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 ≥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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linens, skin scrapings, clothing, or other particulate matter that

tainers and bags for collecting oral, vaginal, and rectal samples,

cervical specimen collection was done for adolescents.

were obtained when the sexual abuse or assault occurred within

supervised by pediatric faculty physicians. Forensic collections

The sexual abuse examinations and forensic laboratory collec-

ions were performed primarily by pediatric residents who were

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 depart-

ment of Arkansas Children's Hospital, Little Rock. The Univer-

sity 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 Ar-

kansas State Crime Laboratory, Little Rock, over a 30-month

period from October 25, 1992, to April 4, 1995. Adequate med-

ical records for 80 of 110 of those patients were obtained and

were included in the study. The forensic semen analysis re-

sults for all subjects obtained from the Arkansas State Crime

Laboratory were matched to the subjects' emergency depart-

ment 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 collec-

tions 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 con-

ainers 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 at-

torneys in confirming the sexual abuse and/or identification of

a perpetrator. Kits contained printed instructions for collect-

ing 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 submit-
ted 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 iden-
tification of sperm (designated “cell” in Table 1) or (2) cros-

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eference to as p30, is a seminal plasma protein found only in adult male urine and

semen.

The p30 antigen can be detected in vaginal fluid only if se-
mens were present" and only up to a maximum of 48 hours. Usu-

ally, p30 is nondetectable in the vagina after 48 hours. Cell

microscopy, or direct visualization, was the other method of

analytical laboratory. 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

days 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 1. Characteristics of the 16 Patients Positive for Semen

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

*Immediate indicates less than 6 hours.
†These methods are described in the “Laboratory Analyses” subsection of the “Methods” section.
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-wiped or bathed; and in 8 patients, the bathing history 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-wiped or bathed; and in 8 patients, the bathing history was unknown.

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 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-

### Table 2. Forensic Evidence Results by Age*

<table>
<thead>
<tr>
<th>Forensic Evidence Result</th>
<th>Subjects Ages ≤12 y</th>
<th>Subjects Ages ≥12 y</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>46 (94)</td>
<td>18 (58)</td>
<td>64</td>
</tr>
<tr>
<td>Negative</td>
<td>13 (6)</td>
<td>13 (42)</td>
<td>26</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Result of Collections Processed</th>
<th>No. of Subjects</th>
<th>Immediate† ≤24 h†</th>
<th>&gt;24 h†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>64</td>
<td>3 (5)</td>
<td>22 (34)</td>
</tr>
<tr>
<td>Positive</td>
<td>16</td>
<td>10 (62)</td>
<td>6 (38)</td>
</tr>
</tbody>
</table>

*P<.001 for the difference between times using an exact Cochran-Armitage trend test.
†Data are given as number (percentage) of each group.

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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 study\(^9\) 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 study\(^{10}\) 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 al\(^2\) 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.”