Time Since Intercourse: Studies and Estimates

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Why TSI in DNA Age?

- Basic Forensic Serology is becoming a lost field of knowledge
- Cases from pre-DNA tests are now on appeal. Present day analysts do not understand the older technologies
- DNA can tell identity but not time
- TSI estimates depend on seminal fluid constituents
History

- TSI- Not a new question.
- 1827-Orfila- Molestation of a 13 year old female.
- Physician id’d semen from vaginal secretions 9 days post intercourse.
- Orfila doubted the finding
- His tests indicated no semen present
Studies in Spermatozoa Survival

- Most studies done by fertility/sterility researchers
- Medical Examiners
- Controlled subjects
- Casework samples
Limitations of Studies

- Objective of fertility studies different than forensic research
- Inaccuracies in post-mortem interval
- Problems with volunteer subjects
- Problems with casework samples
- Initial number of spermatozoa in ejaculate not known
- Menstrual cycle stage which coitus occurred not known.
Limitations of Studies

- Example: Mengee (1887)
- Recovered sperm cells from child 14 days after assault
- Age: survival times for adult females shorter
- Manner of collection
- Location: spermatozoa survive longer in cervical samples than vaginal samples
Studies and Results: Spermatozoa

- Sharp (1963):
- Motile Sperm:
  - Vagina - 30 minutes - 6 hours
  - Cervix - 7 hours - 5 days
- Non-Motile Sperm:
  - Vagina - 7 hours - 12 hours; less often after 24 hours rarely 3-4 days post-coitus
  - Cervix - 17 days
Studies and Results: Spermatozoa

- Enos & Beyer (1977);
- Rectal Swabs - 24 hours
- Oral Swabs - 6 hours (survive tooth brush, mouthwash)
- Vaginal Swabs - 3 days post-coitus
- Note: Found sperm cells on anal swabs w/o anal intercourse. Drainage from vagina.
Studies and Results: Spermatozoa

- Nicholson (1965): 85 patients
- Cervix - non-motile sperm cells - 8 days; motile sperm - 6 days
- Rupp (1969): 84 rape cases
- Vagina - motile sperm - 8 hours; non-motile 8-14 hours
Studies and Results: Spermatozoa

- Morrison (1972): Effect of menstruation
- Sperm cells survived longer if coitus occurred in the first 14 days after menstruation.
- Studies 104 subjects
- Most cases could not find sperm in vagina after 48 hours. Longest period was 9 days (coitus occurred 5th day post-menstruation)
- Cervix - 12 days (coitus occurred 8th day post menstruation)
Studies and Results: Spermatozoa

• Found sperm in pregnant women in vagina up to 7 days post coitus

• Georgidaes & Schneider (1972):
  • Cervix- motile 8 days non-motile 10.5 days

• Wallace and Haager (1975): 22 subjects throughout menstrual cycle
  • Vagina- Motile- 12 hours
  • 6% of samples found spermatozoa after 48 hours
Studies and Results: Spermatozoa

- Breen (1972): vagina- motile 28 hours; non-motile 48 hours
- Brown (1977): vagina- motile 6 hours; non-motile 72 hours
- Dahlke (1977): 500 sexual assault victims- longest interval sperm could be found after assault was 48 hours
Studies and Results: Spermatozoa

- Rape/ Homicide Cases: Sperm cells survive longer
- Wilson (1974): vagina - 16 days
- Willott (1975): vagina dead between 3 and 4 months
Studies and Results: Spermatozoa

- Everard (1971): vagina - motile sperm - 4 days
- Silverman and Silverman (1978): cervix 15 days intact sperm cells
- Paul (1984): vagina - motile sperm 72 hours
- Allard (1997): vagina - intact sperm 5 days *
- Jones (2005): vagina - intact sperm 7 days *
- * note: both of these instances each was just one victim who due to illness was immobile or with limited movement
Acid Phosphatase (AP)

- All of these studies address the persistence of AP activity in the vagina
- Pinto (1959): developed a color chart. Intensity decreased from 6 hours to 48 hours post-coitus
- David and Wilson (1974) AP activity present up to 3 days, but most useful w/in 24 hours, rarely useful > 2 days
Acid Phosphatase (AP)

• McCloskey (1975): between 24 and 48 hours AP activity decreased from 50 U* to 25 U*. 25 U was cut-off value for a negative test result.

• Gomez (1975): assayed vaginal washings from 41 women

• Two quantitative and 2 qualitative tests

• Group 1- no intercourse; Group 2- recent intercourse

• Found quantitative tests more sensitive than qualitative
Acid Phosphatase (AP)

- Results: higher AP values from group 1 overlapped lower AP values from group 2
- Example: one person who had been raped 5 hours before sample collection had lower AP values than the patient who had no intercourse 60 hours prior to exam.
- Good correlation between quantitative and qualitative tests
Acid Phosphatase (AP)

- Enos (1963): 36 sexual assault cases
- Observed a decrease in AP activity over time
- 100 U - 1 hour
- 30 U - 2-3 hours
- 10 U - 6 hours
- 5 U - 12 hours
- 0 U - > 24 hours
Acid Phosphatase (AP)

- Rupp (1969) detected AP >24 hours
- Schurman (1976) & Findley (1977) quantitative assay can develop cut-off thresholds for seminal AP.
- Dahlke (1977) & Duenhooter (1977): Found less AP activity in cases examined within 2 hours than those tested 3-12 hours post intercourse
Acid Phosphatase (AP)

- Sensabaugh (1979) & Rutter (1980)
- 400 data set points combined
- 1.) regular pattern of AP activity decline
- 2.) loss of activity is 1\textsuperscript{st} order (log-linear) throughout the 1\textsuperscript{st} 10 hours. Half-life is 2.6 hours
- 3.) Rate of loss becomes gradual (levels off) past 10 hours
- 4.) at 60 hours AP activity virtually the same as semen free vaginal fluid
Acid Phosphatase (AP)

- 5.) rate of decline in the vagina is more rapid than in the test tube mixture of semen and vaginal fluid
- 6.) after 15 hours the false negative percentage was 50%
- Conclusion: AP test is not precise indicator of TSI. Best to determine interval limit beyond which value is unlikely. Example: > 256 U unlikely after 12 hours; values 64-128 U unlikely after 24 hours
Acid Phosphatase (AP)

• Davis and Wilson (2001): AP test most useful w/in 24 hours post coitus. Rarely useful past 2 days though did find one case where AP tested positive at 3 days.
• Caution: If victim has fungal (Candida albicans) infection or high levels of microbial flora or is pregnant can give misleading AP test results.
• Increased AP reaction time
Post- Mortem AP Activity

- Standeffer and Street (1977)
- Vaginal - 7 days
- Oral – 36 hours
- Anal - 24 hours
p-30 (PSA) Stability

- Macaluso (1999): PSA (p-30) levels decrease with TSI. Amount of ejaculate a factor.
- Inoculate female volunteers with partners semen
- Three doses: 10, 100 and 1000 uL
- Results: 10-100 uL levels fell to normal background w/in 24 hours. 1000 uL levels fell to back ground w/in 48 hours
p-30 (PSA) Stability

- Hochmeister (1997): PSA detectable 14-47 hours post coitus
- Kameneve (1989): PSA detectable 10.5- 24 hours
- Grous (1985): PSA detectable 13-47 hours with an average of 27 hours
Choline and Blood Group Substances

- Davis and Wilson (2001): majority of samples failed to detect choline between 14-26 hours. Some gave weak results at 32, 36 and 54 hours.
- Blood Group Substances: Davis and Wilson (2001) will fail to detect presence w/in 48 hours.
Conclusion

• Drainage is the primary cause of loss of seminal fluid constituents followed by dilution with vaginal secretions
• Effect of drainage is enhanced by menstruation and bathing/showering
• Spermatozoa is the longest lasting seminal fluid constituent with the number of sperm decreasing over time.
TSI: Sorry No Easy Answer

• Take into account:
  1.) Test results: sperm (number, tails present), AP (reaction time and intensity), p30. Blood Group Substances, Enzymes (pre-DNA testing). DNA test results full or partial profile
  2.) Location of sample: vaginal (inner/outer) cervix, anal, oral
  3.) State of victims health, activity, reported time of event and time of last known consensual partner
TSI: Sorry No Easy Answer

- Victim’s age
- Menstruating and post menstruation time frame.
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