Research Article

Clinicopathological correlation of serum prostate specific antigen levels in patients of prostatomegaly in a tertiary care hospital

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Received: October 03, 2016; **Accepted:** October 19, 2016

ABSTRACT

Background: In clinical practice, biopsies are generally performed only when the results of a prostate specific antigen (PSA) test or digital rectal examination (DRE) are abnormal. This leads to misdiagnosis of most small prostatic cancers present in many older men. Patients with lower urinary tract symptoms (LUTS) who have serum PSA levels higher than 4 ng/ml are primarily advised to undergo prostate biopsy to rule out cancer. However, PSA is organ specific but not cancer specific, so the presence of other prostate diseases such as benign prostatic hyperplasia (BPH), and prostatitis may influence its effectiveness for cancer detection. Hence, the PSA-based prostate cancer detection is fraught with high false-positive rate. **Objectives:** The use of Serum PSA levels for the early detection of prostate cancer and evaluate its role with other modalities for diagnosis of prostate cancer and to diagnose different diseases of prostate, i.e., prostatitis, BPH in prostatomegaly, and its correlation with serum PSA levels. **Materials and Methods:** This prospective descriptive study was conducted in Command Hospital (EC), Kolkata, West Bengal, India, in the period of June 2011 to June 2013. The patients were selected from the outdoor of Department of Urology and General Surgery. Institutional Ethical Committee Clearance and informed consent of all patients were obtained. 101 men at or >50 years of age presenting with LUTS specifically attributed to prostate problems were included in the study. Men with calcified or fibrotic prostate, with skeletal or distant metastasis or LUTS caused by any urological malignancy and who had previous prostatic surgery or pelvic radiotherapy or complications of urinary obstruction, were excluded from the study. **Results:** A total of 101 male patients presenting with LUTS were included. Their mean age was 68.66 years. The majority, i.e., 49 (48.5%) of the study group were in the age group of 61-70 years. 52 (51.5%) of patients had serum PSA <4 ng/ml. Biopsy proven adenocarcinoma cases 40% of the cases are in the age group of 71-80 years. Out of the biopsy proven adenocarcinoma cases, DRE was suspicious of malignancy in 90%. The mean serum PSA values for mild, moderate, and severe International Prostate Symptoms Score were 6.15, 12.33, and 7.67 ng/ml, respectively. **Conclusion**: Serum PSA levels correlates with the age group, with the increase in age there is rise in serum PSA levels. Transabdominal ultrasound, DRE, and serum PSA has high sensitivity in diagnosis of prostatomegaly but it was found that none of the single screening tool has got much efficacy in differentiating carcinoma prostate from benign hypertrophy, but the combination of DRE and serum total PSA or DRE, serum total PSA and ultrasound abdomen showed higher efficacy in diagnosis of carcinoma prostate. Increase in serum PSA is directly related to carcinoma prostate, but there is no absolute cut-off for serum PSA for diagnosis of carcinoma.

Access this article online	
Website: http://www.ijmsph.com	Quick Response code
DOI: 10.5455/ijmsph.2017.1059519112016	

KEY WORDS: Prostatomegaly; Lower Urinary Tract Symptoms; Benign Prostatic Hypertrophy; IPSS Score; Prostatic Cancer

INTRODUCTION

The term prostatomegaly encompasses both benign hyperplasia of prostate (BPH) and carcinoma of prostate. Men with lower urinary tract symptoms (LUTS) are screened for prostate cancer with serum prostate specific antigen (PSA) testing and digital rectal examination (DRE) as a part of routine prostate assessment.[1] There is general agreement among clinicians that the PSA test has the highest predictive value for prostate cancer as compared to DRE or transrectal ultrasound.[2,3] In clinical practice, biopsies are generally performed only when the results of a PSA test or DRE is abnormal. This leads to misdiagnosis of most small prostatic cancers present in many older men. The patients with LUTS who have serum PSA levels higher than 4 ng/ml are primarily advised to undergo prostate biopsy to rule out cancer.[4] However, PSA is organ specific but not cancer specific, so the presence of other prostate diseases such as BPH, and prostatitis may influence its effectiveness for cancer detection.[5] Hence, the PSA-based prostate cancer detection is fraught with high false-positive rate.

Among the malignant tumors, the prostate cancer takes a high place worldwide. The incidence and mortality of the disease show a big geographical difference. The increase in incidence started from the 1980s. This rapid increase is due to the extensive spread of determination of PSA. As a cause of death in men who die of malignancy, the prostate cancer is the third one.[1] In general, the prostate cancer is a disease of the old population. The newly diagnosed patients are over 65 years. Thanks to screening programs, the prostate cancer becomes the disease of middle ages as well. On the contrary with decrease in the incidence of prostate cancer in the old ages, there is a continuous increase in the 50-59 years population.

The impact of screening programs is the stage migration at the time of discovery of the tumor. The rate of advanced tumors at the time of discovery decreases, at the same time, the rate of organ confined cancer increases, resulting in increase in the rate of radical prostatectomy. As an early detection of the cause of LUTS is necessary to offer selective treatment to the concerned subjects and also selecting patients for radical prostatectomy in organ confined disease, this study is an attempt to have a comparative analysis among the sensitivity, specificity, and positive predictive value of DRE, serum PSA and ultrasound.

This study may enable us to find out an ideal correlation between serum PSA levels and various clinical parameters as well as with biopsy reports so that a specific treatment can be instituted at an early stage.

Aims and Objectives

a. The use of serum PSA levels for the early detection of prostate cancer and evaluate its role with other modalities for diagnosis of prostate cancer
b. To diagnose different diseases of prostate, i.e., prostatitis, BPH in prostatomegaly and its correlation with serum PSA levels.

MATERIALS AND METHODS

This prospective descriptive study was conducted in Command Hospital (EC), Kolkata, West Bengal, India, in the period of June 2011 to June 2013. The patients were selected from the outdoor of Department of Urology and General Surgery. Institutional Ethical Committee Clearance and informed consent of all patients were obtained. 101 men at or >50 years of age presenting with LUTS specifically attributed to prostate problems were included in the study. Men with calcified or fibrotic prostate, with skeletal or distant metastasis or LUTS caused by any urological malignancy and who had previous prostatic surgery or pelvic radiotherapy or complications of urinary obstruction, were excluded from the study.

Study Area

Department of Surgery, Command Hospital (Eastern Command), Kolkata - 700 027.

Study Population

All patients of LUTS with prostatomegaly.

Study Period

The study was conducted over 2 years from June 2011 to June 2013.

Sample Size

A total of 100 patients of BPH with DRE suggestive of Grade I prostatomegaly and above were selected.

STUDY DESIGN

Cases of LUTS with prostatomegaly were selected from outpatient department (OPD) who were detected to be having Grade I and above of prostatomegaly. All such patients were evaluated with DRE, ultrasound abdomen, serum PSA levels and biopsies of prostate (where indicated) and findings compared and inference drawn.

Study Technique

i. All patients worked up with detailed history, examination with DRE and investigations such as PSA, ultrasonography (USG), and prostatic biopsy (where indicated)

ii. All patients of Grade II and above of prostatomegaly with either nodularity on DRE and/or elevated serum PSA levels underwent prostatic biopsy
iii. Subsequent review of patients was done in the follow-up visits and findings noted in the per forma as in appendix A
iv. In this study, transabdominal USG size of prostate was evaluated and recorded as: Grade I - <30 g, Grade II - 31-50 g, Grade III - 51-80 g, and Grade IV - more than 80 g.

Inclusion Criteria

Patients with:
i. Significant prostatomegaly Grade I and above
ii. Patient's age to be more than 40 years.

Exclusion Criteria

Patients with:
i. Age <40 years
ii. Patients with features of urinary tract infection (UTI)
iii. Patients with proven urological malignancy with metastasis.

The findings of systemic DRE performed was noted for all patients as subjective examination according to the following true findings: Hard swelling of the prostate, firm swelling, nodular swelling, irregular surface, and obligation of middle sulcus attachment to the mucosal of the rectum. As a routine practice, DRE examination was scheduled after collection of blood sample to avoid an increase in serum PSA that may follow digital manipulation of the gland.

Blood samples were collected in 5 ml sterile container containing ethylenediaminetetraacetic acid. The samples were centrifuged within 20 minutes after collection at 500 × for 10 min, and sera were stored at −20°C until assay. The total prostate specific antigen was assessed using ELISA. PSA levels <4 ng/ml were considered as normal, those between 4 and 10 ng/ml as diagnostic gray zone and >10 ng/ml as indicative of cancer.

All the patients were subjected to ultrasound examination and followed by biopsy if required. Ultrasound was performed using a real time Biplanar 4.0 MHz ultrasound probe.

Biopsies were done under antibiotic cover. Biopsies were taken with tru-cut biopsy gun from the base, mid-gland and apex of the right and left side and also from any suspicious area. Each of the samples was submitted for pathological examination. The post-intervention patients were kept for observation for 6 h and discharged accordingly with the advice to continue antibiotic for 48 h and to attend OPD or emergency room in case any problem such as hematuria, fever, dysuria, or hemospermia arises.

Patients were followed-up firstly at 3 months interval and after 6 months interval.

Data were analyzed using the graphs and Chi-square testing.

RESULTS

A total of 101 male patients presenting with LUTS were included in this study. Their mean age was 68.66 years (range 50-97 years) (Table 1). The patients were selected from the Urology and General Surgery OPD of Command Hospital (EC) Kolkata.

Table 1 shows age wise distribution of patients and Table 2 shows age group correlation of serum PSA. The majority, i.e., 49 (48.5%) of study group was in the age group of 61-70 years. Out of 101 patients, 52 (51.5%) patients had serum PSA <4 ng/ml compared to 27 (26.7%) in the range of 4-10 ng/ml, and only 22 (21.8%) with serum PSA >10 ng/ml ($P = 0.0048$).

A total of 66 patients underwent biopsy on the basis of either DRE suspicion and/or raised serum PSA levels, out of which 46 (69.7%) had benign disease whereas 20 (30.3%) had adenocarcinoma. Among, the patients who had biopsy proven benign disease 8 (17.4%) were in age group 50-60 years, 21 (45.6%) in 61-70 years, 13 (28.3%) in 71-80 years, 4 (8.7%) in 81-90 years, and none >90 years. Compared with biopsy proven adenocarcinoma group none in 50-60 years, 7 (35%) in 61-70 years, 8 (40%) in 71-80 years, 4 (20%) in 81-90 years, and 1 (0.5%) in a>90 years age group ($P = 0.004$) (Table 3).

As shown in Table 4, 20 (30.3%) patients had histological proven adenocarcinoma with serum PSA levels among the

Table 1: Age distribution

Age group (years)	Number of patients (%)
50-60	17 (16.8)
61-70	49 (48.5)
71-80	26 (25.7)
81-90	8 (7.9)
91-100	01 (0.9)

Table 2: Age wise distribution of serum PSA

Age group (years)	Serum PSA (ng/ml)		
	<4.0	4.0-10.0	>10
50-60 (%)	13 (12.9)	4 (3.9)	0
61-70 (%)	30 (29.7)	10 (9.9)	9 (8.9)
71-0 (%)	9 (8.9)	8 (7.9)	9 (8.9)
81-90 (%)	0	4 (3.9)	4 (3.9)
91-100 (%)	0	01 (0.9)	0

PSA: Prostate specific antigen

Table 3: Age group correlation with biopsies

Age group (years)	Number of biopsy done	Number of biopsy proven BPH (%)	Number of biopsy proven adenocarcinoma (%)
50-60	8	8 (17.4)	0
61-70	28	21 (45.6)	7 (35)
71-80	21	13 (28.3)	8 (40)
81-90	8	4 (8.7)	4 (20)
91-100	1	0	1 (0.5)
Total	66	46 (100)	20 (100)

BPH: Benign prostatic hyperplasia

patients of proven prostatic malignancy graded as <4 ng/ml, 4 ng/ml to 10 ng/ml and >10 ng/ml were 0 (0%), 5 (25%), and 15 (75%), respectively. The number of biopsy proven benign diseases (BPH as well as prostatitis) patients with serum PSA levels graded as <4, 4-10 and >10 ng/ml were 16 (34.8%), 22 (47.8%), and 7 (17.4%), respectively. $P = 0.0005$ (highly significant).

DRE was suspicious of malignancy in 18 (90%), whereas DRE was suggestive of benign pathology in only 2 (10%) patients out of the 20 biopsy proven adenocarcinoma prostate cases. In 46 patients with biopsy suggestive of benign pathology, suspicious DRE was noted in 16 (34.8%) of cases and 30 (65.2%) of the patients had benign feel on DRE. Shown in Table 5 ($P = 0.00046$, highly significant), effects of DRE stratified with serum PSA has $P = 0.0002$.

On USG, 16 (15.8%) patients had Grade I prostatomegaly (<30 g) out of which 14 (87.5%) patients had serum PSA <4 ng/ml while 2 (12.5%) patients had serum PSA between 4 and 10 ng/ml. 41 patients had Grade II prostatomegaly on USG (31-50 g) out of which 24 (58.53%) patients had serum PSA <4 ng/ml, 10 (24.39%) patients had serum PSA between 4 ng/ml and 10 ng/ml and 7 (17.1%) patients had serum PSA >10 ng/ml. 33 patients had Grade III prostatomegaly (51-80 g) out of which 11 (33.33%) patients had serum PSA <4 ng/ml, 9 (27.27%) patients had serum PSA between 4 and 10 ng/ml and 13 (39.39%) patients had PSA >10 ng/ml. 11 patients had Grade IV prostatomegaly on USG (>80 g) out of which 3 (27.27%) patients hade serum PSA <4 ng/ml, 6 (54.54%) patients had serum PSA between 4 and 10 ng/ml and 2 (18.18%) patients had PSA >10 ng/ml shown in Table 6, $P = 0.0005$.

Among 101 patients, 33 (32.7%) had International Prostate Symptoms Score (IPSS) in the range of 1-7 (mild), 56 (55.7%) had IPSS between 8 and 19 (moderate), whereas only 12 (11.8%) patients had IPSS >19 (severe). Mean IPSS score was 9.88 (Table 7). As for the mild IPSS, 23 (22.8%) patients had serum PSA <4 ng/ml, 3 (2.9%) had serum PSA between 4 and 10 ng/ml, and 7 (6.9%) had serum PSA >10 ng/ml. Out of 56 patients with moderate IPSS score, 26 (25.7%) had serum PSA of <4 ng/ml, while 17 (16.8%) and 13 (12.9%) had serum PSA of 4-10 ng/ml and >10 ng/ml, respectively.

Table 4: Correlation of biopsy report with serum PSA and DRE

Parameters	Serum PSA		
	<4.0	4.0-10.0	>10.0
Biopsy proven adenocarcinoma (%)	0 (0)	5 (25)	15 (75)
Biopsy proven benign (%)	16 (34.8)	22 (47.8)	8 (17.4)

PSA: Prostate specific antigen, DRE: Digital rectal examination

Table 5: Correlation of biopsy report with DRE findings

Parameters	DRE	
	+ve	-ve
Biopsy proven adenocarcinoma (%)	18 (90)	2 (10)
Biopsy proven benign (%)	16 (34.8)	30 (65.2)

DRE: Digital rectal examination

12 patients had severe IPSS score with 3 (2.9%), 7 (6.9%), and 2 (1.9%) patients in <4, 4-10 and >10 ng/ml serum PSA groups, respectively ($P = 0.00046$).

As shown in Table 8, 46 (69.7%) patients had benign reports on biopsy which included 39 (84.8%) of BPH and 7 (15.2%) as prostatitis. The mean total PSA of the entire group was 9.76 ng/ml (range 0.23-84 ng/ml). The mean serum PSA in patients having prostatitis was 3.1 ng/ml (range 1.02-6.08 ng/ml), whereas the mean serum PSA of BPH patient was 6.46 ng/ml (range 0.23-14 ng/ml). Mean serum PSA of patients harboring malignancy was 34.22 ng/ml (Range 4.89-84.0 ng/ml). Most of the patients with diagnosis of BPH had fallen in PSA range of 4-10 ng/ml. Entire group of patients with prostatitis had serum PSA of either <4 or 4-10 ng/ml.

Out of the 20 (30.3%) patients having histological proven malignancy in our study, 15 (75%) had serum PSA of >10 ng/ml whereas 5 (25%) had serum PSA between 4 and 10 ng/ml ($P = 0.0004$).

Table 9 shows correlation of prostate size with IPSS score. 33 (32.7%) patients had mild score on IPSS and had prostatomegaly Grade I, II, III, and IV as 11 (10.9%), 16 (15.8%), 6 (5.9%), and 0 (0%), respectively. Among the patients having moderate IPSS score prostatomegaly grades

Table 6: Correlation of serum PSA with ultrasound size of prostate

Serum PSA (ng/ml)	USG grade of prostate				Mean
	Grade I (<30 g) (%)	Grade II (31-50 g) (%)	Grade III (51-80 g) (%)	Grade IV (>80 g) (%)	
<4.0	14 (13.8)	24 (23.7)	11 (10.9)	3 (2.9)	45.33
4.0-10.0	2 (1.98)	10 (9.9)	9 (8.9)	6 (5.9)	60.80
>10.0	0	7 (6.9)	13 (12.9)	2 (1.98)	65
Total	16 (15.84)	41 (40.6)	33 (32.7)	11 (10.9)	
Mean	1.97	7.02	17.30	8.80	

PSA: Prostate specific antigen, USG: Ultrasonography

Table 7: Correlation of serum PSA and IPSS score

IPSS score	Serum PSA (ng/ml) (*n*=101)		
	<4	4-10	>10
Mild (1-7) (%)	23 (22.8)	3 (2.9)	7 (6.9)
Moderate (8-19) (%)	26 (25.7)	17 (16.8)	13 (12.9)
Severe (20-35) (%)	3 (2.9)	7 (6.9)	2 (1.9)
Total	52	27	22

PSA: Prostate specific antigen, IPSS: International Prostate Symptoms Score

Table 8: Correlation of serum PSA with BPH and prostatitis

Parameters	Serum PSA (ng/ml)			Total
	<4	4-10	>10	
BPH (%)	11 (23.9)	20 (43.5)	8 (17.4)	39 (84.8)
Prostatitis (%)	5 (10.8)	2 (4.3)	0	7 (15.2)
Total	16	22	8	46

PSA: Prostate specific antigen, BPH: Benign prostatic hyperplasia

were 5 (4.9%), 22 (21.8%), 23 (22.8%), and 6 (5.9%), respectively. Patients having severe IPSS score had 0 (0%), 3 (2.9%), 4 (3.9%), and 5 (4.9%), respectively ($P = 0.0036$).

DISCUSSION

A total of 101 male patients presenting with LUTS were included in this study. Their mean age was 68.66 years (range 50-97 years). The patients were selected from the Urology and General Surgery OPD of Command Hospital (EC) Kolkata. Compared to study done by De et al.[6] in which mean age of study group was 66 years which was similar to our study group.

The majority, i.e., 49 (48.5%) of study group were in the age group of 61-70 years. 52 (51.5%) of patients had serum PSA <4 ng/ml in the entire study group compared to 27 (26.7%) in the range of 4-10 ng/ml and only 22 (21.8%) with serum PSA >10 ng/ml. This shows that with the increase in age group, the shift is toward increasing serum PSA levels. The results of our study were comparable with PSA best practice statement 2009[7] age specific PSA range for Asian population which also showed increasing serum PSA levels with the increasing age.

On the other hand, a study conducted by Lin et al.[8] showed that serum PSA range for the age group of Taiwanese men was 0.8-1.7 ng/ml which was much lower than the mean serum PSA in our study, this is probably due the higher average serum PSA levels in Eastern Indian population.[6]

In our study, among the biopsy proven adenocarcinoma cases, 40% of the cases are in the age group of 71-80 years (Table 6). These results are comparable with study conducted by Anushree and Venkatesh[9] in which maximum incidence of adenocarcinoma was seen in the age group on 70-79 years.

Among the biopsy proven adenocarcinoma patients, 25% patients had serum PSA levels between 4 ng/ml and 10 ng/ml and 75% had serum PSA levels >10 ng/ml, whereas the number of biopsy proven benign diseases (BPH as well as prostatitis) patients had serum PSA levels graded as <4 ng/ml, 4-10 ng/ml and >10 ng/ml were 34.8%, 47.8%, and 17.4%, respectively, as shown in Table 7. This shows that the correlation of serum PSA levels in detection of adenocarcinoma prostate was very high. Results of our study were comparable to numerous studies done by Murthy et al.,[10] Diamandis,[11] Partin and Oesterling,[12] Anushree and Venkatesh[9], and De et al.[6] who showed higher incidence of adenocarcinoma with higher serum PSA levels.

Out of the biopsy proven adenocarcinoma cases, DRE was suspicious of malignancy in 90% whereas DRE was suggestive of benign pathology in only 10% patients. In 46 patients with biopsy proven benign pathology, suspicious DRE was noted in about 35% of cases and 65% of the patients had benign feel on DRE (Table 7). This correlation was found to be highly significant. This indicates higher pick up rates of carcinoma prostate on DRE. On the contrary, the study conducted by Cooner et al.[13] and De et al.[6] showed that DRE positivity ranges between 21% and 53%.

The mean size of prostate in our study was 54 g. The mean serum PSA for Grade I prostatomegaly was 1.97 ng/ml, for Grade II - 7.02 ng/ml, Grade III - 17.30 ng/ml, and for Grade IV prostatomegaly was 8.80 ng/ml. There was a significant correlation noted between the prostate size and serum PSA levels in our study. Comparing the results with studies done by Carvalhal et al.[14] and Park et al.,[15] who showed mean prostate size of 51.7 g whereas the mean serum PSA was

Table 9: Correlation of IPSS score and size of prostate

IPSS grade	USG grade of prostate				Total (%)
	Grade I (<30 g) (%)	Grade II (31-50 g) (%)	Grade III (51-80 g) (%)	Grade IV (>80 g) (%)	
Mild (1-7)	11 (10.9)	16 (15.8)	6 (5.9)	0	33 (32.7)
Moderate (8-19)	5 (4.9)	22 (21.8)	23 (22.8)	6 (5.9)	56 (55.4)
Severe (>20)	0	3 (2.9)	4 (3.9)	5 (4.9)	12 (11.9)
Total	16 (15.8)	41 (40.6)	33 (32.7)	11 (10.9)	101

IPSS: International Prostate Symptoms Score, USG: Ultrasonography

much less when compared to the prostate size. This variation in our study group is attributable to higher incidence of prostatitis and UTI in our country which causes a rise in mean serum PSA.[6]

About 33 (32.7%) patients presented with mild IPSS score OF 1-7, 56 (55.7%) had IPSS between 8 and 19 (moderate) whereas only 12 (11.8%) patients had IPSS >19 (severe). Mean IPSS score was 9.88.

The mean serum PSA values for mild, moderate, and severe IPSS were 6.15, 12.33, and 7.67 ng/ml, respectively. There was a significant correlation noted between the IPSS and serum PSA levels. Compared to study done by Park et al.[15] who showed mean serum PSA levels with mild, moderate, and severe IPSS as 0.55, 0.53, and 0.54 ng/ml, respectively, our results were significantly high.

A total of 66 patients in the study underwent biopsy. 46 (69.7%) patients had benign reports on biopsy which included 39 (84.8%) of BPH and 7 (15.2%) as prostatitis. The mean serum PSA in patients having prostatitis was 3.1 ng/ml (range 1.02-6.08 ng/ml), whereas the mean serum PSA of BPH patients was 6.46 ng/ml (range 0.23-14). Mean serum PSA of patients harboring malignancy was 34.22 ng/ml (range 4.89-84.0 ng/ml). Mean serum PSA range in our study is higher than the study done by Murthy et al.,[10] who showed mean serum PSA levels of <4 ng/ml. This is attributable to the higher levels of serum PSA in Eastern Indian population.[6]

The majority of patients with diagnosis of BPH had fallen in PSA range of 4-10 ng/ml. Entire group of patients with prostatitis had serum PSA of either <4 or 4-10 ng/ml. This is contrarily to the results of Lin et al.[8] in which maximum number of patients had fallen into of <4 ng/ml serum PSA. Attributable to higher serum PSA levels in cases of prostatitis.

Among, the 101 patients studied the mean IPSS score were 11.56. The average size of prostate with mild, moderate, and severe IPSS score was 38.9, 59.60, and 68.75 g, respectively. A significant correlation between IPSS and prostate size was noted in our study which is contrary to the findings of Vesely et al.[16] who showed a poor correlation of serum PSA with IPSS. A similar study with weak or poor correlation of serum PSA with IPSS was done by Morote et al.[17] and Barry.[18]

CONCLUSION

Serum PSA levels correlates with the age group, with the increase in age there is rise in serum PSA levels. Transabdominal ultrasound, DRE and serum PSA has high sensitivity in diagnosis of prostatomegaly but it was found that none of the single screening tool, i.e., serum total PSA, DRE, or ultrasound has got much efficacy in differentiating carcinoma prostate from benign hypertrophy, but the combination of DRE and serum total PSA or DRE, serum total PSA and ultrasound abdomen showed higher efficacy in diagnosis of carcinoma prostate. Increase in serum PSA is directly related to carcinoma prostate, but there is no absolute cut-off for serum PSA for diagnosis of carcinoma.

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How to cite this article: Popli V, Rajan A, Bose S, Kamewad A. Clinicopathological correlation of serum prostatic specific antigen levels in patients of prostatomegaly in a tertiary care hospital. Int J Med Sci Public Health 2017;6(3):593-599.

Source of Support: Nil, **Conflict of Interest:** None declared.