

Forensic Laboratory Evidence in Sexually Abused Children and Adolescents

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Objectives: To determine if forensic laboratory evidence could be recovered from alleged sexual abuse victims more than 24 hours after the event and to determine if age or historical factors could be used to determine the need for forensic evidence collections.

Design: Retrospective study of hospital records matched with forensic evidence reports from the Arkansas State Crime Laboratory, Little Rock.

Setting: The emergency department at Arkansas Children's Hospital, Little Rock.

Participants: Eighty children (aged <12 years) and adolescents (aged \geq 12 years) who presented to the emergency department within 72 hours of an alleged event of sexual abuse or assault with genital contact.

Main Outcome Measures: Cases positive for semen were correlated with age of the victim and postevent length

of time to presentation to the emergency department.

Results: Of the 80 subjects, 16 had positive findings for semen. All 16 subjects who tested positive for semen presented to the emergency department less than 24 hours after the alleged abuse or assault event ($P < .001$). Of the 16 subjects who tested positive, 13 (81%) were adolescents. None of the prepubertal children had semen recovered from any body site; semen was recovered only from clothing or linen in those 3 children.

Conclusions: Forensic evidence collections from body sites in child and adolescent rape patients are unlikely to yield positive results for semen (1) more than 24 hours after the event and (2) when taken from prepubertal patients. Consideration should be given to amending guidelines regarding forensic evidence collections in child and adolescent sexual abuse or assault victims.

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WHEN AN ALLEGATION of sexual abuse is reported within 72 hours after the event, the American Academy of Pediatrics¹ recommends that children and adolescents be taken immediately to a medical facility so that a physical examination can be performed and forensic evidence collected when appropriate. However, when the likelihood of forensic evidence contributing positively to the diagnosis of sexual abuse is low, the potential emotional harm to the child by evidence collection may be greater than the likelihood of benefit.² The child can perceive the evidence collection as uncomfortable,² frightening, and reminiscent of the abuse. Sedation, when required, also has attendant risks.

The goals of this study were to determine the usefulness of forensic collections for semen in child (aged <12 years) and adolescent (aged \geq 12 years) sexual assault victims more than 24 hours after the event and to find other factors that may

be reliably associated with the presence or absence of semen.

The standard of care is to perform forensic evidence collections if the event occurred less than 72 hours before presentation or if bleeding or recent injury is present. This "72-hour rule" is based on adult data and may not hold true for children.² Some adult data suggest that sperm could be found inside the adult cervix after this period if there was significant trauma, pain, or bleeding, so physician judgment should always be used.³⁻⁵

Most published studies involving evidence collection kits in children provide little information as to how often these kits are actually positive for semen, and whether some circumstances warrant omission of forensic specimen collection with confidence that the likelihood of missing evidence is low. Dahlke et al,⁶ in 1977, reported sperm detection in 3% of children younger than 11 years who were raped, compared with 36% of 11- to 14-year-old subjects who were raped.

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Table 1. Characteristics of the 16 Patients Positive for Semen

Patient No./ Sex/Age, y	Time to Emergency Department, h*	Genital-to-Genital Contact	Bathed or Wiped	Location of Semen	Method Used†
1/F/6	Immediate	Yes	Unknown	Underwear	p30
2/F/8	Immediate	Yes	Unknown	Underwear and washcloth	p30
3/M/11	Immediate	No	Unknown	Underwear	p30
4/F/12	<24	Yes	Wiped	Vaginal and underwear	Cell
5/F/13	Immediate	Yes	Unknown	Unknown	Unknown
6/F/13	Immediate	Yes	Unknown	Vaginal	Cell
7/F/13	<24	Yes	Wiped	Vaginal	Cell
8/F/14	Immediate	Yes	No	Vaginal, pants, and underwear	Cell
9/F/14	<24	Yes	Unknown	Vaginal	Cell
10/F/14	<24	Yes	Unknown	Vaginal, rectal, and underwear	Cell
11/F/14	<24	Yes	Bathed and wiped	Vaginal, rectal, and underwear	Cell
12/F/14	Immediate	Yes	Wiped	Vaginal, shorts, and underwear	Cell
13/F/14	<24	Yes	No	Vaginal, pants, and underwear	p30
14/F/14	Immediate	Yes	Wiped	Vaginal and shorts	Cell
15/F/16	Immediate	Yes	Unknown	Vaginal	Cell
16/F/16	Immediate	Yes	No	Vaginal and underwear	Cell

*Immediate indicates less than 6 hours.

†These methods are described in the "Laboratory Analyses" subsection of the "Methods" section.

METHODS

SETTING

This study was a retrospective review of records of suspected victims of sexual abuse or sexual assault who were examined and had forensic evidence collected in the emergency department of Arkansas Children's Hospital, Little Rock. The University of Arkansas for Medical Sciences Hospital institutional review board approved this study.

SUBJECTS AND RECORD ABSTRACTION

We reviewed the medical records of 110 patients aged 16 years and younger who had forensic evidence processed by the Arkansas State Crime Laboratory, Little Rock, over a 30-month period from October 25, 1992, to April 4, 1995. Adequate medical records for 80 of 110 of those patients were obtained and were included in the study. The forensic semen analysis results for all subjects obtained from the Arkansas State Crime Laboratory were matched to the subjects' emergency department visit when the forensic evidence was collected. Specific information was then extracted from that visit and included in this study.

PROCEDURES

The sexual abuse examinations and forensic laboratory collections were performed primarily by pediatric residents who were supervised by pediatric faculty physicians. Forensic collections were obtained when the sexual abuse or assault occurred within the previous 72 hours. Speculum examination with attempted cervical specimen collection was done for adolescents.

The forensic evidence kits contained swabs, slides, and containers and bags for collecting oral, vaginal, and rectal samples, linens, skin scrapings, clothing, or other particulate matter that could aid law enforcement investigators and prosecuting attorneys in confirming the sexual abuse and/or identification of a perpetrator. Kits contained printed instructions for collecting the forensic evidence. Nurses trained in forensic evidence collection assisted in the collections, and the protocols were

followed in a standardized fashion. The kits were then submitted to the Arkansas State Crime Laboratory for analysis.

LABORATORY ANALYSES

Investigators at the Arkansas State Crime Laboratory who tested the 80 kits used 2 possible methods to identify the presence of sperm in the forensic collections: (1) direct microscopic identification of sperm (designated "cell" in **Table 1**) or (2) cross-over electrophoresis, which identifies a prostate-specific antigen by causing a union with a matching antibody using an electrical accelerator to process the results (designated "p30" in Table 1). Prostate-specific antigen, also referred to as p30, is a seminal plasma protein found only in adult male urine and seminal fluid.^{3,7}

The p30 antigen can be detected in vaginal fluid only if semen were present⁷ and only up to a maximum of 48 hours. Usually, p30 is nondetectable in the vagina after 48 hours.³ Cell microscopy, or direct visualization, was the other method of laboratory analysis. Both highly sensitive methods detected and identified spermatozoa collected on oral, vaginal, or rectal swabs from the victim or from stains on clothing or linens.

STATISTICAL ANALYSES

The association between forensic examination results and the time from the alleged event to presentation at the emergency department was investigated using an exact Cochran-Armitage trend test with computer software (StatXact 4.01, StatXact Software; Cytel, Cambridge, Mass).

RESULTS

Of the 80 children and adolescents in this study, 49 (61%) were younger than 12 years and 31 (39%) were 12 years or older. The median age of the 80 children and adolescents in the study was 9 years (mean, 8.5 years). The age range was 4 months to 16 years. Of the subjects, 8 (10%) were male, of whom 6 (75%) were younger than 12 years.

Table 2. Forensic Evidence Results by Age*

Forensic Evidence Result	Subjects Aged <12 y	Subjects Aged ≥12 y	Total
Positive	3 (6)	13 (42)	16 (20)
Negative	46 (94)	18 (58)	64 (80)
Total	49 (100)	31 (100)	80 (100)

*Data are given as number (percentage) of each group.

Of the 80 subjects, 64 had a negative semen test result, while 16 had a positive result when their kits were analyzed at the Arkansas State Crime Laboratory (**Table 2**).

The findings of our study are presented in relation to historical findings, victims' ages, and site of semen recovery.

HISTORICAL FINDINGS

All 16 subjects who tested positive for semen from body sites and/or linens presented to the emergency department less than 24 hours after the alleged abuse or assault event, and 10 (62%) arrived at the emergency department immediately after the alleged event. Table 1 details the characteristics noted in the 16 subjects who tested positive. **Table 3** shows the length of time between the event and presentation to the emergency department for all 80 patients. Of the semen-positive patients, 1 was known to have bathed and washed the genital area before the visit and 4 had wiped; 3 patients had not wiped or bathed; and in 8 patients, the bathing history was unknown. All 15 semen-positive girls reported genital-to-genital contact; the only semen-positive boy disclosed penile-leg contact.

AGES OF VICTIMS

Positive test results for semen were present in 3 (6%) of the 49 children younger than 12 years, whereas results were positive in 15 (48%) of the 31 adolescents. The 3 youngest children with positive collections for semen were aged 6, 8, and 11 years, and presented to the emergency department promptly after the alleged sexual assault. Of the 16 patients who tested positive for semen, 13 (81%) were adolescents.

SITE OF POSITIVE TEST RESULT FOR SEMEN

None of the prepubertal children had semen recovered from any body site; semen was recovered only from clothing or linen in those instances. Four adolescents had semen found in the vagina only. The remaining 8 adolescents with known sites of recovery had seminal fluid in specimens from multiple body sites and/or clothing (Table 1).

COMMENT

Many findings on investigation of suspected child sexual abuse and assault influence the decisions of law enforcement to arrest a suspected offender and a social agency

Table 3. Time to Emergency Department Presentation for the 80 Subjects*

Result of Collections Processed	Total No. of Subjects	Time to ED Presentation		
		Immediate†	≤24 h†	>24 h†
Negative	64	3 (5)	22 (34)	39 (61)
Positive	16	10 (62)	6 (38)	0

* $P < .001$ for the difference between times using an exact Cochran-Armitage trend test.

†Data are given as number (percentage) of each group.

to take steps to protect a victim. When forensic laboratory evidence plays a role, it can be invaluable. The collections are not necessarily emotionally benign procedures, however, especially for prepubertal children. Establishment of medical evidence that justifies the guidelines for forensic collections in the pediatric population is imperative, because extrapolation from adult data may not be reliable when applied to children or adolescents.

Christian et al² report that more than 90% of 67 children younger than 10 years with positive forensic evidence findings were seen within 24 hours of their sexual abuse or assault. All evidence recovered after 24 hours was found on clothing and linens, except for 1 child, on whom a pubic hair was identified 44 hours after the assault.² Our findings are consistent with those in the report of Christian et al. All of the patients in our study who tested positive for semen arrived in the emergency department within 24 hours of the event. Christian et al reported some form of forensic evidence recovered from 24.9% of their collections, although only 11% of that was from body sites. Our yield was only 6%. This difference can likely be explained by the fact that Christian et al reported findings that included blood, semen, hair, sperm, and others (grease stain and synthetic fibers), whereas our findings were limited to semen and sperm. We would like to emphasize the critical role that early forensic evidence collections have in the recovery of semen from body sites for all age groups, while allowing for the importance of physician judgment to deviate from the standard on a case-by-case basis. We also agree with Christian et al that recovery and analysis of unwashed clothing and linens should be vigorously pursued because seminal fluid and blood can remain stable for long periods on cloth. In the study by Christian et al,² most of the evidence positive for semen was found on linens and clothing. In our study, this was exclusively the case for the 3 prepubertal children.

The prepubertal age group of victims seems to be predictive of the absence of semen. No child younger than 12 years had semen recovered from any body site in this study. Christian et al,² in, to our knowledge, the only other published study regarding forensic evidence collections in childhood, found that 11% of children younger than 10 years were positive for forensic findings from body sites, including blood, semen, hair, and other. Our study was limited to semen. One possible explanation for the low detection rates of sperm in children younger than 12 years may be that the sexual abuse of prepubertal chil-

dren is less likely to involve vaginal intercourse because of the relatively small size of the hymen and vagina. The likelihood of identification of seminal fluids in the vagina is, thus, diminished. The collection technique for prepubertal children is also different from that of adolescents and adults. For vaginal swabs in young children, a blind swab is the preferred collection method, and there is no anticipation of collecting cervical fluids. In the adolescent and adult collections, a vaginal speculum is used, thus ensuring that deep vaginal, cervical, and other noticeable fluids can be obtained, which would likely increase the positive yield. One study⁸ reports that it is possible that sperm can be found in the adult endocervix up to 6 days after intercourse. In vaginal samples, motile sperm commonly are not found after a few hours.⁹ In a study¹⁰ that looked at 1007 adult rape survivors, 919 vaginal specimens were collected and 344 (37.4%) were positive for sperm; 37% of the total number of cases were examined within 20 hours of the assault.

This study had limitations. It was a retrospective review, and many patient medical records had incomplete data. In addition, the number of semen-positive subjects was small.

In conclusion, our findings support those of the study by Christian et al² that forensic evidence collections from child or adolescent patients are unlikely to yield positive results more than 24 hours after the event. No child younger than 12 years in our study was positive for semen from body sites; if semen is present in children younger than 12 years, it is likely to be on linens and clothing. Evaluation of these findings by experts in the field is recommended so that guidelines can be amended to reflect the latest medical evidence.

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Correction

Error in Abstract. The article "Hearing Thresholds and Tympanic Membrane Sequelae in Children Managed Medically or Surgically for Otitis Media With Effusion," by Stenstrom et al in the December issue of the ARCHIVES (2005;159:1151-1156), contained 2 incorrect numbers in the abstract. The sentence in the methods paragraph of the abstract on page 1151 should read as follows: "Thirty of 57 medical subjects received ventilation tubes and 18 of 56 VT subjects received more than 1 set of tubes."