposcope in sexual assault cases was described more than a decade ago. Advantages include magnification and the ability to take digital photographs, which can be used for documentation, education, and peer review. Photographs taken with a colposcope or directly with a camera may prevent the need for repeated examinations.

Classification systems for child sexual abuse examination findings have been published. A normal examination does not confirm or disprove a history of sexual abuse. Perpetrators and victims may report “vaginal penetration” when only vulvar coitus has occurred, thus resulting in a normal examination. Findings diagnostic of anogenital trauma that may be seen in the acute setting include lacerations or bruising of the labia, hymen, posterior fourchette, penis, scrotum, or perianal tissues.

Although studies suggest that less than 10% of long-term sexual abuse patients have abnormal anogenital findings, studies of prepubertal and adolescent female acute sexual assault patients indicate a higher rate of anogenital injuries in the range of 13% to 40%. The most common injuries were posterior fourchette tears. The degree of injury was highly correlated with time to examination, and the incidence of hymenal tears was higher in self-described virgins. Because most acute sexual assault patients have a normal anogenital examination, knowledge of normal anatomy is essential (Figures 2 and 3), and there are references available with photographs illustrating normal and abnormal anogenital findings. It is also important to recognize that, in addition to anogenital trauma, acute sexual assault victims may also have other body injuries. One study of acute sexual assault patients who were 15 years or older found 52% with injuries from being hit, kicked, or from attempted strangulation.

Sexual abuse needs to be strongly considered in the presence of penetrating genital injury and absence of a convincing history of accidental trauma. A case series of 4 prepubertal children who sustained anogenital injuries similar to those seen in sexual abuse after being run over by low-speed motor vehicles has been published. This study emphasizes the importance of good history taking to avoid a misdiagnosis of child sexual abuse. Although the history is usually the most important.
element in determining whether a patient has been sexually abused, in some cases, the child's history may overly influence interpretation of genital findings, particularly for less experienced examiners. Physicians should be aware of this potential for misdiagnosis.

**SEXUALLY TRANSMITTED INFECTIONS AND SEXUAL ASSAULT**

Factors that influence the likelihood of STI acquisition after sexual assault include the prevalence of STIs in the adult population, number of assailants, type of sexual contact, microorganism infectivity, patient susceptibility, recent antimicrobial treatment, and timing of the examination. Sexually transmitted infection prevalence in the sexually abused population is low (<10%). Not all infections noted at baseline are necessarily preexisting because it is possible that a test could be positive as a result of exposure to infected secretions from the alleged perpetrator.

Anogenital human papilloma virus (HPV) is the most common STI in the United States. It can be acquired perinatally, vertically through caregiving activities, or through sexual contact. The risk of acquiring HPV from a sexual assault is not known, but adolescents have developed cervical dysplasia due to HPV after a single episode of rape. The American Academy of Pediatrics (AAP) considers anogenital warts suspicious for sexual abuse if perinatal or vertical transmission is excluded.

In the case of hepatitis B prophylaxis, fully vaccinated individuals do not need further doses of hepatitis B vaccine after a sexual assault. Unvaccinated patients should receive the hepatitis B vaccine series. If the perpetrator is known to have acute hepatitis B, then hepatitis B immune globulin should also be administered. The risk of acquiring syphilis after sexual assault is 0.3% to 3%; however, in patients with other STIs, the risk is increased. Because of the low risk of acquiring syphilis, many centers perform selective testing. Human immunodeficiency virus seroconversion has occurred in persons whose only known risk factor was sexual abuse, although the frequency of this is likely low. The estimated probability of HIV transmission associated with unprotected vaginal intercourse is 0.1% to 0.2%, and for receptive anal intercourse, 0.5% to 3%.

Determination of the perpetrator's HIV status is usually impossible. Factors associated with increased risk for HIV transmission include vaginal or anal penetration, ejaculation on the mucous membranes, multiple perpetrators, a male perpetrator who has sex with other men, a perpetrator with a history of injected drug use, and mucosal trauma to either the patient or the perpetrator. When estimating risk of acquiring HIV from a sexual assault, clinicians should also review HIV epidemiology in their local area. If the patient appears to be at risk for HIV transmission from the assault, postexposure prophylaxis (PEP) should be discussed with the patient and/or caregiver. If PEP is considered in a child, consultation with a child abuse pediatrics or infectious disease specialist should be considered. Postexposure prophylaxis should be started as soon as possible within 72 hours of the sexual assault (see CDC recommendations for regimens). If PEP is prescribed, provide enough medication to last until a return visit with a specialist in 3 to 7 days. A complete blood count and serum chemistry at baseline should be performed if PEP is initiated. Patients initiating PEP will need 28 days of treatment and side effect surveillance. Human immunodeficiency virus testing should be performed at the initial assessment and at 6 weeks, 3 months, and 6 months.

The CDC recommends specimen collection for *N gonorrhoeae* culture from the pharynx and anus in prepubertal patients. Specimen collection for *N gonorrhoeae* culture from the vagina in prepubertal girls has been the criterion standard and continues to be the standard of care in some centers. The CDC now states that NAATs can be used as an alternative to culture with vaginal specimens or urine from prepubertal girls. The CDC recommends that NAATs be used for detection of *C trachomatis* in vaginal specimens or urine from prepubertal girls because of the low sensitivity of culture. The CDC now recommends that all positive NAATs in...
prepubertal girls be retained for additional testing if necessary. In adolescents and adults, NAATs are routinely used. Nucleic acid amplification tests have been used to detect chlamydia and gonorrhea at extragenital sites, and many institutions have these tests available. Vaginal secretions should be examined with wet mount for Trichomonas vaginalis and clue cells. A sample can be sent for T vaginalis culture. Nucleic acid amplification tests have been developed for T vaginalis, and many institutions have this test available. Lesions suggestive of herpes simplex virus infection should be swabbed for viral culture and/or polymerase chain reaction.

**DRUG-FACILITATED SEXUAL ASSAULT**

Acute sexual assault patients who report amnesia or loss of consciousness or who present with decreased mental status should be evaluated for possible DFSAs. There are numerous substances that can potentially be used in DFSAs, most of which are central nervous system depressants or substances that lower the user's inhibitions. Alcohol is frequently used in DFSAs, either alone or in combination with other substances. Benzodiazepines, including Rohypnol, which has received much media attention, are also often implicated in DFSAs. These drugs may cause anterograde amnesia that prevents the victim from remembering the assault even if he or she was conscious at the time of the event. Many benzodiazepines have multiple metabolites that cross-react poorly with common immunoassays, and they may be present in very low concentrations in blood and urine that may make them difficult to detect on toxicology screens. \( \text{\lambda}-\text{Hydroxybutyrate} \), another central nervous system depressant, is also used to facilitate sex crimes, available as a street drug, and common in the “rave” community. \( \text{\lambda}-\text{Hydroxybutyrate} \) has a very short half-life, is difficult to interpret analytically, and requires a targeted analysis for detection. Other drugs that may be used in DFSAs include ketamine, barbiturates, chloral hydrate, cannabinoids, cocaine, amphetamines, and antihistamines.

With the exception of a serum ethanol level, urine is usually the specimen of choice for toxicology screen because it allows for a longer window of detection of drugs and their metabolites, usually within 96 hours of the alleged assault. Specimens should be collected and refrigerated as soon as possible. Blood should be obtained for toxicology screening when the alleged assault occurred within the preceding 24 hours. Drugs identified in urine specimens can be specifically targeted for in blood drug screens. An individual who is impaired from ingestion of alcohol and other substance, whether ingested willingly or not, may be unable to give informed consent for sexual activity. The patient should also be interviewed when able to better understand what, if any, substances were ingested. This information used in consultation with a toxicologist can aid in the interpretation of test results.

**FORENSIC EVIDENCE COLLECTION**

The AAP recommends forensic evidence collection when sexual abuse occurs within the preceding 72 hours or when there is acute injury. Evidence collection may include swabs from the genital, anal, and oral areas as well as from areas of stained skin or bite marks as described in the section on patient assessment. Santucci et al have shown that an alternate light source, Bluemaxx, has the correct wavelength for semen fluorescence and can aid trained clinicians in detection of evidence. However, swabs of the umbilical area, perineal area, inner thighs, and buttocks should be obtained for forensic evaluation regardless of the results of light source examination. Hair and blood standards as well as clothing and foreign debris may also be collected. These items are labeled and placed in a designated container and sent to the crime laboratory with documentation of the individuals who handled the kit in order to maintain a “chain of evidence.”

Once in the crime laboratory, swabs are tested for blood, sperm, chemical evidence of semen, or analyzed for DNA in an attempt to identify the perpetrator(s). Acid phosphatase tests may be used to identify semen. These tests may give false-positive results, so a positive test is only presumptive evidence of semen. The semen protein antigen p30 is not found in body fluids of women and is therefore more sensitive and specific than acid phosphatase. A monoclonal antibody (MHS-5) to seminal vesicle–specific protein has been devised for use in an enzyme-linked immunoassay. This assay is highly sensitive and specific for seminal fluid and can be detected in dry semen stains for up to 6 months.

Data vary on the length of time that motile and nonmotile sperm may be found in the vagina or cervical mucus. Motile sperm have been found in 31.7% of victims within 6 hours of the alleged sexual assault and in 18% of those examined 7 to 24 hours after the incident. It is important to correlate hospital laboratory findings of sperm on wet mount with the crime laboratory evaluation of sperm using hematoxylin and eosin stain to ensure that the
initial result is not a false positive. Nonmotile sperm may be present in the vagina for 3 to 5 days and in the endocervical canal for up to 17 days.43

Blood group antigens can be evaluated by many forensic laboratories. DNA analysis of semen, blood, and other biologic material is now commonly used. It is potentially the most useful form of forensic evidence because of the high specificity and stability of DNA, making possible analysis of extremely small samples. DNA evidence can provide courts with a better estimation of the odds for a particular perpetrator.40,44,45 Y-short tandem repeat analysis may be used in the detection of male DNA in evidentiary samples. The presence of male DNA in the genitalia of a child victim who has no previous sexual history is suggestive of sexual contact.46

Previous studies evaluating the yield of forensic evidence collection within 72 hours of the assault found that swabbing a prepubertal child's body for evidence was unnecessary after 24 hours and that clothing and linens yielded most of the evidence.22,23,47 More recent studies that included the use of DNA analysis suggest that, in a small number of child sexual assault cases, evidence from the child's body can be retrieved beyond the previously suggested 24-hour time frame.48,49 One study demonstrated that 7 (23%) of 30 of children 12 years old and younger had positive DNA body swabs more than 24 hours after the assault.48 A second study found that, of the 15 cases younger than 13 years old with DNA detected on body swabs, 33% were more than 24 hours after the assault.49 These new data support consideration of evidence collection beyond 24 hours in the prepubertal child.

SUMMARY

Demographic data suggest that a significant number of children and adolescents are victims of sexual abuse. Many of these individuals present to the ED for evaluation of acute sexual assault. By becoming familiar with the assessment of acute sexual assault, the emergency medicine clinician can more effectively diagnose, treat, and advocate for the safety and well-being of these patients.43

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REFERENCES