The Effect of Acute Urinary Retention on The Accuracy of Serum Prostate-Specific Antigen Level Measurements

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ABSTRACT:

BACKGROUND:

The level of PSA in serum is increased by inflammation of the prostate, urinary retention,prostatic infection, benign prostatic hyperplasia,prostate cancer, and prostatic manipulation. [3]

OBJECTIVE:

To study the effect of acute urinary retention on the serum prostate-specific antigen (PSA) concentration.

METHODS:

Blood samples for serum PSA measurement were obtained (PSA1), and an indwelling urethral catheter was inserted for 2 weeks. Before catheter removal, a second blood sample for measurement of serum PSA level (PSA2) was obtained. In patients who were able to void, a third sample was obtained 3 weeks later (PSA3). In the first and second visits, digital rectal examinations (DRE1, DRE2) were performed to assess prostate volume. Mean PSA levels (PSA1, PSA2, and PSA3) and prostate volumes (DRE1, DRE2) were compared.

RESULTS:

Fourty-two patients with a mean age of 70.18 years (range 56 to 85 years) participated in this study.mean PSA level at the time of AUR (PSA1) was 7.02 ng/mL (median, 5.8 ng/mL; range, 0.9 to 30.4 ng/mL). The mean PSA2 level was 5.5 ng/mL (median, 3.9 ng/mL; range, 0.7 to 39 ng/mL), lower than the PSA1 level .This association was statistically non significant $P > 0.05$. The mean prostate volume at the time of DRE1 (43.4 mL; median, 45 mL; range, 30 to 60 mL) was significantly higher than at DRE2 (37.8 mL; median, 40 mL; range, 25 to 50 mL) ($P < 0.001$).

PSA3 was measured in 42 patients 4 weeks after retention (2 weeks after catheter removal). In this group of patients, mean PSA2 and PSA3 levels were 5.5 ng/mL and 5.1 ng/mL, respectively (median, 3.9 and 3.5, respectively, $P > 0.05$).

CONCLUSION:

Acute urinary retention can increase serum PSA levels. In this series, we found that this effect may continue up to 2 weeks.

KEY WORDS: urinary retention, prostatic hyperplasia, prostate-specific antigen

INTRODUCTION:

Over the past 25 years, prostate specific antigen (PSA) early detection programs have transformed the diagnosis and treatment of prostate cancer. The most widely used tumor marker in clinical oncology , PSA allows for detection of prostate cancer at an early asymptomatic stage amenable to curative treatment. Early detection has resulted in a dramatic reduction in prostate cancer-specific mortality; 20years ago, 1 in 3 men with prostate cancer died from the disease; now, only 1 in 100 does.[1]

PSA is a 34KD glycoprotein enzyme(serine protease) produced by the columnar acinar and ductal prostatic epithelial cells. It is a member of the human kallikrein family and its function is to liquefy the ejaculate, enabling fertilization. Large amounts are secreted into the semen, and small quantities are found in the urine and blood.

The function of serum PSA is unclear, although it is known to liberate the insulin-like growth factor type 1 (IGF-1) from one of its binding proteins. 75% of circulating PSA is bound to plasma proteins (complexed PSA) and metabolized in the liver, while 25% is free and excreted in the urine. Complexed PSA is stable, bound to A1-antichymotrypsin and A2-macroglobulin.[2]

The level of PSA in serum is increased by inflammation of the prostate, urinary retention,prostatic infection, benign prostatic hyperplasia,prostate cancer, and prostatic manipulation.[3]

Elevated serum PSA levels are probably a

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product of disruption of cellular architecture within the prostate gland. The loss of the barrier afforded by the basal layer and basement membranes within the normal gland is a likely site for the egress of PSA into the circulation. Prostatic inflammation (acute and chronic) and urinary retention can cause PSA elevations to variable degrees.

Studies of the effect of ejaculation on serum PSA have shown both no significant change in PSA and a significant decrease in serum PSA in men 30 to 40 years old or younger. However, in the age group in which PSA testing is primarily used for early detection of prostate cancer (50 years and older), ejaculation can lead to an increase in PSA that can result in a false-positive elevation. After 48 hours, this fractional increase in PSA would be expected to return to baseline levels in most men. A history of sexual activity and a repeated PSA test after 48 hours of sexual abstinence may be helpful in the interpretation of serum PSA levels that are minimally elevated. [4]

The serum half-life of PSA, calculated after removal of all prostate tissue, is 2 to 3 days. In the absence of prostate cancer, serum PSA levels vary with age, race, and prostate volume. [4]

However, there are some reports about the inaccuracy of PSA in detecting prostate cancer in the presence of acute urinary retention (AUR).[5,7]

To date, however, to the best of our knowledge,no study has precisely elucidated the duration and magnitude of this effect. Armitage and colleagues have observed that patients with AUR

have a higher level of serum PSA, [8]and Hicks has reported a case with a dramatic increase in serum PSA level following AUR. [6]

In 7 patients with AUR, Semjonow and colleagues showed that

PSA levels at the time of retention are about twice as high as levels measured 24 to 48 hours after suprapubic catheterization. [5]

Acute retention of urine (AUR) is a common urological condition that often presents as an emergency with a sudden inability to pass urine associated with lower abdominal pain. [9,10] The reported incidence varies between studies from a 4 to 73% 10-year risk of AUR.[11,12] One of the most common causes of acute urinary retention is benign prostatic hyperplasia (BPH), which with an ageing population is likely to increase. It may be anticipated, therefore, that the incidence of AUR will also rise, unless preventative measures are taken for the treatment of BPH.[13]

A scientific explanation for the clinically observed aetiologies has been explored, with prostatic infarction. Prostatic infarction has been discussed as a potential cause for AUR by several authors.[14-16]Spiro *et al* evaluated the potential role of prostatic infarction as a cause of AUR by examining open prostatectomy specimens of 200 patients. The first 100 patients had large prostates and AUR, while the second group of 100 patients had elective surgery for BPH. In all, 85% of the AUR group had histological evidence prostatic infarction compared with 3% of the elective group. It has also been proposed that the elevated prostate-specific antigen (PSA) found in patients with AUR is secondary to prostatic infarction.[16]

McNeill and Hargreave evaluated the efficacy of PSA for detecting prostate cancer in patients with AUR and concluded that PSA should not be measured at the time of AUR.[7]Since urinary retention is one of the most frequent indications for surgical intervention, and measuring serum PSA levels is usually necessary before surgery, it is important to know the magnitude and duration of increase in serum PSA levels following AUR.

Given the preceding, in this prospective study, we aimed to more accurately assess the effect of AUR on PSA levels.

MATERIALS AND METHODS:

From April 2009 to September 2011, 74 men aged 50 years and older (mean age, 70.18 years; range, 56 to 85 years) with AUR due to benign prostatic hyperplasia (BPH) were referred

to our center and my clinic. Fifty patients were enrolled in this study. Patients with urethral stricture, neurogenic bladder, prostate cancer, and those with a history of recent instrumentation or prostate biopsy were excluded. All cases were managed with an indwelling urethral catheter. A blood sample for PSA was obtained (PSA1), and a urethral catheter was left in place for 2 weeks.

Urine samples (obtained by catheterization) were sent for culture. Prior to catheter removal, another blood sample for PSA (PSA2) was obtained. Also, in patients who were able to void, a third blood sample was obtained 2 weeks later (PSA3). The ELISA test was used to measure serum PSA levels. At the first and second visits, after taking blood samples, a digital rectal examination (DRE1, DRE2) was performed to assess prostate volume. Patients were asked about their last ejaculation time to consider its effect on serum PSA levels. Surgical intervention was performed for patients who could not void after removal of the urethral catheter. If the last

serum PSA level was higher than 4 ng/mL, the patient was referred for a prostate biopsy. Mean PSA levels (PSA1, PSA2, and PSA3) and prostate volumes (DRE1 and DRE2) were compared using nonparametric statistical methods (Wilcoxon signed rank test), and P values less than 0.05 were considered statistically significant.

RESULTS:

Urine cultures performed at the time of retention were positive in 8 patients. None of the patients had a history of ejaculation within the preceding 48 hours. Prostatic adenocarcinoma was diagnosed during follow-up in 2 patients. The mean PSA level at the time of AUR (PSA1) was 7.02 ng/mL (median, 5.8 ng/mL; range, 0.9 to 30.4 ng/mL). The mean PSA2 level was 5.5 ng/mL (median, 3.9 ng/mL; range, 0.7 to 39 ng/mL), lower than the PSA1 level .This association was statistically non significant $P > 0.05$. The mean prostate volume at the time of DRE1 (43.4 mL; median, 45 mL; range, 30 to 60 mL) was significantly higher than at DRE2 (37.8 mL; median, 40 mL; range, 25 to 50 mL) ($P < 0.001$).

PSA3 was measured in 42 patients 4 weeks after retention (2 weeks after catheter removal).

In this group of patients, mean PSA2 and PSA3 levels were 5.5 ng/mL and 5.1 ng/mL, respectively (median, 3.9 and 3.5, respectively, $P > 0.05$). By excluding 8 patients with positive urine cultures, mean PSA1, PSA2, and PSA3 levels were 7.02 ng/mL, 5.5 ng/mL, and 5.1 ng/mL, respectively (median: 5.8, 3.9, and 3.5 ng/mL). The difference was not significant between PSA1 and PSA2 ($P >0.05$),and also not between PSA2 and PSA3 ($P > 0.05$).

Of 32 patients with PSA1 levels greater than 4.0 ng/mL, 19 had a lower PSA2 level and 3 had a lower PSA3 level.

Overall, after 2 weeks of free drainage in these 42 patients, PSA levels decreased in 40 patients, and increased in 2.

DISCUSSION:

In the present study, we showed that AUR could increase serum PSA levels. Since the half-life of serum PSA is 2 to 3 days, [4] we evaluated patients at 2-week intervals—more than 5 half-life periods—which is sufficient for PSA levels to return to normal values. In a study of 6 patients by Semjonow and colleagues, PSA levels decreased by 50% compared with those at the time of retention 24 to 48 hours after catheterization [5]This indicates that free PSA, which has a serum half-life of 2 to 3 hours[17] may be the major factor for the increase seen in serum PSA levels after AUR. McNeill and Hargreave have reported a significant difference between PSA levels at the time of admission for 11 patients with AUR and their respective follow up PSA levels; however, the interval between retention and follow-up PSA is not clear in this article.[7]

In our study, a nonsignificant difference between PSA2 and PSA3 suggests that the 2-week interval between retention and PSA measurement is acceptable and can prevent unnecessary biopsies.

We excluded all patients with a history of disease other than BPH that could result in AUR (ie, urethral stricture, neurogenic bladder, prostate cancer) and patients who had a condition or procedure that could affect serum PSA levels (recent instrumentation, prostate biopsy, urinary tract infection, and ejaculation in the last 48 hours) to accurately evaluate the effect of AUR due to BPH.

The effect of catheterization or presence of an indwelling urethral catheter on serum PSA levels is controversial. By daily checking the PSA level in 21 patients catheterized due to nonurologic problems, Matzkin et al demonstrated that catheterization had no effect on serum PSA levels.[18]In another study of 35 patients with AUR, Erdogan and coworkers managed patients with either a urethral or suprapubic catheter and found that there was no difference in serum PSA levels between the two.[19]In 2 studies on 19 and 83 patients, respectively, Dutkiewicz et al and Batislam et al demonstrated that serum PSA levels increased in patients catheterized owing to AUR; these authors therefore concluded that catheterization, per se, could increase serum PSA levels.[20,21]Ignoring the effect of AUR seems to be a major flaw of these studies, however. Because we found no statistically significant difference between PSA2 and PSA3, we suggest that an indwelling urethral catheter has no effect on serum PSA level.

Although it has been reported that serum PSA concentration and prostate volume are powerful predictors of a need for surgery in men with BPH,[22]we did not find significant differences in serum PSA levels and prostate volumes between patients who needed surgery and those who did not.

In our study, prostate volume increased at the time of AUR and returned to its normal value after a period of time. We speculate that prostate congestion or inflammation is the factor

responsible for both urinary retention and enhancement of serum PSA levels. Considering the shortcomings of DRE, we recommend transrectal ultrasonography to more precisely evaluate prostate volume changes in future studies.

Since serum PSA level is frequently recorded at the time of a patient's presentation with AUR, ignoring its effect on serum PSA levels could be associated with unnecessary and sometimes hazardous biopsies.

CONCLUSION:

Acute urinary retention can increase serum PSA levels. This impact will disappear after 2 weeks. Considering this effect, the clinician can prevent unnecessary biopsies in many patients. Also, we recommend PSA measurement at least 2 weeks after AUR.

Given the decrease in prostate volume after the period of catheterization we observed in the current study, we suggest that the decision regarding treatment options (ie, TURP or open prostatectomy) should not be made based on the findings of DRE at the time of retention.

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