

## ORIGINAL ARTICLES

# Detection of Semen on the Underwear of Females Involved in Sexual Assaults by Using Prostate Specific Antigen (PSA) Kit and its Medicolegal Significance

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Received: 1/3/2019 Accepted: 20/4/2019 Published: 1<sup>st</sup> May, 2019

### Abstract:

**Background:** Detection of semen in forensic cases, mostly sexual assault or abuse, is critical for evidence collection. As the number of rape cases is increasing day by day, there is a need for detection of semen, even if present in small quantity, no matter how old the stains are presence of semen is the most reliable marker for the investigation in cases of rape, sodomy, sexual murder etc. rapid detection of semen is an important factor in confirming sexual assaults.

**Aim:** To detect semen in the underwear of suspected women who were involved in sexual assault by using two rapid methods; the Ultra Violet Forensic Light Source (UV FLS), and detection of Prostate Specific Antigen (PSA).

**Material and methods:** The study included 74 female cases of suspected sexual assault. The underwear of these cases were submitted to light screening by UV FLS, and then examined for the presence of prostate specific antigen as confirmatory test for the presence of semen.

**Result;** the majority of cases were under 30 years age. All cases were positive for UV light, (20.3%) of the underwear of these females showed positive results for PSA; the highest frequency was in the age group (21-30) years.

**Conclusions:** though the PSA test is highly sensitive and specific for semen detection, yet they are not conclusive as to the source of semen, and therefore, further test for DNA print is very necessary to determine the source of semen on the underwear of suspected women.

**Key words:** Semen, Underwear, Prostate specific antigen (PSA), Forensic Light Source (FLS), Sexual assault.

### Introduction

Detection of semen in forensic cases, mostly sexual assault or abuse, is critical for evidence collection. As the number of rape cases is increasing day by day, there is a need of detection of sperms and semen even if present in small quantity. No matter how old the stains or spots are, we have to detect these stains precisely. Since presence of sperms and or semen in the scene of the crime is the most reliable

marker for the investigation in cases of rape, sodomy, bestiality, sexual murder, detection of semen is an important factor in confirming sexual assaults [1].

The semen consists of two main components; the seminal plasma, which is a mixture of secretion derived from the male accessory reproductive organs like epididymis, seminal vesicles, the prostate, vasa-differentia, bulbourethral and urethral glands [2]. The seminal plasma contains citric acid, ascorbic acid, lactic acid, and fructose [2,3]. Seminal stains are usually detected in: a) clothes, underwear, bed sheet, carpet, towel, pillow cover. b) Body: perineum, thigh, vagina and pubic hair. Etc), c) crime scene: on the floor or grass. Tests for semen identification included the fast blue test for acid phosphatase [4]. Microscopic identification of spermatozoa, and the PSA, P30 card test for detection of prostate specific antigen (PSA).

#### **Aim of the study**

Detection of semen in the underwear of women who were involved in sexual assault or rape by applying two methods: Forensic Light Source for screening (FALS), forensic Alternative light sources /Alternate Light Sources (ALS) and verifying the screening results by using Prostate Specific Antigen test (PSA). Study the medicolegal significance of these two methods in the light of results obtained from this study.

#### **Materials and Method**

The study included the examination of the underwear of 74 female forensic cases, referred to the Forensic Medicine Institute in Baghdad, as suspected cases of rape and sexual offense. The study extended from period 30<sup>th</sup> January 2018 to 30<sup>th</sup> June 2018. The age varied from (11 to 56) years: range 45, with mean  $24.9 \pm 8.14$  years. The underwear for each case was taken and submitted to examination by UV light lamp (Figure 1) and then chemical examination by PSA kits (Figure 2); the cases were categorized according to age group, positive or negative results. The age groups were stratified as 10 years interval, e.g. (1-10, 11-20). In this study UV -26-EL series, 2UV lamp providing 365 nm wave lengths was used. The EL series includes lamps that provide one wavelength of UV, or a combination of one or more wavelengths of UV and white light. The EL Series also include the 2UV and 3UV<sup>TM</sup> Multi-Wavelength lamps.



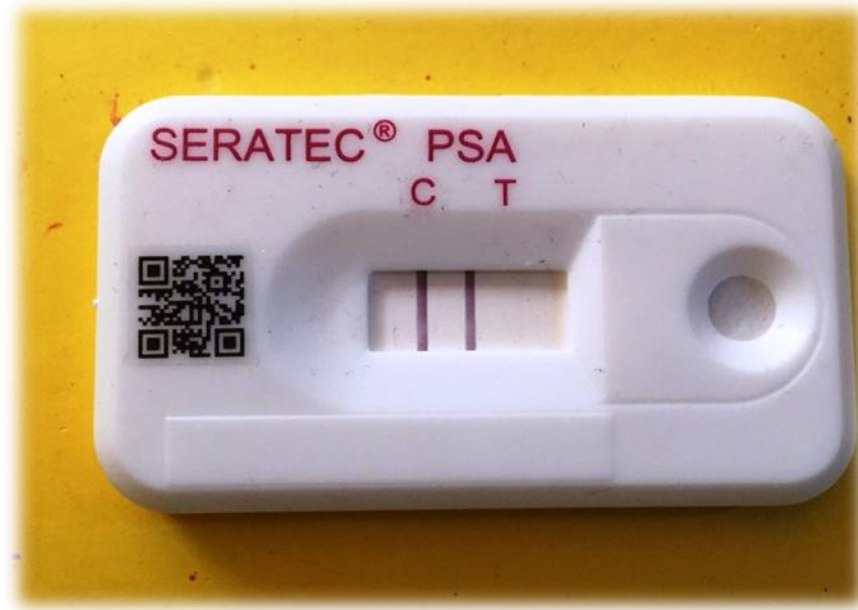
**Figure (1): UVP Light Lamp 26-EL Series, Providing 365 nm wave Length**

**Samples used for Test for PSA.**

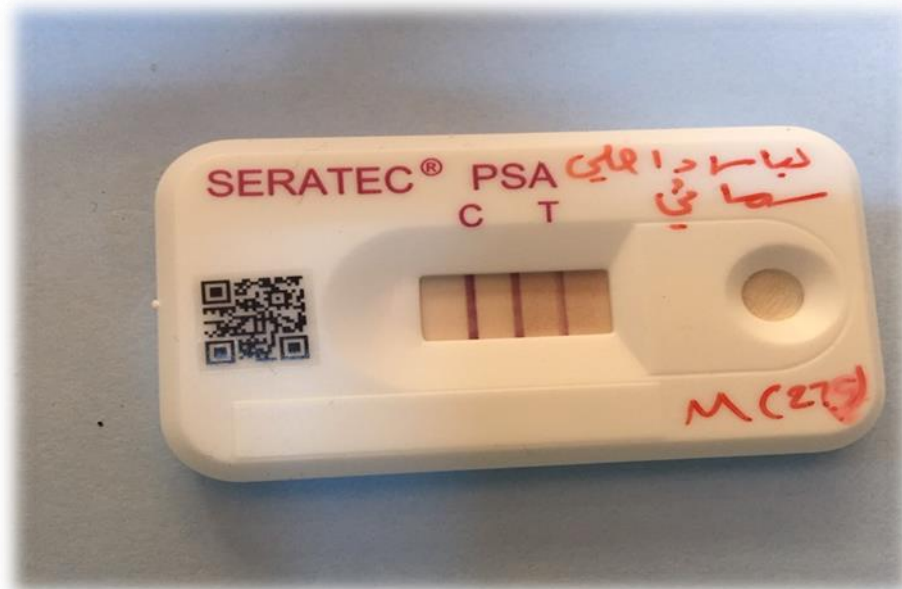
Circular or rectangular pieces of (1-3) cm<sup>2</sup> were taken from all emitting spots by using disposable plastic scissors. From 2-3 pieces should be taken from each item and the place from which it was taken. Then each piece was put in a disposable tube (Eppendorf tube). The tube is labeled by inerasable pen, regarding the place from which it was taken.

**Examination by PSA**

Volume of (0.5 ml) of the buffer, provided together with the kits, is added to the pieces of cloths in the Eppendorf tube and the buffer volume may be increased according to the thickness of the piece of the cloths. The piece should be left in the buffer for (5-10) minutes, until saturation. Then, the piece is mixed with the buffer by using micropipette, and then we take an amount of the buffer in the Eppendorf tube and add three drops of the sample (about 120 *ML*) to the cassette of P30 kit until red lines will appear. Figures 2 and 3. After (10) minutes, PSA Negative will show only two lines, whereas PSA Positive samples will show three lines: Test result Line (T), (Figure 3).



**Figure (2): PSA Kit Shows Two Red Lines Reflecting Negative Results for PSA, C indicates Control, (T) Indicates Test**



**Figure (3): PSA Kit Shows Reveal Three Red Lines, Positive and Valid Result**

**Results**

Table 1 show that most of the cases were in female with age of 11 to 40 years. All cases were positive in UV screening and were subjected to PSA test, Table 2.

**Table (1): Frequency Distribution of Cases According to Age Group**

Age group	Female
1-10	0(0%)
11- 20	28 (51.9%)
21- 30	27 (75%)
31- 40	16 (80%)
41- 50	2 (100%)
51- 60	1 (100%)
<b>Total Number</b>	<b>74 (64.3%)</b>



**Figure (4) Underwear with Visible Suspected Seminal Spot by Normal Light, with Results Positive for PSA**

**Table (2): Frequency Distribution of Female Cases According to Age Group and Results of PSA Test**

Age group	Positive	Negative	P value	Total
1-10	0(0%)	0(0%)	Non	0(0%)
11-20	7 (25%)	21 (75%)	0.00	28 (100%)
21-30	8 (29.6%)	19 (70.4%)	0.00	27 (100%)
31-40	0(0%)	16 (100%)	0.00	16 (100%)
41-50	0(0%)	2 (100%)	0.00	2 (100%)
51-60	0(0%)	1(100%)	0.00	1 (100%)
<b>Total</b>	<b>15 (20.3%)</b>	<b>59 (79.7%)</b>	<b>0.00</b>	<b>74 (100%)</b>

**Discussion**

Although UV light method is rapid and hands-off, still, fluorescence from ultraviolet light does not prove the presence of semen. [5]. The semen responds to illumination by longer wavelength frequencies of UV light (~350 nm), which is invisible to the human eye. When the substance is illuminated, it absorbs the energy and exhibits luminescence at a lower energy (longer wavelength) frequency of visible blue light [1]. The advantage of this method is that you can make invisible semen stains appear visible to the human eye [6].

All samples in this study, which were subjected to UV screening, gave positive visible fluorescence and considered suspected positive for the presence of semen. Since there are many molecules (natural and artificial) that will fluoresce in a similar way as semen, this detection technique is highly presumptive. Semen fluorescence can also be masked by certain types of fabrics and fabric treatments. [7,8]. These facts make it necessary for further technique to precisely identifying semen.

In this study the confirmatory test for semen presence relied on detecting prostate specific antigen in the suspected spots on the underwear to confirm the positive UV result or deny it. Semen has over (900) identified proteins [9,10] among which are semenogelin I and II (gel-forming proteins produced by the seminal vesicles). Prostate-specific antigen PSA (a protease which breaks down semenogelin) [11,12], and acid phosphatase AP (which breaks down spermatozoa cell membranes). These proteins can be identified by immune chromatographic assay, which forms the principle of the PSA test in the SERATEC Kit.

The SERATEC\_ PSA SEMIQUANT test is a chromatographic immunoassay for the rapid semi-quantitative detection of PSA in forensic samples. It contains two monoclonal murine antihuman-PSA antibodies, (the human PSA is the target antigen) as active compounds [13]. Prostate-specific antigen is a glycoprotein produced in the prostate and secreted into the seminal fluid. PSA is one of the major proteins in seminal fluid with concentrations between 0.2 to 3.0 mg/ml. The main function of PSA is to liquefy the seminal fluid [14]. The high concentration of PSA in seminal fluid and its very low concentration in female vaginal fluid make PSA a suitable marker in forensic casework for identifying even small amounts [15].

The underwear of all cases in the present study (74) showed positive fluorescence result for UV light [1]. That is why all cases were submitted for PSA test for confirmation. Other samples were also found to fluoresce and were difficult to distinguish from semen. Two of the substances that most commonly mistaken for semen were a hand cleanser and urine. It would be time consuming, costly, and tedious to test large number of samples for the presence of PSA. Instead large samples number is visually examined and stained areas are identified and tested.

The results show that only 15 cases (20.3%) of total females (74) cases gave positive results for PSA. The reason for this is that most cases were suspected assault and not witnessed. The highest incidence of positive cases in the age group below 30 years can be explained by the fact that most Iraqi women are married at this age, and the source of contamination could be from their husband.

In conclusion, the highest incidence of sexual assault in females occurred in younger age group. Though the PSA test is highly sensitive and specific for semen detection, yet it is not conclusive as to the source of semen, and therefore, further test for DNA print is very necessary to determine the source of semen on the underwear of suspected women.

#### **References:**

1. Harel VS, Khairkar SR, Kulkarni KV, Malve MK. Detection of semen stains in rape cases by a very high powered UV-VIS light source, facilitated conviction of accused person. *J Forensic Research* 2015;6(4):290-1. .
2. Knight B, Saukko P. The pathology of wounds. *Forensic pathology* 1996;3:136-73.

3. Owen DH, Katz DF. A review of the physical and chemical properties of human semen and the formulation of a semen stimulant. *J Andrology* 2005;26(4), 459-469.
4. James SH, Nordby JJ. *Forensic Science: An Introduction to Scientific & Investigative Techniques*. 3<sup>rd</sup> ed. Boca Raton, Florida: CRC Press Taylor & Francis Group; 2009.
5. Sato I, Sagi M, Ishiwari A, Nishijima H, Ito E, Mukai T. Use of the "SMITEST" PSA card to identify the presence of prostate-specific antigen in semen and male urine. *Forensic Science Int* 2002;127(1-2):71-74.
6. Parik CK. *Violent Asphyxial Deaths*, Parikh's Text Book of Medical Jurisprudence Forensic Medicine and Toxicology for classrooms and court rooms, 2007.
7. Kobus HJ, Sileniaks E, Scharnberg J. Improving the effectiveness of fluorescence for the detection of semen stains on fabrics. *J Forensic Sci* 2002; 47(4):1-5.
8. Marshall S, Bennett A, Fravel H. Locating semen on live skin using visible fluorescence. In *Sixth International Conference in Clinical Forensic Medicine of the World Police Medical Officers*, March 2001, pp. 17-22.
9. Gauttam N, Singh SP, Khinchi MP, Nama N, Jain S. Different body fluids : An overview. *Asian J Pharmaceut Res Develop* 2017;5(1):1-9.
10. Mann T. *The biochemistry of semen*, NY, Wiley, 1954..
11. Pang BCM, Cheung BKK. Identification of human semenogelin in membrane strip test as an alternative method for the detection of semen. *Forensic Sci Int* 2007;169(1):27-31.
12. Ricci LR, Hoffman SA. Prostatic acid phosphatase and sperm in the post-coital vagina. *Annals Emergency Medicine* 1982;11(10):530-534.
13. Gartside, B. O., Brewer, K. J., & Strong, C. L. Estimation of prostate-specific antigen (PSA) extraction efficiency from forensic samples using the seratec PSA semiquantitative membrane test. *Forensic Sci Communications* 2003;5(2):1-4.
14. Schmidt S, Franke M, Lehmann J, Loch T, Stöckle M, Weichert-Jacobsen K. Prostate-specific antigen in female urine: a prospective study involving 217 women. *Urology* 2001;57(4):717-720.
15. Haimovici F, Anderson DJ. Detection of semen in cervicovaginal secretions. *J AIDS Human Retrovirology* 1995;8(3):236-238.