

## Evaluating Pulmonary Embolism with CT: Time for a New Paradigm?

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### Introduction

As biomedical technology progresses, the medical practitioner is presented with rapidly changing multiple options to diagnose acute disease states. Advances in technology often outpace the supporting literature, and health care providers may find themselves in the unenviable position asking, "What do I do with the results of a negative test?" Nowhere is this more true in acute care than in diagnosing pulmonary embolism (PE) and deep vein thrombosis (DVT), the two diseases that form the spectrum known as venous thromboembolism (VTE).

VTE remains an elusive diagnosis; presenting signs and symptoms may be vague and indistinguishable by clinical or laboratory tests from a multitude of other diseases. The need for an accurate diagnosis is crucial; it is estimated that more

than 400,000 cases of PE are missed annually in the United States, leading to 100,000 deaths in patients undiagnosed and untreated.<sup>1</sup>

The 1989 PIOPED study, the largest multicenter PE study to date, combined clinical pretest probability with a number of noninvasive as well as invasive diagnostic tests to confirm or exclude the diagnosis of PE. The study used ventilation-perfusion (V/Q) as the imaging modality of choice, and conventional pulmonary angiography as the "gold standard" diagnostic tool. Recent advances with multidetector computerized tomography (CT) angiography have revolutionized our ability to diagnosis VTE. But new technology raises new issues: the inherent risks of radiation, ability to detect subsegmental arterial disease, and the accuracy of a negative test result.

Articles were selected for review based upon their ability to present

up-to-date information as well as provide answers to timely questions that are relevant to clinical practice. While the majority of the literature reviewed is from the last two years, less recent studies are included that have clinical applicability. The objective of this article is to provide the reader with the latest information regarding the clinical validity of different options available to diagnose VTE in this rapidly changing technological landscape, and to answer the question: Is it time for a new paradigm?

### Evaluation

**Source:** Fedullo PF, et al. Clinical practice. The evaluation of suspected pulmonary embolism. *NEJM* 2003; 349; 13:1247-1256.

This comprehensive review article defines the approach to evaluating a patient with suspected

VTE. The authors discuss the varied clinical presentations of VTE and the importance of combining standardized risk prediction rules with diagnostic tests, to increase the diagnostic accuracy of detecting PE.

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Prediction rules classify patients into *low* (subgroup prevalence of 10% or less), *intermediate* (subgroup prevalence of 25-40%), and *high* probability (subgroup prevalence of 70% or higher). (See Table 1.) The degree of clinical suspicion should guide both the choice of the initial test and the subsequent decision process. High and intermediate clinical probability of PE require that a negative CT or low/intermediate probability V/Q scan be followed by lower extremity duplex ultrasonography, and if negative, evaluated further by pulmonary angiography. This differs from low clinical probability PE that can be effectively ruled out by two approaches: either a negative enzyme-linked immunoadsorbent assay (ELISA) d-dimer test or a negative doppler ultrasound following a negative CT scan or low/intermediate probability V/Q scan.

### Commentary

The authors updated the recommendations of the original PIOPED study to include the advances in helical CT technology and d-dimer assays. However, the recent advent of multidetector CT with higher resolution, faster scanning times, better peripheral visualization, and less motion artifact have further revolutionized our approach to the evaluation of VTE. This article is important in that it gives us a context on which much of the current and upcoming research is based.

From the calculated clinical probability, a variety of noninvasive and invasive tests may be employed to definitively confirm or exclude the diagnosis of VTE. The authors applied different testing strategies depending upon the patient's pre-test probabilities—and developed a logical stepwise approach to diagnostic testing. They commented about special clinical circumstances

that may dictate which tests are most useful. D-dimer tests, such as the ELISAs, are highly sensitive as a screening tool for low-risk patients. However, it is a nonspecific test and may give false-positive results in those patients with advanced age, pregnancy, or any inflammatory state.

While V/Q scans have held a central role in diagnosing PE for almost three decades, the majority of patients who undergo scanning do not have findings that are considered definitive, which leads to further imaging studies. Helical CT has a wide range of sensitivities due to technological variations and emboli location. Isolated subsegmental emboli occur in 6-30% of patients, and the sensitivity of detecting these is 71-84%. The study used risk stratification and reviewed outcome studies to recommend that it is safe to withhold anticoagulation therapy in patients with a negative CT scan and negative ultrasound study of the lower extremities except in those patients with a high or intermediate pre-test probability of embolism.

### What to do with a negative CT scan

**Source:** Quiroz R, et al. Clinical validity of a negative computed tomography scan in patients with suspected pulmonary embolism. A systematic review *JAMA* 2005; 293(16): 2012-17.

Quiroz and colleagues authored a review article that examined the ability of CT angiography to detect isolated peripheral pulmonary emboli, long considered the principal limitation of CT, and the safety of withholding treatment after a negative CT scan. The authors acknowledged that a prospective validation study would establish true diagnostic accuracy,

**Table 1. Rules for Predicting the Probability of Embolism**

VARIABLE	NO. OF POINTS
<b>Risk Factors</b>	
Clinical signs and symptoms of deep vein thrombosis	3.0
An alternative diagnosis deemed less likely than pulmonary embolism	3.0
Heart rate > 100 beats/min	1.5
Immobilization or surgery in the previous 4 weeks	1.5
Previous deep venous thrombosis or pulmonary embolism	1.5
Hemoptysis	1.0
Cancer (receiving treatment, treated in the past 6 mo, or palliative care)	1.0
<b>Clinical Probability</b>	
Low	< 2.0
Intermediate	2.0-6.0
High	> 6.0

Reprinted with permission: Fedullo T. The evaluation of suspected pulmonary embolism. *NEJM* 2003;349:1247-1256. Copyright© 2003 Massachusetts Medical Society.

but pulmonary angiography's poor ability to detect peripheral emboli (45-66%) makes it an unpractical comparison. The approach used to establish the validity of CT and the clinical significance of the findings was to conduct a systematic review of the outcome in patients who had a negative CT scan, and were not treated with anticoagulation therapy. A meta-analysis of 15 studies with a minimum of 30 patients and at least 3 months follow-up provided 3500 negative CT scans, with only 42 cases of subsequent thromboembolic disease. The calculated negative likelihood ratio (NLR) was 0.07, and the negative predictive value (NPV) was 99.1%. These values are comparable to those reported in the literature for conventional pulmonary angiography.

### Commentary

Recent trends and technological refinements have seen the increasing use of CT scans to study patients with suspected PE. Current recommendations suggest that a negative CT scan cannot be used singly to adequately rule out the diagnosis, but must be used in con-

junction with additional tests that subsequently increase health care costs, radiation exposure, and risk of invasive complications. Single-detector helical CT scanners were used in the majority of studies reviewed in the meta-analysis, with miss rates of 30% and higher for peripheral emboli. The results in this study concur with another meta-analysis by Moores<sup>2</sup> who found similar low rates of recurrent VTE in those with a negative CT scan and not anticoagulated—indicating that isolated peripheral emboli have little impact on patient outcome.

Many studies in the analysis often used CT in combination with V/Q scans or lower extremity ultrasonography. The authors appropriately noted that adding additional imaging to the CT will lower the NLR and raise the NPV for a recurrent VTE more than CT alone. The authors also recommended additional imaging tests in the high-risk patient with a negative CT scan. More studies are needed to prospectively determine the relevance of peripheral emboli and treatment.

## CT or V/Q?

**Source:** Katsouda E, et al. Evaluation of spiral computed tomography versus ventilation/perfusion scanning in patients clinically suspected of pulmonary embolism. *In vivo* 2005;19:873-8.

For the last three decades, ventilation-perfusion (V/Q) scanning has been the test of choice in most practitioners for evaluating patients with suspected PE. This study sought to prospectively evaluate the diagnostic accuracy of CT versus V/Q scanning.

Patients who were considered to have a high clinical probability for PE were evaluated, undergoing both CT and V/Q scanning within a 12-hour period. Only high probability V/Q scans were considered positive. PE was diagnosed in 42 of the 63 patients. The sensitivity of spiral CT and V/Q scanning was 92.9% and 57.1%, respectively, and specificity was 85.7% and 42.9%, respectively. A total of 28 V/Q scans had interpretable findings of high probability or normal, while the remaining exams were indeterminate. The sensitivity and specificity of V/Q scans were significantly worse in those older than 50 years. In addition, a survey of participants revealed greater satisfaction and comfort with CT over V/Q scanning (85.7% vs 14.3%).

The authors concluded that helical CT was superior to V/Q scanning in detection and exclusion of disease, and should be used as the first-line imaging modality for patients suspected of PE.

### Commentary

The subject of choosing the optimal imaging modality to diagnose PE remains a contentious issue among clinicians. This study shows the startling difference between helical CT and V/Q scanning by com-

paring the two on the same patient population. Sensitivity and specificity for helical CT were comparable to previous studies.<sup>3,4</sup>

Katsouda and colleagues chose to report intermediate and low probability V/Q scans as negative, which contributed to the poor sensitivity of this test. However, studies have shown that the sensitivity of V/Q scanning can approach 98% if only normal scans are considered negative and grouping the remaining outcomes as positive,<sup>5</sup> which causes specificity to fall dramatically. In clinical practice, the only useful findings from a V/Q scan are high probability or normal.

Low and intermediate probability scans require further testing to prove or disprove the diagnosis. In the PIOPED study, a majority of all scans were nondiagnostic and required additional studies to be performed.

Potential weaknesses from this study are the small number of participants and the selected patient population. High pre-test probability patients were enrolled in this study, therefore the selection bias makes the study both difficult to reproduce, as well as artifactually increasing the NPV.

Regardless, the abysmal performance of V/Q scans in a head-to-head comparison reflects the growing disenchantment with this test among many practitioners.

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## The new technology

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**Source:** Patel S, et al. Helical CT for the evaluation of acute pulmonary embolism. *AJR* July 2005;185:135-49.

In this review article, the authors summarized the role and emerging trends of helical CT in the evaluation of PE. Technological advances have allowed better visualization of the distal pulmonary

vasculature, while being more cost-effective than either V/Q scanning or pulmonary angiography and improving interobserver agreement. The authors reviewed the clinical outcomes in 18 studies (a total of 4,233 patients with a negative CT angiogram and a negative CT venogram), resulting in a weighted incidence of 1.3% for recurrent VTE and 0.4% for fatal PE.

### Commentary

This article furthers the support for multidetector computed tomography (MDCT) in the evaluation of the subsegmental branches in the pulmonary vasculature, and supports the clinician's decision to withhold anticoagulation after a negative study. The pivotal argument that helical CT lacks the ability to detect peripheral emboli needs to be clinically weighed and rethought.

The multicenter prospective PIOPED II study, yet to be published, examined 773 patients to evaluate the accuracy and precision of MDCT. The researchers found that patients with low or intermediate pre-test probability with negative CT scans had low post-test probabilities of having VTE, 0.5% and 7%, respectively. In contrast, patients with a high probability undergoing a negative CT scan and a concordant negative venography, still were associated with a significant risk of 28% (although this scenario only occurred in 2% of evaluated patients). This study and resulting guidelines will help quantify the capabilities and limits of MDCT.

In this review, the benefits of MDCT were extensively discussed with minimal mention of the risks. Nickoloff states that the impact of thin cuts increases radiation exposure up to 36%.<sup>6</sup> Most notably, the potential long-term sequelae of this technology are still unclear.

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## MDCT: One-stop shopping?

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**Source:** Revel MP, et al. Diagnosing pulmonary embolism with four-detector row helical CT: prospective evaluation of 216 outpatients and inpatients. *Radiology* 2005; 234:265-73.

The advent of the MDCT offers impressive advantages over single-detector row helical CT, including the ability to reduce image acquisition time and section thickness, thereby, limiting motion artifact and increasing diagnostic yield. Until this paper, there has been no large-scale prospective clinical study looking at the quality of these new images and how they facilitate the diagnosis of PE. Prevalence of PE was 24.5 % (54 of 220), with 8 (15%) isolated subsegmental emboli. Adjunctive CT venography was performed on all the patients older than 40 years, demonstrating DVT in 15% (26 of 178). In the 3-month follow-up obtained of 111 patients with a negative CT angiography and CT venography, there were only 2 cases of (1.8%) recurrent VTE. Concordance between radiologists reading these studies at different sessions was good (kappa 0.88). Nondiagnostic scans occurred at a rate of 9%, mostly due to respiratory motion artifact. The authors concluded that multi-row detector CT scanners are more accurate than previously thought in evaluating peripheral emboli, and that CT venography may be an effective adjunctive test to verify thromboembolic disease.

### Commentary

This is the first, with probably more to come, of articles prospectively evaluating the benefits of MDCT in the diagnosis of PE. Revel and colleagues detected a greater proportion of isolated sub-

segmental emboli than prior single-detector CT studies.<sup>4,7,8</sup> However, the true incidence of peripheral emboli is hard to determine and, even with pulmonary angiography, varies widely from 6% in PLOPED to 30% by Oser and colleagues.<sup>9</sup> The authors stated that with the documented poor interobserver agreement of subsegmental arterial findings in angiography as well as the accuracy of MDCT, pulmonary angiography should no longer be considered the standard in diagnosing distal PE.

Some disappointing results from this study are the minimal improvements in sensitivity, specificity, and the percentage of nondiagnostic studies. In spite of shorter acquisition times with MDCT, 18 of the 20 nondiagnostic studies were due to respiratory motion artifacts.

In addition to helical CT of the chest, delay-timed venography of the lower extremities also was performed. Current guidelines recommend CT imaging of the chest along with Doppler ultrasonography of the lower extremity to comprehensively evaluate a patient for VTE. CT venography has comparable sensitivity and specificity to ultrasound.<sup>10,11</sup> Combination of chest CT with venography shows promise as a complete package to offer the patient “one-stop shopping” for the evaluation of thromboembolic disease.

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## Right ventricular dysfunction

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**Source:** Gibson N, et al. Prognostic value of echocardiography and spiral computed tomography in patients with pulmonary embolism. *Curr Opin Pulm Med* 2005;11:380-4.

**P**ulmonary embolism is a potentially fatal disease that can rapidly progress to circulatory collapse.

While aggressive therapies are available, such as thrombolysis and embolectomy, it remains difficult to predict which stable patients are at greater risk of developing hemodynamic compromise. The authors performed a literature review, comparing the prevalence and prognostic value of right ventricular dysfunction (RVD) on echocardiography (ECHO) and CT as an indicator of adverse outcomes. Seven studies were reviewed using ECHO in a total of 3468 patients; RVD was associated with a mortality of 4-33% compared with 2-14% mortality in those with normal ventricular function.

Meanwhile, 6 studies with 786 patients were reviewed, showing that RVD determined with CT has a less clear association with mortality. The CT studies were plagued with differences in definition of what constituted RVD, and indices could not be computed. Two studies allowed direct comparison of RVD in 83 patients, finding similar prevalence between CT and ECHO (22% vs 30%, and 81% vs 71%, respectively). The authors concluded that it is still too early to draw conclusions on the usefulness of CT in evaluation of RVD in those with known PE.

### Commentary

Identifying patients with PE who are at risk for severe morbidity or mortality early in the disease process is important if they are to benefit from more aggressive monitoring and early treatment. The reviewed data supports ECHO-diagnosed RVD as an early indicator of increased mortality, especially during the in-hospital period (PPV of 12-18% for short-term mortality). However, in hemodynamically stable patients, the PPV for short-term mortality was only 4-5%. This contrasts with findings in a study

comparing 256 patients with “submassive PE” who had stable hemodynamic parameters and RVD on ECHO: The group without early thrombolysis was associated with almost three times the risk of death or clinical deterioration.<sup>12</sup>

Details of what compromises RVD on CT remain debatable, and the reviewed journals had differing quantitative and qualitative descriptions, affecting the prevalence of RVD in each study. Among the various articles, RVD was defined as anything from the ratio between the right and left ventricular diameter with various cutoff values, to the diameter of the central pulmonary artery and superior vena cava. Consensus on a uniform set of criteria for the diagnosis of RVD in CT is imperative before significant progress can be made in this area of study. The prospect of utilizing CT not only to diagnose disease, but also to predict prognosis is a powerful draw. However, large randomized studies are needed before any management decisions can be made based on the CT findings.

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## Imaging and pregnancy

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**Source:** Winer-Muram, et al. Pulmonary embolism in pregnancy patients: Fetal radiation dose with helical CT. *Radiology* 2002;224(2):487-92.

**P**regnancy is a known risk factor for thromboembolic disease, increasing the risk by a factor of five over nonpregnant women. Winer-Muram and colleagues attempted to calculate the mean fetal radiation dose from helical chest CT. The authors studied the geometric relationship of 23 pregnant women and applied varying calculation models to determine the absorbed scattered radiation at differing gestational ages. They found the estimated

doses in the first trimester to be 0.003-0.02 mGy, 0.008-0.07 mGy in the second trimester, and 0.05-0.13 mGy in the third trimester, values all less than those of V/Q scans, estimated at 0.1-0.37 mGy.

### Commentary

PE is a major cause of maternal mortality, occurring in 0.5-3.0 of 1,000 pregnancies. The risks are highest in the third trimester and immediately post-partum, but some estimate that VTE happens with equal frequency in all trimesters. Pregnancy induces an inflammatory state that makes the d-dimer assay, with its high false-positive rate, a useless test. Considering the high frequency of nondiagnostic V/Q scanning, there is a high likelihood of requiring further imaging, compounding radiation exposure.

The authors of this paper attempted to define the most appropriate diagnostic test that would limit the risk of radiation exposure to the fetus. Other reports estimated radiation exposure of helical CT to be 0.01-0.12 mGy and V/Q to be 0.9-1.8 mGy, consistent with the estimates in this article.<sup>13,14</sup>

A weakness of this study is that direct measurements were not obtained, only mathematical models, which may not fully represent the actual *in utero* exposure. However, until a safe method is found to directly measure radiation, mathematical models may be our only source of data. This article supports the author's conclusion that helical CT appears to be the diagnostic test of choice for a pregnant patient.

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## Current trends

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**Source:** Stein PD, et al. Trends in the use of diagnostic imaging in patients hospitalized with acute pulmonary embolism. *Am J Cardiol* 2004;93:1316-17.

It has been suggested that spiral CT should replace V/Q scans as the primary diagnostic method to evaluate patients suspected of an acute VTE. This study examined trends in the proportion of diagnostic tests ordered between 1979 and 2001, using the National Hospital Discharge Survey. In 1979, V/Q scans represented 83% of diagnostic imaging tests obtained in patients discharged from the hospital with PE, this decreased to 32% by 2001. Alternately, CT imaging increased in the late 1990s to 36%, 2.56 times the use of pulmonary angiography and 1.12 times the use of V/Q scans.

### Commentary

Collecting hospital discharge data from only 8% of U.S. hospitals may incompletely identify diagnostic studies, therefore using proportions and not absolute numbers of tests obtained is the appropriate focus of this paper. However, there is an unavoidable selection bias in this form of retrospective data analysis: Only patients who have been diagnosed with a PE are included. The reported prevalence of PE is 25% in those studied, therefore, one can imagine that the majority of imaging tests ordered would be negative, which were not included in this study. Also, patients who received multiple studies due to nondiagnostic results were not identified, an important point in this era of health care fiscal reform.

In 2001, CT scanners were available in a larger percentage of hospitals in the United States than radioisotope facilities (87% vs 62%, respectively). This trend is mirrored in Australia and the Netherlands, while the majority of hospitals in the United Kingdom in 1999 had only V/Q scanners. The pattern is emerging that V/Q scans may become obsolete, but the author's opinion is that they are still a neces-

sary adjunct in the work-up of a patient suspected with PE.

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## The risks

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**Source:** Lee CI, et al. Diagnostic CT scans: assessment of patient, physician, and radiologist awareness of radiation dose and possible risk. *Radiology* 2004; 231(4):393-8.

This study is the first to prospectively examine awareness levels among patients, ED physicians, and radiologists regarding radiation dose and possible risks associated with diagnostic CT. In the United States, CT accounts for 70% of the collective radiation dose administered to patients, and with MDCT refinement, this rate can be expected to rise. The authors reported that only 7% of patients stated that they were told about risks and benefits of undergoing CT imaging, while 22% of ED physicians reported that they had provided the information. Forty-seven percent of radiologists believed that there was an increased cancer risk, while this was true in 9% of ED physicians and 3% of patients. All patients and physicians were unable to accurately estimate the radiation dose received from a CT scan compared with that of a chest radiograph.

### Commentary

We have set high expectations for CT as a diagnostic tool, but must not be ignorant of the fact that this beneficial instrument also comes with inherent risks and dangers. There is continued controversy over the actual cancer risk from diagnostic CT scans, with some estimates as high as 700 annual deaths attributable to head scans performed during childhood.<sup>15</sup> While these findings and their implications are heavily debated, the authors demonstrated that nearly all of the sampled

patients were not provided with enough information to make an informed decision. Furthermore, the physician needs to be educated regarding the magnitude of radiation to which the patient is exposed: approximately 100-250 times that of a chest radiograph.

Limitations of this study include the small sample size and the fact that patients with mild to moderate discomfort undergoing abdominal/flank CT were enrolled—requiring us to extrapolate the results to the clinical setting of CT chest in a dyspneic population. The authors appropriately noted the difficulty in engaging in lengthy communications in the subset of patients who present *in extremis* or are unable to give informed consent. They also stated that educational policies should be instituted for both ordering physicians and their patients—but in a manner that will not cause public panic.

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## Conclusion/ Recommendations

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There is a changing paradigm in how we evaluate a patient with suspected PE. Given a patient without renal insufficiency or contrast allergy, there is rarely a time to choose a modality other than helical CT angiography to confirm or exclude the diagnosis. While guidelines to date have recommended secondary studies after a negative CT scan to confidently rule out VTE, Fedullo and colleagues presented a logical approach to evaluating the low-risk patients without an additional work-up.

Perhaps the most important point of this article is the elaboration on clinical validity of a negative helical CT scan for excluding VTE. Several of the papers either directly or indirectly demonstrated the safety of

withholding treatment after a negative CT scan. Current evidence suggests that MDCT can reliably detect the presence of emboli in the peripheral pulmonary vasculature as well, if not better, than the traditional diagnostic standard of pulmonary angiography. And if these locations are truly responsible for 30% of PE, a larger question is raised: What is the clinical significance of the isolated subsegmental arterial obstruction? In a meta-analysis review, Quiroz and associates demonstrated the low morbidity and mortality among those with “missed” single peripheral emboli. Ultimately, prospective studies with extended follow-up will settle the debate whether withholding treatment is a safe alternative.

For the clinician working in the middle of the night there may be only one diagnostic option available for use. However, the physician should be able to articulate the risks, benefits, and rationale for choosing one imaging modality over another. The findings of Katsouda and Winer-Muram showed the superiority of helical CT over V/Q scanning in most clinical settings, even with the pregnant patient. Its greater availability in the United States is only one advantage.

Helical CT allows the clinician to differentiate alternative causes for the patient’s symptoms, such as pneumonia or aortic dissection. In conjunction with EKG-gated technology, researchers are using the 64-row detector CT scanners to study the flow of coronary arteries. A consensus rule defining RVD to make Gibson’s study stronger cannot be far in the future. MDCT is clearly the way of the future, and when combined with a lower extremity scan as in the Revel article, will soon replace V/Q scans and duplex sonography as the primary noninvasive imaging modality.

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## Future Issues

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- *Should RSI be used in the prehospital setting?*
- *What’s new in adult asthma management?*

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## CME QUESTIONS

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**21. Radiation from a CT scan is approximately how times greater than radiation from a chest radiograph?**

- 10-25
- 100-250
- 1000-2500
- 10,000-25,000

**22. Which one of the following imaging modalities is best to definitively describe isolated subsegmental pulmonary emboli?**

- V/Q scanning
- Pulmonary angiography
- Multidetector CT scanning
- Transthoracic echocardiography

**23. Which one of the following studies has the highest likelihood of a nondiagnostic result?**

- D-dimer
- Helical CT
- Ventilation-perfusion scan
- Pulmonary angiography

**24. Which one of the following is a reported benefit of MDCT over single-row detector CT?**

- Decreased collimation distance while reducing the amount of time per study
- Increased collimation distance while decreasing the amount of time per study
- Decreased amount of time and radiation per study
- Decreased collimation distance and decreased incidence of reaction to contrast dye

**25. A patient with an intermediate risk of having a PE undergoes a negative CT angiography and CT venography. Which one of the following is the most appropriate follow-up plan?**

- Lower extremity ultrasound
- Pulmonary angiography
- D-dimer assay
- Nothing

**Answers:** 21. b; 22.c; 23. c.; 24. a.; 25. d

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# Trauma Reports

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*Child abuse is common and frequently presents to the emergency department (ED). Sometimes the presentation is subtle and masked by vague histories and nonspecific physical findings.*

*Considering sexual abuse in the differential diagnosis is critical for the child and his/her safety. Understanding techniques for obtaining a history, the range of normal physical findings and abnormalities that are clearly associated with abuse, enables the physician to complete a thorough evaluation and to document with confidence. High-risk populations, such as children with special needs, present unique challenges to the clinician.*

*This article carefully reviews the history, physical examination, diagnostic evaluation, and reporting expectations for children with suspected sexual abuse.*

— The Editor

Child sexual abuse is no longer the “hidden pediatric problem” that Dr. Kempe described in 1977.<sup>1</sup> In fact, many physicians faced with the care of children will care for victims of child sexual abuse. Many victims of abuse present to their local emergency department (ED) for evaluation.<sup>2,3</sup> Children may present to the ED with acute life-threatening injuries, an acute sexual assault, or with vague complaints such as vaginal discharge or behavioral concerns.<sup>3</sup> This article aims to demystify what child sexual abuse is and how to evaluate a potential case.

Child abuse is quite prevalent in our society.<sup>4,6</sup> It is estimated that 1 in 4 girls and 1 in 6 boys will experience some form of child sexual abuse by the time they become 18 years of age.<sup>6</sup>

The national rate of child sexual abuse is 1.2 per 1,000 children.<sup>4</sup> It is believed that child sexual abuse may be under-reported for several reasons, such as delayed disclosure, inability to

## Pediatric Trauma: Recognizing and Managing Child Sexual Abuse

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disclose due to developmental level of the child and the child not recognizing that the abusive act is wrong.<sup>5,6</sup>

The *syndrome of child sexual abuse accommodation* sheds light on why a child's disclosure may occur so long after the abuse and is particularly informative as to why the disclosure may be problematic or even retracted by the child.<sup>7</sup> This syndrome occurs in the following stages: secrecy, helplessness, entrapment/accommodation, disclosure, and retraction.

In the first stage of this syndrome, the victimized child is forced to keep the inappropriate sexual contact a secret and at first feels trapped and helpless. Because the child is either directly or implicitly coerced into the sexual contact, the feeling of entrapment continues as the abusive behavior persists over a period of time in an environment that has failed to provide necessary protection. The feelings of helplessness lead to accommodative behaviors, because the child fears that no one will believe the story if he or she does tell. Such a child is usually the product of an environment that already has failed to protect him or her. The child does not always reach disclosure and retraction. If the child does disclose, any subsequent failure of the people and the surrounding environment to protect and support the child adequately only serves to reinforce the child's initial feelings of helplessness and may lead to retraction of the initial disclosure.

The barriers that initially stood in the way of recognizing the sexual abuse of children are increasingly being surmounted as health care professionals, child protection workers, law enforcement officers, and attorneys become more knowledgeable about the sexual exploitation of children and are more readily able to identify the problem and intervene. The reasons behind the fail-

ure of professionals to recognize the sexual abuse of children are many and include the following: a) social and cultural taboos around the notion of adults sexually exploiting children, b) personal anxiety surrounding discussion of sexual topics in general, c) collective and personal denial that sexual victimization of children occurs at all, and d) a relative lack of knowledge about the victimization of children.<sup>7</sup> As openness in society around the discussion of sexually related topics increases, and as the general public's and professionals' awareness and understanding of the problem of sexual abuse has grown, we are developing a greater awareness of how to identify children who may have been sexually abused, how to evaluate them optimally, and how to best work with them to help them overcome the effects of such a traumatic experience.

## Definition

*Child sexual abuse* can be defined as "a dominant, more powerful person involving a dependent, developmentally immature child or adolescent in sexual activities for that dominant person's own sexual stimulation or for the gratification of other people, as in child pornography or prostitution."<sup>7</sup> The American Academy of Pediatrics defines child sexual abuse as "the engaging of a child in sexual activities that the child cannot comprehend, for which the child is developmentally unprepared and cannot give informed consent, and/or that violate the social and legal taboos of society."<sup>2</sup> Children younger than 12 years cannot *consent* to sexual activity with an adult.<sup>8</sup> Any sexual contact with coercion or force is reportable to a child protective service agency.<sup>8</sup>

The essential components of the definition of sexual abuse involve the child's developmental immaturity and inability to consent, and the perpetrator's betrayal of the child's trust. In cases of sexual abuse, the perpetrator has authority and power over the child ascribed by his or her age or position and is thus able, either directly or indirectly, to coerce the child into sexual compliance. In intrafamilial sexual abuse, the involvement of the child in sexual activities violates the social taboos of family roles.<sup>7</sup>

Child sexual abuse can include fondling of a child's genitals, penetration of the genitals, anus or mouth, incest, rape, indecent exposure and the production of pornography.<sup>5</sup> State and federal laws define and classify sexual abuse. Some child sexual abuse can be more passive including viewing pornography or sexual acts at the request of an adult. This also can be part of the "grooming" process that some sexual perpetrators use with their victims. In this, the perpetrator becomes close to the child gaining their trust and then slowly exposes the child to inappropriate sexual contact or knowledge hoping to breakdown barriers to future inappropriate sexual contact. This grooming process over a period of time may lead to active sexual abuse of the child.<sup>9</sup>

Child sexual abuse is part of a spectrum of coercive sexual acts involving children and adolescents. The following are legal definitions of such coercive acts and help to demonstrate what these acts have in common, as well as the differences, with child sexual abuse.<sup>10</sup>

*Sexual assault* is a comprehensive term that includes multiple

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**Table 1. Signs and Symptoms in Child Sexual Abuse**

NONSPECIFIC PHYSICAL AND BEHAVIORAL COMPLAINTS		PHYSICAL FINDINGS	
Physical	Behavioral	Specific Findings	Nonspecific Findings
Anorexia	Compulsive or excessive masturbation	Hymenal bruising or tears	Normal genital, anal, and perianal examination
Abdominal pain	Unusual sexual curiosity; repetitive sexualized play	Recent or healed lacerations of hymen extending to the vaginal mucosa	Generalized or localized erythema or increased vascularity of genital or perianal areas
Enuresis	Excessive distractibility	Posterior fourchette scarring	Posterior fourchette or fossa navicularis midline avascular areas
Dysuria	Nightmares	Genital bite marks	Labial agglutination
Encopresis	Phobias, fears, anxiety	Sexually transmitted diseases	Hyperpigmentation or hypopigmentation of genital or perianal areas
Vaginal itching	Clinging behavior, difficulty in separation	Thickening of anal verge tissues with alteration of normal rugal pattern	Hymenal irregularities, notches, or bumps not extending to the vaginal mucosa or fossa navicularis or not associated with vascular pattern alterations
Vaginal discharge	Aggressive behavior	Perianal scars or tags outside of midline location	Significantly enlarged hymenal orifice
Vaginal bleeding	Abrupt change in behavior		Small skin fissures in posterior fourchette and perianal areas
Urethral discharge	Attempted suicide		Purulent vaginal discharge
Painful defecation	Depression		Perianal smooth areas or anal tags in midline location
	Post-traumatic stress disorder (PTSD)		
	Dissociation		

types of forced or inappropriate sexual activity. Sexual assault includes situations in which there is sexual contact with or without penetration that occurs because of physical force or psychological coercion. This includes touching a person's sexual or intimate parts or the intentional touching of the clothing covering those intimate parts.<sup>10</sup>

The term *molestation* is applied when there is noncoital sexual activity between a child and an adolescent or adult. Molestation may include viewing of sexual materials, genital or breast fondling, or oral-genital contact.

From legal and clinical perspectives, *rape* is defined as "forced sexual intercourse" that occurs because of physical force or psychological coercion. Rape involves vaginal, anal, or oral penetration by the offender. This definition also includes incidents in which penetration is with a foreign object, such as a bottle, or situations in which the victim is unable to give consent because of intoxication or developmental disability.<sup>10</sup> The terms *acquaintance rape* and *date rape* are applied to those situations in which the assailant and victim know each other.

*Statutory rape* involves sexual penetration by a person 18 years or older of a person under the age of consent.<sup>10</sup> Statutory rape laws are based on the premise that, until a person reaches a certain age, he or she is legally incapable of consenting to sexual intercourse. The age of consent varies from state to state. In some states, there are new statutory rape laws mandating that sexual

intercourse and sexual contact now must be reported if certain age differences exist between a minor (usually defined as younger than 18 or 21 years) and his or her sex partner (whether minor or adult), even if the sexual act was voluntary and consensual. There is concern that the new laws and mandated reporting statutes may have a significant impact on the interaction between the health care provider and the patient. Adolescents and health care providers may have concerns regarding medical or social history, access to care, and confidentiality, and some adolescents may refuse to seek care or refuse to disclose personal risk information because of possible reporting of sexual partners.<sup>10</sup>

At this point, clarification of *child sexual abuse* and *acute sexual assault* of adolescents and adults is necessary. Sexual abuse of children is a distinct, unique form of victimization and differs markedly from sexual assault in several important ways.<sup>7</sup> First, sexual abuse of children is commonly a longitudinal pattern of abusive contacts that may occur over weeks, months, or years prior to ending through disclosure or discovery. In contrast, adult sexual assault often occurs as a single, violent episode. The perpetrator in child sexual abuse is often a trusted caregiver known to the child and family and less commonly a complete stranger. Although the perpetrator in adult sexual assault may be a family member, as seen in cases of domestic violence, or an acquaintance, as in date rape, in some cases, the perpetrator is a stranger not known to the victim. Finally, physical violence is uncommon

in child sexual abuse owing mainly to the manipulation of the child's trust and the perpetrator's desire to avoid discovery of the abuse. On the other hand, physical violence is a common component seen in cases of adolescent and adult sexual assault. These distinctions are not absolute, and there is some overlap between what is typically seen in child and adolescent sexual abuse and what is seen in adolescent and adult sexual assault.

Sexual abuse includes and overlaps with intrafamilial abuse, pedophilia, and rape.<sup>7</sup> *Intrafamilial abuse* (sometimes referred to as incest) is sexual activity between individuals who are not permitted to marry, including step-relatives. In the cases involving stepfamily relationships, the presence or absence of a blood relationship is not as important as the kinship role that the abuser has in relation to the child. *Pedophilia* is defined as the preference for sexual contact with children by an adult. Pedophiles typically are skilled at ingratiating themselves with children and are likely to target the most vulnerable among them for sexual contact. Finally, rape is a legal term defined by various statutes, typically seen as a violent act that includes some form or variant of forcible sexual intercourse. Rape includes actual or threatened physical force sufficient to coerce the victim and may include some cases of child sexual assault.

## Presentation

Sexual victimization of children is very different from physical maltreatment in two important dynamics. The first is that most perpetrators do not intend to actually physically harm their victims; because of this, few children present with injuries. The second dynamic is that few children disclose their experience immediately following the sexually inappropriate action and this lack of disclosure results in some diagnostic challenges in identifying residua and collecting forensic evidence. Therefore, physicians must understand the dynamics of sexual victimization and be able to obtain a medical history from the child in a manner that is nonleading, facilitating, and empathetic. An appropriately obtained medical history will assist the physician in assessing the residual effects, both physical and psychological, as well directing a treatment plan.

The diagnosis of child sexual abuse is based primarily on the history provided by the patient. Often there are no physical signs. The child's developmental stage and developmental limitations on event recall make obtaining a child sexual abuse history difficult. The health care provider must rely on a history that, at times, does not seem reliable. Any weakness in the history may reflect factors other than the truth of the child's allegation.

Sexually abused children can present in a variety of ways. Some are nonspecific behavioral changes such as acting out, increased aggressiveness, or withdrawal and depression (*Table 1*). Some are somewhat more specific behavioral changes such as excessive masturbation, acting out adult sexual acts, or perpetrating sexual acts on other children.<sup>3</sup> Some physical symptoms are nonspecific such as dysuria, pain in the genital area, or blood in the underwear.<sup>3</sup> Some are commonly associated with nonabusive etiologies, such as irritant vaginitis or urinary tract infections, and

must be differentiated from child sexual abuse.

Not all sexually abused children appear to have psychological or behavioral symptoms, at least not at the time of medical assessment. Therefore, abuse is not inevitably pathogenic, and some victims have limited sequelae. It has been demonstrated that children may be more likely to have psychological and behavioral sequelae with repeated episodes of abuse. Posttraumatic stress disorder and other trauma-related symptoms (e.g., dissociation) generally have been lowest among those surviving only one type of abuse (physical or sexual) and highest among those surviving combined abuse.

Another way children can present is a parental concern about a child's statements.<sup>3</sup> To interpret a child's statements about sexually abusive acts requires that one be familiar with how a child refers to his/her genitalia. A young child might make a statement such as "hurt boo boo" with a gesture to the genital area. An older child might state, "he held me down and put his ding a ling in my coochie". The context in which the disclosure arises can be important also. Did the child spontaneously disclose abuse or was the caretaker questioning him/her about whether anyone had hurt him/her?

## Timing of Examination

The timing of the physical exam is dependent on many variables: physical symptoms such as genital bleeding or discharge, a parent or victim's anxiety about the abuse, and the time of last contact with the perpetrator. If the alleged abuse occurred within 72 hours of presentation or if the child has genital bleeding, discharge or pain, a complete examination should be done immediately.<sup>3,5,11-13</sup> Although some residua to genital trauma may last beyond 72 hours, the potential to collect seminal products and other body fluids that could potentially identify a perpetrator is minimal.

If the child discloses abuse and the last incident of possible contact was more than 72 hours and the child is asymptomatic, the full detailed examination may be scheduled with a primary care physician or specialist in child abuse at a later date.<sup>7</sup> However, if the child has presented to an ED with the concern of child sexual abuse, it still may be necessary to conduct a screening examination.

## Medical Evaluation

The medical evaluation itself serves many purposes, such as identifying trauma or conditions that require medical care, collecting forensic evidence, reassuring the child and caretakers, and returning control of the child's body to him or her.<sup>8,14,15</sup> The examination also will allow the examiner to assess the child's mental health and medical needs and make appropriate referrals.<sup>8</sup>

The evaluation includes obtaining history from the parent or caretaker, if present, and then obtaining a medical history from the child if possible.<sup>14,16</sup> The physical exam should include a complete physical examination with a focused examination of the genitalia to look for residua to the abuse, such as trauma or sexually transmitted disease (STD).<sup>3</sup>

Some hospitals have protocols in place for response to allegations of child abuse, be it physical or sexual.<sup>17</sup> Physicians should be aware of their own agency's policies regarding this. However, the law on reporting suspected child maltreatment applies to all physicians and exists in all 50 states.<sup>16</sup> If a mandated reporter, such as medical personnel or a social worker, suspects that a child has been physically or sexually abused, he or she must report those suspicions to the local child protective services agency.<sup>3,5</sup> State laws may vary in regard to notifying law enforcement; therefore, physicians should make themselves aware of the laws in their particular state. Some hospitals have specialists in child abuse available to answer questions or to help evaluate children in acute settings.<sup>17</sup>

## History

**From Caretaker.** When obtaining a history from the parent or caretaker, do this out of the presence of the child.<sup>16</sup> Find out what concerns the caretaker has and why. *Did the child disclose something to someone? What has made the caretaker suspicious? If the child has disclosed something, exactly what words did she or he say and in what context?*<sup>8</sup> *Has the caretaker noticed any behavioral changes recently?* This could include moodiness, increased anger, sexual promiscuity, or running away depending on the age and developmental level of the child.<sup>3</sup> *Has the child had any physical symptoms such as genital or rectal bleeding, pain, dysuria, discharge or itching? Has the caretaker had any other concerns? Who cares for the child? What is the caretaker's biggest concern?*

**From Child.** In cases of alleged child sexual abuse, a child protective services agency and/or law enforcement may become involved. These professionals often need to conduct interviews of the child for their investigation. This, however, does not prevent the physician from obtaining a history from the child. This history should include relevant review of systems and questions needed for a pediatric history.<sup>3</sup> The interview with the child should take place outside the caretaker's presence if at all possible. Sometimes a child will spontaneously blurt out what has happened to him or her. In these cases, it is vital to document exactly what the child said using his or her words.<sup>3,16</sup> When talking with children, try to use open-ended and non-leading questions to obtain details of what happened.<sup>16</sup> Questions such as, "*Can you tell me why you are here?*" or "*Can you tell me more about that?*" are helpful, especially with older children who can talk more freely. It is helpful to explain that "*I am a doctor (or nurse, physician assistant, etc.) who checks children to make sure they are healthy. I need to check you from head to toe including your private area.*" Asking if the child has told anyone about what has happened is important to ascertain if they are being appropriately protected (this is important for the child protective services agency to know). If the child is frightened or extremely anxious, a detailed history should be deferred.<sup>3</sup> If, at any time, you begin to feel uncomfortable, stop and let the investigating professionals do their interviews. They should be trained in how to question children in cases of suspected abuse. Just remember that the

child is your patient and should be your main focus.

The history should include from whom the history was obtained and specific words the child used in his/her disclosure.<sup>3,5</sup> If you interviewed the child, clearly document what you asked and what the child's words were in response. This can be very important if the case later goes to court. Good documentation of history and examination findings can aid in the prosecution of cases of child sexual abuse.<sup>18</sup>

A high percentage of child sexual abuse victims are younger than 5 years. The age and concomitant developmental level of these children present a distinct management challenge. Many children in this preschool group do not have fully formed language skills. Their words for their own sexual anatomy may be rudimentary and imprecise. For example, some children at this age are unable to distinguish between their genitals and their anus. Others use terms such as "peepee" or "hinie" without distinct meaning. Children younger than 5 years also may have difficulty with two other developmental skills: 1) sense of time and 2) sequencing ability. Some children may be unable to differentiate last week or last month from yesterday. Others will be unable to sequence a story as to what happened first, second, third, and so forth. Both of these developmental deficiencies may result in difficult-to-understand histories and what seem to be changing or impossible stories.

Children at older developmental levels may be reluctant to reveal and describe their abuse for fear of negative peer or parental reaction or because of a feeling that they will be seen as being a contributor to the abuse. They may be old enough to realize the embarrassment and shame that come with being a victim, even an innocent victim. A clever perpetrator will know how to gauge a child's developmental level and use the child's developmental stage to the perpetrator's own benefit.

## Physical Examination

When examining children, restraint or sedation is rarely needed and some experts believe that procedural sedation is not very helpful in examinations for alleged child sexual abuse.<sup>17,19</sup> If the child has a significant injury and the child is unable to cooperate for an examination, procedural sedation or even general anesthesia may rarely be needed.

The exam should include a complete physical exam to look for overall health, other signs of trauma, and disease. The exam should not add emotional distress to the child.<sup>3</sup> A supportive adult, who is not suspected of abusing the child, should be present during the examination if possible.<sup>2</sup> The child should be prepared for the examination by a professional who can explain what is going to happen in terms the child understands. This is quite helpful in getting children to cooperate for a comprehensive physical examination.<sup>3,17</sup> Some hospitals have child life specialists or nurses who can help facilitate this examination.

**Examination Positions and Techniques.** Some exam positions that may be helpful to visualize the anogenital area are the supine frog leg, supine knee chest, prone knee chest, or dorsal lithotomy position, which is often used in adolescents or

women.<sup>8,14</sup> The ideal examination position is one in which the child feels most comfortable and is most cooperative. Under no circumstances should an uncooperative child be physically restrained for an examination.

In young children, having the child sit on the mother's lap with mom in the lithotomy position and the child's legs lying over mom's can be useful. The prone knee chest position is quite helpful to visualize the vaginal canal, especially when looking for foreign bodies. Most children and adolescents tolerate this position well. Helpful techniques for visualization of the female genitalia include labial separation, labial traction, moistened cotton swabs or Foley catheters.<sup>10,15</sup> In acute examinations, toluidine blue dye may be helpful in documenting superficial tears in the genital or anal areas.<sup>20,21</sup> This technique should be done before any digital or speculum examination.<sup>21</sup> The dye is taken up by nucleated cells, thus revealing superficial tears.<sup>20,21</sup> This dye has even been used at autopsy to help in the detection of injuries from sexual abuse.<sup>22</sup>

To visualize the anogenital area, one needs a good light source.<sup>14</sup> If available, an otoscope or hand-held magnifying glass can be helpful. For documentation, a detailed description and diagrams are adequate. Photographs taken by a camera with macro lens or a colposcope with attached camera or video camera can be helpful, but not necessary for a good examination.<sup>8,14,15,23,24</sup> Photographs are helpful not only for documentation, but also for peer review or second opinions. Even if photographs or video is obtained, one still should maintain a detailed description and diagrams in the medical record.<sup>23</sup>

The emergency physician (EP) should not force the examination on the child or restrain the child beyond infancy or toddlerhood. Speculum exams are rarely, if ever, needed in prepubertal girls.<sup>3,14</sup> If a speculum exam is needed in a prepubertal girl, it will most likely be done under general anesthesia because the prepubertal hymen is exquisitely sensitive to touch and pain.

## Physical Findings

A medical evaluation of the child suspected of being sexually abused includes the child's account of his or her experience; a past medical history; a review of systems, with particular attention paid to the genitourinary and gastrointestinal systems; a thorough physical examination (*Table 1*); and appropriate laboratory testing. In the evaluation of alleged sexual abuse, the genitalia and anus deserve special attention, but they are examined only within the context of a complete physical assessment. The general examination helps remove the focus on the child's genital area and helps emphasize the child's physical normality.

One must remember that all injuries to the anal or genital area may not be the result of sexual abuse. There have been case reports of motor vehicle crashes causing anogenital injuries that can mimic findings in cases of child sexual abuse.<sup>25</sup> There are also reports of inline skating accidents causing significant genital injuries requiring surgical repair.<sup>26</sup> Accidental injuries to the hymen do occur, but are quite rare and should have a clear history consistent with the physical exam findings.<sup>27</sup> Also, anal tone can be decreased with sedation or stool in the anus and rectum.

Differential diagnosis of genital bleeding in girls includes lichen sclerosus et atrophicus, urethral prolapse, straddle injuries, precocious puberty, or vaginitis.<sup>17</sup> Erythema of the genitals is nonspecific and could be caused by hygiene, bacterial infection, or chemical irritation in addition to trauma, either accidental or inflicted.<sup>14</sup> Straddle injuries usually involve injury to the labia or perineum and rarely involve the hymen.<sup>28</sup> (*See Table 2.*)

There are many articles and texts available about various findings regarding child sexual abuse. Physicians who are regularly involved in care of children and adolescents should become familiar with normal anogenital findings in girls and boys and findings that are highly suspicious for child sexual abuse.<sup>5,29</sup> There have been some recommendations that pediatric EPs receive additional training in the area of child sexual abuse and that all children with abnormal examination finding in an ED have follow-up examinations by a physician with specialty training in child abuse.<sup>30</sup> There have been multiple studies looking at normal anogenital anatomy in girls of all ages.<sup>31-37</sup> This is important because some findings that were initially thought to be due to sexual abuse now are known to be found in "nonabused" girls.

In evaluating a child for the possibility of sexual abuse, more attention is given to the hymen than any other structure. Unfortunately, there is an exceptional amount of misunderstanding concerning the anatomy of the hymen. A common misconception is that there is a clinical entity known as congenital absence of the hymen. This condition does not exist as an isolated congenital anomaly with otherwise anatomically normal genitalia. The hymenal membrane and orifice may be quite variable in configuration. The appearance of the hymenal membrane and the orifice will change with age and the influence of estrogen.

Anal abuse can occur to both girls and boys. The anus itself is designed to relax and contract to allow for the passage of stool. Anal findings that may be concerning for penetrating trauma are perianal scars and lacerations deep to the external anal sphincter.<sup>14,29,38</sup> Again, studies suggest that positive anal findings are rare.<sup>38</sup>

Sexual abuse involving male victims occurs, but seems to occur at a slightly lower rate than that involving female victims.<sup>18,28,39</sup> The reporting of male sexual abuse may be more likely to bring up social taboos and/or teasing from other children.<sup>18</sup> Injuries to the male genitalia in sexual abuse do occur. They can include bite or pinch marks on the penis or scrotum or inner thighs near the genitalia.<sup>14,29</sup> Injuries due to physical abuse also may be seen in the genitalia.<sup>40</sup> These may be seen in children around toilet training age and include injuries to the penis or scrotum or immersion burns to the genitalia.<sup>41</sup> They also can be seen in older children in the context of bullying, harassment, and gang attacks.<sup>40</sup>

In the majority of cases, the physical exam will not reveal any findings definitive for sexual contact.<sup>28,38,42</sup> This can be because trauma to the genital area heals quickly and rarely leaves scars.<sup>43</sup> This again emphasizes the importance of the child's history. In some cases, the child will have definitive findings for penetrating trauma without a history.<sup>3</sup>

**Table 2. Differential Diagnosis of Genital Findings**

GENITAL FINDINGS	DIFFERENTIAL DIAGNOSIS
Genital bleeding	<ul style="list-style-type: none"> <li>• Straddle injury (or other accidental trauma)</li> <li>• Vaginal foreign body</li> <li>• Lichen sclerosus et atrophicus</li> <li>• Dermatitis (e.g., atopic, contact, seborrhea)</li> <li>• Vaginitis (e.g., nonspecific, shigella, streptococcus)</li> <li>• Estrogen withdrawal (e.g., newborn, stopping exogenous estrogen, precocious puberty)</li> <li>• Neoplasm (e.g., sarcoma botryoides)</li> <li>• Congenital or structural abnormalities</li> </ul>
Vaginal discharge	<ul style="list-style-type: none"> <li>• Normal physiologic leucorrhea</li> <li>• Vaginal foreign body</li> <li>• Vaginitis</li> <li>• Local irritation (e.g., chemical irritant)</li> <li>• Structural abnormality (e.g., ectopic ureter, fistula, draining pelvic abscess)</li> </ul>
Anogenital bruising/bleeding	<ul style="list-style-type: none"> <li>• Accidental injury</li> <li>• Dermatologic condition (e.g., lichen sclerosus, vascular nevi, Mongolian spot)</li> <li>• Systemic illness (e.g., vasculitis)</li> <li>• Anal fissure</li> <li>• Hemorrhoids</li> </ul>
Anogenital redness or lesions	<ul style="list-style-type: none"> <li>• Local irritation (from poor hygiene, restrictive clothing, chemical contact)</li> <li>• Dermatitis (e.g., contact, atopic, seborrhea)</li> <li>• Lichen sclerosus et atrophicus</li> <li>• Vaginitis (e.g., nonspecific, streptococcal)</li> <li>• Pinworm or scabies infestation</li> <li>• Candidiasis</li> <li>• Systemic illness (e.g., Stevens Johnson, Behcet's, Kawasaki's disease, molluscum contagiosum, Crohn's disease)</li> </ul>
Penile redness/swelling <sup>6</sup>	<ul style="list-style-type: none"> <li>• Accidental trauma (e.g., penis caught in zipper)</li> <li>• Balanitis</li> <li>• Hair tourniquet</li> <li>• Phimosis or paraphimosis</li> <li>• Dermatologic condition (e.g., balanitis xerotica obliterans)</li> </ul>
Scrotal discoloration	<ul style="list-style-type: none"> <li>• Accidental trauma</li> <li>• Testicular torsion</li> <li>• Torsion of the appendix testis or appendix epididymis</li> </ul>
Dysuria	<ul style="list-style-type: none"> <li>• Urinary tract infection</li> <li>• Vulvovaginitis</li> </ul>

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### Specific Findings of Sexual Abuse (Table 1)

History is of paramount importance in cases of suspected child abuse. In fact, one recent study suggested that more than 95% of medical examinations in cases of alleged sexual abuse show no definitive findings of sexual contact.<sup>48</sup> This finding reiterates the need for good documentation of the child's history (if there is one) in their own words. Studies of healing show that acute injuries from trauma resolve quickly.<sup>49</sup>

Findings that can be considered definitive for child sexual abuse include pregnancy or sperm found in or on the child's body.<sup>14,28</sup> Findings that can be considered clear evidence of penetrating or blunt force trauma include an area of absence of hymenal tissue on the posterior rim between 3 o'clock and 9 o'clock, a complete hymenal transection, bruising on the hymen or an acute laceration of the hymen.<sup>11,14,50</sup> History, in addition to the physical findings, can help differentiate between child sexual abuse and accidental or other injury.<sup>28,47</sup>

### Forensic Evidence Kits

When collecting forensic evidence, sexual assault kits may be modified for prepubertal children.<sup>3,12</sup> Chain of evidence must be maintained. Hospitals often have protocols in place for collection of such evidence.<sup>3</sup> Again, good documentation is essential. Many states have kits available for collection of such forensic evidence. One study showed that swabs from the body of prepubertal children were not necessary after 24 hours post assault.<sup>12</sup> Law enforcement sometimes needs to be reminded to collect bedding and clothing as these often yield the majority of forensic evidence.<sup>12</sup> Some hospitals have sexual assault nurse examiners (SANEs) or forensic nurse examiners (FNEs) available to help with forensic evidence collection.<sup>44</sup> A smaller subset of hospitals has SANEs or FNEs with adequate knowledge and training in collection of forensic evidence in child sexual abuse cases.

### Sexually Transmitted Infections

Sexually transmitted infections are a rare sequela of child sexual abuse.<sup>45-47</sup> The clinician who evaluates children or adolescents for suspected sexual abuse should always consider testing for the presence of sexually transmitted organisms. The extent to which a child or adolescent victim of suspected sexual abuse should be evaluated for sexually transmitted organisms should be individualized and based upon the circumstances of the abuse, the child's age, the presence of symptoms, the prevalence of a STD in a community, and any information available on the medical conditions and risk status of the perpetrator. Obtaining specimens requires skill and expertise to avoid unnecessary physical and psychological trauma to the child victim. If the sexual abuse has resulted in infection, this must be identified and treated. Additionally, the presence of sexually transmitted organisms may be an important piece of medicolegal evidence indicating the need for further investigation and protection of the child.

It always should be remembered that if the child has symptoms, signs, or evidence of an infection that might be sexually transmitted, the child should be tested for other common STDs.

The following recommendation for scheduling examinations

is a general guide.<sup>47</sup> The exact timing and nature of follow-up contacts should be determined on an individual basis and should be considerate of the child's psychological and social needs. Compliance with follow-up appointments may be improved when law enforcement personnel or a child protective services agency is involved.

### Prepubertal Children

During the initial examination and 2-week follow-up examination (if indicated), the following should be performed:

#### All children

- Visual inspection of the genital, perianal, and oral areas for genital warts and ulcerative lesions

#### Selected children if history or examination indicates presence of a STD.

- Cultures for *Neisseria gonorrhoeae* specimens collected from the pharynx and anus in both boys and girls, the vagina in girls, and the urethra in boys. Cervical specimens are not recommended for prepubertal girls. For boys, a meatal specimen of urethral discharge is an adequate substitute for an intraurethral swab specimen when discharge is present.
- Cultures for *Chlamydia trachomatis* from specimens collected from the anus in both boys and girls and from the vagina in girls. Limited information suggests that the likelihood of recovering *Chlamydia* from the urethra of prepubertal boys is too low to justify the trauma involved in obtaining an intraurethral specimen. A urethral specimen should be obtained if urethral discharge is present. Pharyngeal specimens for *C. trachomatis* also are not recommended for either sex because the yield is low, perinatally acquired infection may persist beyond infancy, and culture systems in some laboratories do not distinguish between *C. trachomatis* and *C. pneumoniae*.
- Wet mount and/or culture of a vaginal swab specimen for *Trichomonas vaginalis* infection. The presence of clue cells in the wet mount or other signs, such as a positive whiff test, suggests bacterial vaginosis in girls who have vaginal discharge.
- Collection of a serum sample to be evaluated immediately, preserved for subsequent analysis, and used as a baseline for comparison with follow-up serologic tests. Sera should be tested immediately for antibodies to sexually transmitted agents. Agents for which suitable tests are available include *Treponema pallidum*, HIV, and hepatitis B and C. The choice of agents for serologic tests should be made on a case-by-case basis. Vaccination for the hepatitis B virus (HBV) should be recommended if the medical history or serologic testing suggests that it has not been received or immunity has waned.

An examination approximately 12 weeks after the last suspected sexual exposure is recommended to allow time for antibodies to infectious agents to develop if baseline tests are negative. Serologic tests for *T. pallidum*, HIV, and HBsAg should be considered. The prevalence of these infections differs substantially by community, and serologic testing depends upon whether risk factors are known to be present in the abuser or assailant. In

addition, results of HBsAg testing must be interpreted carefully, because HBV also can be transmitted nonsexually. The choice of tests must be made on an individual basis.

The risk for a child's acquiring an STD as a result of sexual abuse has not been determined. It is believed to be low in most circumstances, although documentation to support this position is inadequate.

Presumptive treatment for children who have been sexually assaulted or abused is not widely recommended because preadolescent girls appear to be at lower risk for ascending infection than do adolescent or adult women, and regular follow-up usually can be ensured. However, some children – or their parent(s) or guardian(s) – may be concerned about the possibility of infection with an STD, even if the risk is perceived by the health care provider to be low. Patient or parental/guardian concerns may be an appropriate indication for presumptive treatment in some settings (e.g., after all specimens relevant to the investigation have been collected). Typically, prepubertal children are not routinely given prophylaxis for STDs at acute examination because follow-up after incubation period allows for appropriate specimens to be collected. However, otherwise sexually active adolescents may benefit from STD prophylaxis as the prevalence of STDs in this population is higher than that in preadolescent children.

Many sexually transmitted infections also can be transmitted vertically from infected mother to child. These include HIV, gonorrhea, *Chlamydia*, herpes, human papilloma virus and others.<sup>39,46</sup> In child sexual abuse, cultures for gonorrhea and *Chlamydia* still are considered the legal “gold standard” even with ligase chain reaction (LCR) and polymerase chain reaction (PCR) testing available.<sup>45,46</sup>

Diagnosis of gonorrhea, syphilis, HIV, or *Chlamydia* if other modes of transmission have been excluded (i.e., perinatal or related to blood transfusion), is diagnostic of sexual abuse until proven otherwise.<sup>3</sup>

#### Adolescents

An initial examination should include the following procedures:

- Cultures for *N. gonorrhoeae* and *C. trachomatis* from specimens collected from any sites of penetration or attempted penetration
- If chlamydial culture is not available, nonculture tests, particularly the nucleic acid amplification tests, are an acceptable substitute. Nucleic acid amplification tests offer advantages of increased sensitivity if confirmation is available. If a nonculture test is used, a positive test result should be verified with a second test based on a different diagnostic principle. EIA and direct fluorescent antibody are not acceptable alternatives because false-negative test results occur more often with these nonculture tests, and false-positive test results may occur.
- Wet mount and/or culture of a vaginal swab specimen for *Trichomonas vaginalis* infection. If vaginal discharge or malodor is evident, the wet mount also should be examined for evidence of bacterial vaginosis and yeast infection.
- Collection of a serum sample for immediate evaluation for HIV, hepatitis B, and syphilis.

Although it is often difficult for people to comply with follow-up examinations weeks after an assault, such examinations are essential to: a) detect new infections acquired during or after the assault; b) complete hepatitis B immunization, if indicated; and c) complete counseling and treatment for other STDs. For these reasons, it is recommended that assault victims be reevaluated at follow-up examinations. This also allows for the incubation period to pass for some sexually transmitted infections, which then allows specimen collection.

Examination for STDs should be repeated 2 weeks after the assault. Because infectious agents acquired through assault may not have produced sufficient concentrations of organisms to result in positive test results at the initial examination, a culture (or cultures), a wet mount, and other tests should be repeated at the 2-week follow-up visit unless prophylactic treatment has already been provided. Serologic tests for syphilis and HIV infection should be repeated 6, 12, and 24 weeks after the assault if initial test results were negative.

Many experts recommend routine preventive therapy for adolescents after a sexual assault. Most patients probably benefit from prophylaxis because follow-up of patients who have been sexually assaulted can be difficult, and they may be reassured if offered treatment or prophylaxis for possible infection. The following prophylactic regimen is suggested as preventive therapy:<sup>47</sup>

- Postexposure hepatitis B vaccination (without HBIG) should adequately protect against HBV. Hepatitis B vaccine should be administered to victims of sexual assault at the time of the initial examination. Follow-up doses of vaccine should be administered from 1 to 2 months and from 4 to 6 months after the first dose.
- An empiric antimicrobial regimen for chlamydia, gonorrhea, trichomoniasis, and bacterial vaginosis should be administered.

The examining physician should not forget to test girls who have had menarche for pregnancy. The use of pregnancy prophylaxis may be discussed with the child/adolescent and her parents/caretakers (if appropriate).<sup>3</sup>

One cautionary note about *T. vaginalis* infections: *T. vaginalis* can be diagnosed only by wet prep or culture (if available). Occasionally a urine specimen from a child shows “*Trichomonas*” and this leads to suspicion of child sexual abuse. *Trichomonas hominis* lives in the gastrointestinal tract and can be found on urine specimens. *T. hominis* is not indicative of sexual abuse. Only positive wet preps or cultures can diagnose trichomoniasis relevant to child sexual abuse.

## Vaginal Discharge

Vaginal discharge is a common complaint that can raise suspicion of child sexual abuse and may be a presenting symptom. However, there are many other etiologies of vaginal discharge (see Table 2). Shigella infection can cause a bloody vaginal discharge. Foreign bodies also may cause a discharge. A common foreign body is a small piece of toilet tissue that migrates up into the vagina. To help differentiate abuse from other causes, the child needs a good physical exam and laboratory studies as indi-

cated. These could include genital cultures for gonorrhea and *Chlamydia* in addition to a routine culture and wet prep (in girls).

## Children with Special Needs

In 1993, in response to a congressional mandate, the National Center on Child Abuse and Neglect issued a report that presented data showing that children with a variety of special needs were at approximately two times the risk for child maltreatment when compared with children without such disabilities (DHHS, 1993).<sup>6</sup> Specifically looking at child sexual abuse, the incidence for children with special needs was 3.5 per thousand children compared with an incidence rate of 2.1 per 1000 for all children and an incidence of 2.0 per 1000 for children without special needs. Using a nationally representative sample of children, this study validated what had long been a clinical observation that children with disabilities were at increased risk for child abuse and neglect, and sexual abuse in particular.<sup>6</sup> A number of reasons have been identified that may explain why children with a variety of developmental disabilities may be at increased risk for sexual maltreatment: a) cognitive impairments and limited capacity for judgment that may place the child with special needs in situations that have a high risk of inappropriate sexual activities; b) limited language and verbal abilities that may make disclosure more difficult; c) the likelihood of multiple caregivers throughout the day between home, school, health care setting, and transportation required to get to these settings; d) the possibility of residing in an institutional setting; e) a high degree of dependency around typically private behaviors, such as bathing and toileting; and f) physical impairments that may prevent escape from sexually inappropriate situations.<sup>6</sup> Performing the medical evaluation of children with special needs presents a number of unique challenges to the health care provider related to both the interview and the physical examination that require extra attention and additional training.

## Conclusion

Child sexual abuse cases will present to physicians who care for children. It is important to remember to approach the case knowing that the history is the most important factor in determining if sexual abuse has likely occurred. Physical findings indicative of abuse are rare, but when present do aid in the prosecution of cases and protection of children. The child's developmental level should be considered when interviewing them about their symptoms and potential disclosure. Thorough documentation of the history and physical examination is of paramount importance in these cases.

Sexual abuse represents a violation of a child's trust and the imposition of age-inappropriate sexual activity upon a less powerful person by one in a position of authority over the child. The medical evaluation of children and adolescents who have been sexually victimized must not then become one more instance in which powerful adults impose their authority on the child's body and remove the child's control of events in his or her life. If not done in a knowledgeable and sensitive manner, the process of taking a complete history, performing a thorough physical exam-

ination, and obtaining the necessary laboratory tests can be invasive and threatening. Therefore, the health care professional and team can optimize this experience for the child or adolescent by conveying a gentle, concerned manner and by explaining to the child or adolescent what to expect during the evaluation. A calm, gentle, and unhurried approach will help tremendously to make the examination part of the recovery process rather than another form of assault. Awareness of the circumstances that these children and adolescents may have experienced, along with anticipating and addressing their fears, can help make a child more secure throughout the examination process and will enhance his or her cooperativeness. When the child is uncooperative, the health care provider should not resort to force to complete the examination but, rather, should address the underlying concerns of the child. This, coupled with efforts to demystify what the child will experience, will increase the chances of successfully completing an examination. The approach of the examining health care professional and the entire multidisciplinary team should be to complete the necessary medical evaluation in as nonthreatening and therapeutic a manner as possible.

A diagnosis of child sexual abuse may have many civil, criminal, physical and psychological sequelae.<sup>3</sup>

### Summary of Key Points

- Accidental genital injuries rarely result in trauma to the hymen in girls.<sup>51</sup>
- Child sexual abuse rarely results in physical trauma.
- The history given by the child is vital in cases of child sexual abuse.
- Children may present with the chief complaint of suspected sexual abuse, based on a child's disclosure, observed behaviors, or specific/nonspecific signs and symptoms.
- Specific criteria exist for the emergent or deferred evaluations and referral of a child with possible sexual abuse.
- Medical evaluation involves history, physical examination, laboratory studies, and documentation.
- All genital symptoms are not due to abuse.
- Don't forget to assess the need for mental health referrals and treatment.
- A child with an STD should be evaluated for possible sexual abuse.
- Clear documentation of the child's statements and physical findings are an integral part of the sexual abuse evaluation.

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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.

## CE/CME Questions

- The child sexual abuse accommodation syndrome includes all the following stages, *except*:
  - conviction
  - secrecy
  - helplessness
  - disclosure
- Which one of the following conditions has *not* served as a barrier to the recognition of sexual abuse in children?
  - Denial that sexual abuse of children occurs at all
  - Lack of a specific laboratory test to document sexual abuse
  - Lack of knowledge about the victimization of children
  - Anxiety surrounding discussion of sexual topics
- Which one of the following statements is *false*?
  - Sexually abused children often do not present with significant and diagnostic injuries.
  - The child's disclosure of sexual abuse often is delayed.
  - The perpetrator in child sexual abuse is usually a stranger.
  - Sexual abuse in children differs from adult sexual assault in several ways.
- The diagnosis of child sexual abuse is based primarily on the history provided by the patient.
  - True
  - False
- Which one of the following conditions is *not* considered a specific physical finding of child sexual abuse?
  - Hymenal bruising or tears
  - Genital bite marks
  - Enlarged hymenal orifice
  - Laceration of the hymen extending to the vaginal mucosa
- A 4-year-old girl comes to the ED with her mom for allegations of sexual abuse. The child discloses to you, "John put his sausage in my cake." On exam, you find no acute or chronic findings. Your impression is:
  - There are always findings in cases of sexual abuse, especially penetration, so the child must be making this up.
  - Lack of physical findings does not rule out or confirm sexual abuse. Therefore, you must report these allegations to a child protective services agency for alleged sexual abuse.
  - You can refer the child back to her physician who can deal with this later.
  - No report regarding these allegations needs to be filed.
- A 16-year-old girl comes to the ED for a psychiatric evaluation. She discloses to you that her mother's boyfriend has been sexually abusing her since age 11 years. She states the last incident of abuse was 2 weeks ago. Your plan is:
  - No need to report; children always disclose abuse immediately.
  - To continue with psychiatric evaluation and report to a local child protective services agency for investigation.
  - To do rape kit immediately and report to law enforcement and a child protective services agency.
  - Schedule an examination in the operating room.
- An 11-year-old girl comes to the ED in active labor. She states that her stepfather is the father of the baby. Your plan is to:
  - Send the patient to labor and delivery department and let them handle this.
  - Ask the stepfather if he is the father while in patient's presence.
  - Send the patient to labor and delivery department and make report to a local child protective services agency for investigation.
  - No report needs to be filed in this situation.
- Which of the following are essential components of the definition of child abuse?
  - The child's developmental maturity
  - The inability of the child to consent
  - The perpetrator's betrayal of the child's trust
  - All of the above
- Statutory rape involves sexual penetration by a person 18 years or older of a person under the age of consent.
  - True
  - False

### Answers:

- A
- B
- C
- A
- C
- B
- B
- C
- D
- A

**In Future Issues:**

**Radiologic evaluation of head trauma**

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Dear *Trauma Reports* Subscriber:

This issue of your newsletter marks the start of a new continuing medical education (CME) or continuing education (CE) semester and provides us with an opportunity to review the procedures.

*Trauma Reports*, sponsored by Thomson American Health Consultants, provides you with evidence-based information and best practices that help you make informed decisions concerning treatment options and medical practices. Our intent is the same as yours — the best possible patient care.

The objectives of *Trauma Reports* are to:

1. Discuss conditions that should increase suspicion for traumatic injuries;
2. Describe the various modalities used to identify different traumatic conditions;
3. Cite methods of quickly stabilizing and managing patients; and
4. Identify possible complications that may occur with traumatic injuries.

Each issue of your newsletter contains questions relating to the information provided in that issue. After reading the issue, answer the questions at the end of the issue to the best of your ability. You can then compare your answers against the correct answers provided in an answer key in the newsletter. If any of your answers were incorrect, please refer back to the source material to clarify any misunderstanding.

Enclosed in this issue is an evaluation form to complete and return in an envelope we will provide. Please make sure you sign the attestation verifying that you have completed the activity as designed. Once we have received your completed evaluation form we will mail you a letter of credit. This activity is valid 24 months from the date of publication. The target audience for this activity is emergency, trauma, and surgical physicians and nurses.

If you have any questions about the process, please call us at (800) 688-2421, or outside the U.S. at (404) 262-5476. You can also fax us at (800) 284-3291, or outside the U.S. at (404) 262-5525. You can also email us at: [ahc.customerservice@thomson.com](mailto:ahc.customerservice@thomson.com).

On behalf of Thomson American Health Consultants, we thank you for your trust and look forward to a continuing education partnership.

Sincerely,

A handwritten signature in black ink that reads "Brenda L. Mooney". The signature is written in a cursive style with a large, looping "y" at the end.

Brenda Mooney  
Vice-President/Group Publisher  
Thomson American Health Consultants