

Research Article

Association between the victim's menstrual cycle phase and genital injuries following sexual assault

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Abstract

Background: It is unknown what effect the menstrual cycle can have on the susceptibility to trauma following sexual assault.

Objectives: To compare the incidence of genital injuries following sexual assault in women with relationship to the three phases of the menstrual cycle

Methods: The design was a retrospective, cohort analysis set in a community-based nurse examiner program over a five-year study period. Sexual assault victims were between the ages of 13 - 40 years and agreed to a forensic examination. The menstrual cycle was divided into three phases: follicular, luteal and menses phase. The primary outcomes were the frequency and type of genital injuries documented in relation to the different phases of the menstrual cycle.

Results: Case files of 1376 cases of sexual assault were reviewed; 682 (49.6%) met the inclusion criteria. A total of 220 victims (32.3%) were in the follicular phase, 361 (52.9%) were in the luteal phase and 101 (14.8%) were in the menses phase. The three groups were comparable in terms of demographics, assault characteristics, and overall frequency of non-genital injuries. Assault victims in the follicular phase of the menstrual cycle had significantly more documented genital injuries (72.3%; 95% CI 66.4 - 78.2) compared to the luteal phase (64.0%; 95% CI 59.0 - 68.9) and the menses phase (58.4%; 95% CI 48.8 - 68.0).

Conclusion: Forensic examiners documented more genital injuries in the follicular phase of the menstrual cycle. Sex hormones may have confounding effects through influences on vaginal epithelial and mucosal integrity.

Introduction

The forensic examination of sexual assault victims is performed to detect and treat trauma, as well as collect specimens and document injuries for prosecution. Colposcopy with digital imaging and staining with toluidine blue has led to reports of anogenital injury prevalence from 64% to 83% [1]. Prevalence rates may vary depending on examiner training and experience, examination type, age of the victim, the force of penetration, number of assailants and sedative or alcohol use within hours of the sexual assault [2,3]. While little is known about the role of female hormones in the potential for anogenital injury during sexual assault, estrogen and progesterone may have confounding effects through influences on vaginal epithelial and mucosal integrity [2].

For example, the menstrual cycle has long been considered a factor that could alter injury risk in female athletes [4]. Cyclical fluctuations in sex hormones such as estrogen and progesterone can influence musculoskeletal tissues such as ligaments, tendons and muscles. A recent study by Martin, et al. reported that muscle and tendon injuries in international footballers occurred almost twice as often in the days preceding ovulation, or the late follicular phase [5]. They even suggested that female athletes should monitor menstrual cycle length to determine when they are at increased risk for musculoskeletal injury. Several other studies have found a greater risk of Anterior Cruciate Ligament (ACL) injuries in the late follicular/ovulatory phase when estrogen concentrations are highest [6,7]. To date, the impact of menstrual cycle

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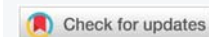
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Keywords: Sexual assault; Menstrual cycle; Follicular phase; Genital injuries; Epidemiology





phases on genital injuries following sexual assault has not been explored.

The aim of this study was to compare the incidence of genital injuries following sexual assault in women with a relationship to the three phases of the menstrual cycle: follicular or preovulatory, luteal and menses.

Materials and methods

Study design/setting

We conducted a retrospective, cohort analysis in conjunction with a community-based Nurse Examiner Program (NEP) over a five-year study period. Sexual assault victims presenting directly to any of the four downtown Emergency Departments (ED) are routinely referred to the NEP for evaluation after triage and initial assessment. The NEP is staffed by forensic nurses trained to perform medicolegal examinations using colposcopy with nuclear staining [8]. The nurse examiners at the NEP have completed a specialized Sexual Assault Nurse Examiner (SANE) program which includes a minimum of 40 hours of didactic and 40 hours of clinical training. Each nurse had performed over 200 sexual assault examinations prior to study initiation. An Institutional Review Board (IRB) affiliated with the NEP program approved this retrospective observational study.

Procedures

Nurse examiners identified anogenital injuries via visual inspection, magnification with colposcopy, and toluidine blue contrast application. The following anatomical sites are routinely evaluated and photographed for the presence and type of injury: external genitalia (thigh, mons pubis, labia majora, and perineum), internal genitalia (labia minora, periurethral area, posterior fourchette, fossa navicularis, hymen, cervix and vagina), and anus. Anoscopy is performed at the examiner's discretion. Examiners used the TEARS (Tear, Ecchymosis, Abrasion, Redness, Swelling) classification to document injuries [1,9]. The number of genital and nongenital injuries was determined by simply counting each injury occurrence and totaling the count for each individual. Injury frequency was the number of genital or nongenital injuries sustained by each woman.

Population

Eligible patients were assault victims between the ages of 13 - 40 years who consented to a forensic examination and reported a regular menstrual cycle. Women were excluded if they were found to be pregnant, used hormonal birth control, had a history of irregular menstrual cycles, had missing or incomplete documentation, were examined more than 72 hours following the assault, or were unable to accurately recall their Last Menstrual Period (LMP). Women over 40 years were excluded to eliminate those in perimenopause, which can often precede menopause by years [10]. Women

with vulvovaginal dermatoses (e.g. lichen planus) which might predispose them to vaginal injury were also excluded.

Data collection

Medical records were reviewed by three forensic nurses with training in research methodology. Research staff was taught how to perform data abstraction using a set of mock case records. One of the investigators met often with the abstractors to resolve questions and ensured that data variable definitions were uniformly applied. Patient demographics, menstrual cycle phase, assault characteristics and injury patterns were recorded using a standardized classification system.

Study definitions

Stringent criteria were used to define the menstrual cycle. Menstrual cycle phases were identified using self-reported days since their LMP. Patients were categorized into three groups: the follicular phase (the 9-day period following cessation of menses), the luteal phase (beginning 15 days after LMP) and the menses phase [2,11].

Statistical analyses

The primary outcome measure was the frequency and type of genital injuries documented with a relationship to the separate phases of the menstrual cycle. Data were entered into a Microsoft Excel database (Microsoft Corp, Redmond, WA, USA). All analyses were performed using SAS statistical software (SAS Institute, Cary, NC, USA). One investigator performed a critical review of a random sample of 10% of the charts to determine data reliability using the Kappa reliability test. Descriptive statistics were used to describe the frequency, location and type of anogenital injury according to the TEARS classification system. Chi-square and analysis of variance (ANOVA) tests were used to compare anogenital injuries in the examined victims; 95% Confidence Intervals (CI) were used to quantify uncertainty.

Results

Case files of 1376 cases of sexual assault were reviewed; 682 (49.6%) met the inclusion criteria. A total of 220 victims (32.3%) were in the follicular phase, 361 (52.9%) were in the luteal phase, and 101 (14.8%) were in the menses phase of the menstrual cycle. The three groups were comparable in terms of demographics, parity, assault characteristics, and overall frequency of non-genital injuries (Table 1). Assault victims in the follicular phase of the menstrual cycle had significantly more documented genital injuries (72.3%; 95% CI 66.4 - 78.2) compared to the luteal phase (64.0%; 95% CI 59.0 - 68.9) and the menses phase (58.4%; 95% CI 48.8 - 68.0). These differences were statistically significant using the chi-square test for multiple categories ($p = 0.022$).

Using the TEARS classification system, the localized pattern, type, and frequency of anogenital injuries did not



vary significantly between the three phases of the menstrual cycle (Figure 1). The common sites of injury were located posteriorly, including the fossa navicularis, posterior fourchette, labia minora and anus. The interrater agreement for this sample of charts was excellent (K statistic = 0.91).

Discussion

This is the first clinical study to compare the documentation of genital injuries following sexual assault in women with a relationship to the separate phases of the menstrual cycle.

Table 1: Patient demographics and assault characteristics.

Menstrual Cycle				
	Menstrual	Follicular	Luteal	p - Value
Total #	101 (14.8%)	220 (32.3%)	361 (52.9%)	
Age of victim, mean years	22.1 ± 7.5	21.7 ± 7.9	23.0 ± 8.1	0.144
Ethnicity (% white)	75 (74.3%)	167 (75.9%)	271 (75.1%)	0.946
Marital status (% single)	78 (77.2%)	161 (73.2%)	256 (70.9%)	0.806
Time interval to the exam, mean h	21.8 ± 22.1	20.0 ± 20.9	21.0 ± 26.8	0.742
Alcohol or drug use < 24 h	55 (54.5%)	130 (59.1%)	203 (56.2%)	0.848
No prior history of sexual intercourse	7 (6.9%)	16 (7.3%)	22 (6.1%)	0.563
Previous sexual assault	45 (44.6%)	87 (39.5%)	140 (38.8%)	0.573
Police report filed	78 (77.2%)	164 (74.5%)	285 (79.0%)	0.470
Known assailant	85 (84.2%)	191 (86.8%)	322 (89.2%)	0.353
Multiple assailants	12 (11.9%)	29 (13.2%)	39 (10.8%)	0.688
Type of sexual assault				
Vaginal	76 (75.3%)	174 (79.1%)	289 (80.1%)	0.577
Oral	27 (26.7%)	63 (28.6%)	101 (28.0%)	0.940
Anal	14 (13.9%)	28 (12.7%)	45 (12.5%)	0.933
Digital	28 (27.7%)	81 (36.8%)	129 (35.7%)	0.252
Non-genital injuries	41 (40.6%)	93 (42.3%)	143 (39.6%)	0.818
Anogenital injuries	58 (58.4%)	157 (72.3%)	231 (64.0%)	0.021
Anogenital injuries, total	162	462	614	
Anogenital injuries, mean (SD)	1.6 ± 1.9	2.1 ± 2.0	1.7 ± 1.8	0.022

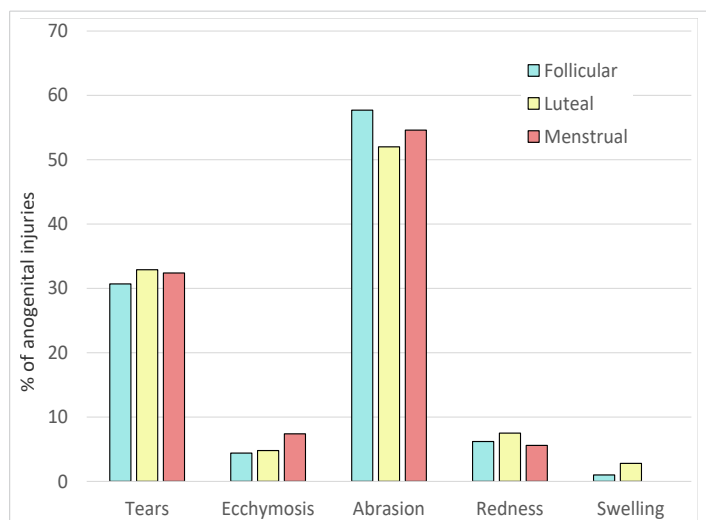


Figure 1: Types of genital trauma in relation to menstrual cycle.

Assault victims in the follicular phase of the menstrual cycle had significantly more documented anogenital injuries compared to the luteal phase or the menses phase. The follicular phase includes the stimulation and development of ovarian follicles via Follicle-Stimulating Hormone (FSH) and Luteinizing Hormone (LH) [12]. Estrogen levels are high during this phase as estrogen increases the growth of the endometrium and stimulates the emergence of spiral arteries. At the end of the follicular phase and nearing ovulation, estrogen levels are the highest due to follicle maturation. This leads to an increase in FSH and LH levels, called the LH surge, which causes an oocyte to be released. The next phase is the luteal phase and progesterone, stimulated by LH, is the dominant hormone involved in this phase as it prepares the corpus luteum and endometrium for possible fertilized ovum implantation. If no fertilized ovum is implanted, the levels of estrogen, progesterone, FSH and LH decrease and lead to menstruation with atresia of the corpus luteum and endometrium [12].

Little is known about the role of sex hormones, estrogen, and progesterone, in the potential for anogenital injury during coitus. However, estrogen regulates host immune responses, increases glycosaminoglycans and collagen production and affects skin thickness as well as tissue integrity [2,13]. Older or postmenopausal women have more anogenital injuries due to their decreased estrogen levels and loss of tissue elasticity [14]. A study of women following consensual sexual intercourse found that among menstruating women, those in the follicular phase had a greater prevalence and frequency of genital injuries than those in other phases [2]. The same study also reported that women using hormonal birth control had 38% more genital injuries and more than twice the anal injuries as the non-hormonal birth control menstruating group. These findings are similar to a study by Sommers, et al. who found that the odds of anogenital injury after consensual sexual intercourse among women who used hormonal birth control were 2.5 times greater than among women who used no birth control [15]. Other studies suggest that female sex hormones facilitate the transmission of sexually transmitted infections (STIs) by altering vaginal epithelial and mucosal barrier integrity [2,16,17]. Both the phase of the menstrual cycle and the use of hormonal contraceptives have been shown to influence susceptibility to initial infection with chlamydia, gonorrhea, herpes simplex, and human immunodeficiency virus in women [16,17].

We also found that menstruating women had 6% - 14% fewer documented anogenital injuries when compared to non-menstruating victims (Table 1). This is consistent with an earlier retrospective study from our institution which examined 177 cases of sexual assault in menstruating women matched (1:4) with non-menstruating sexual assault victims presenting to the same clinic [13]. Their report demonstrated that menstruating victims had 11% fewer anogenital lacerations and 12% fewer abrasions and ecchymoses than



non-menstruating women. They concluded that the presence of menstrual blood during colposcopic examination likely masked anogenital injuries such as superficial lacerations and abrasions. An alternative explanation is that sex hormone levels could have confounding effects through influences on vaginal epithelial and mucosal integrity [2].

Research has consistently shown that documented physical injury influences decision-making and legal outcomes throughout the criminal justice process. Because the examination is based on scientific evidence, it may influence victims to report their experiences to the police, encourage police to file a complaint, and persuade prosecutors to file sexual assault charges and pursue a conviction [18,19]. For example, McGregor, et al. demonstrated that the presence of genital trauma was significantly related to the filing of charges by the prosecutor as well as conviction [20]. Predisposing or etiologic factors specific to genital injury following sexual assault in women are not well defined in the literature. The factors listed in Table 2 are characteristics associated with genital trauma in general. This broad assortment is likely affected by examiner training and experience, differences in injury definitions, patient population, as well as exam technique. The novel findings from this study may contribute to this list and may account for the greater number of genital injuries in documented in postmenopausal women [14].

Limitations

This small retrospective study can show association but cannot be used to prove causation. Prospective studies will be needed to establish the causative link between the menstrual cycle phase and genital injuries after sexual assault. The study design also prevented the control for clinical evaluations by different forensic examiners. It could be that documentation was not uniform, although all the nurse examiners had a similar level of training and experience. Injury prevalence was calculated based on injury identification by three methods: visual inspection, colposcopic magnification and toluidine blue staining. Although these methods are considered state-of-the-art, human error may have led to injury misidentification. The findings of the examiners were recorded on state-mandated reporting forms and were taken as the most accurate representation of the actual physical findings. Since the LMP was self-reported by the victims, the identification of the different phases of the menstrual cycle could not be verified and may be inaccurate. This study, like all studies of sexual assault victims, is vulnerable to sample bias. Feldhaus, et al. [21] reported that fewer than half of sexual assault victims reported the assault to the police or sought medical care. Because the data in this study are based on victims presenting for medical evaluation, they may not be completely generalizable to all cases of sexual assault. Therefore, it is possible that the proportion of sexual assaults involving significant force and injuries may be overrepresentation. Finally, the presence of menstrual bleeding might also affect

Table 2: Known predisposing factors for genital injury following sexual assault [3,9,13,14,18].

The assailant was known to the victim
Presence of nongenital injuries
Alcohol or drug use by an assailant
Physical coercion
Digital penetration
Use of Weapons
Adolescent postmenopausal victims
Multiple assailants
Location of assault outdoors
No prior sexual intercourse
Preexisting vaginal infection
Insertion of foreign bodies
Previous anogenital surgery

the identification of anogenital injury in the menses phase [13]. Despite these limitations, it seems reasonable to theorize that the different phases of the menstrual cycle influence the frequency of documented anogenital injuries following sexual assault.

Conclusion

This is the first clinical study to compare the documentation of genital injuries following sexual assault in women with a relationship to the different phases of the menstrual cycle. Using colposcopy with nuclear staining, forensic examiners consistently documented more anogenital injuries in the follicular phase of the menstrual cycle which is characterized by increasing amounts of estrogen. While little is known about the role of female hormones in the potential for anogenital injury during the sexual assault, sex hormones may have confounding effects through influences on vaginal epithelial and mucosal integrity. Further research is needed to investigate biological factors that influence the incidence of anogenital injuries following sexual assault in women.

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