The Effect of Long-distance Cycling on the Prostate-Specific Antigen Level

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The prostate-specific antigen (PSA) level has become an important tool in the diagnosis and management of prostate cancer. Screening for PSA has become more common in male subjects older than 50 years. However, false-positive results of the test can often lead to excess expenditures through unnecessary medical workups. Bicycling has been suggested as a possible cause of PSA elevation. We conducted a trial on 20 male cyclists aged 27 to 54 years who were recruited from a local cycling club. All subjects had an initial enrollment medical history and physical examination with a digital rectal examination performed, and a baseline PSA level measured. Subjects also had possible symptoms for benign prostatic hyperplasia surveyed by the International Prostate Symptom Score questionnaire. Cyclists then had another measurement of their PSA level after a long cycling tour that they had all entered prior to joining the study (mean time on bike, 4 hours 37 minutes). No significant differences were seen in the PSA level at any time owing to bicycle riding. However, most of the subjects did complain of numbness in the perineal region. Therefore, we conclude that cycling does not cause elevations in the PSA levels in normal subjects.

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Prostate cancer has become the most common cause of newly diagnosed cancer in men.[1] The prostate-specific antigen (PSA) blood test was developed after the initial discovery of the tissue-specific antigen in 1979.[2] Since then, some groups such as the American Cancer Society have recommended that the PSA test be used as a screening measurement along with digital rectal examination for early detection of prostatic cancer in men aged 50 years and older.[3] The test has not been recommended by several groups, including the US Preventative Services Task Force and the International Union Against Cancer, because it has not been shown to reduce mortality from prostatic cancer.[4] However, there is no question that prostate cancer can often be detected at its earliest stages by PSA screening.

The PSA test has also been maligned because other conditions beside carcinoma may elevate the level. It is apparent that benign prostatic hyperplasia often increases the PSA level. Initially, it was also believed that a digital rectal examination immediately prior to obtaining the blood sample would cause a falsely high level of PSA. This, however, was later refuted.[5,6] Another study[7] reported an elevated PSA level in 6 of the 22 patients with renal cell carcinoma with some test kits. Acute prostatitis can also cause fairly large elevations in the level of PSA anecdotally as can biopsy, prostatic instrumentation, or prostatic infarct.[8] Studies[9,10] have shown an age-related increase in the "normal" values for PSA level. A recent case report[11] described a 70 year-old man with a history of a prostatic adenocarcinoma with an unusually high baseline PSA level of 3244 ng/mL. He had no apparent spread of the disease at the time of diagnosis. However, he

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was using an exercise bike regularly. After discontinuing exercise cycling, the patient's PSA level dropped to 5.9 ng/mL.

Some experts believe that for the PSA test to be of value, even with all of its limitations, it would best be used in the 40- to 50-year-old population, in which finding early disease may make the biggest difference.[12,13] This population may be more likely to be exercising regularly and may be using a bicycle. Physicians may order a PSA test on an otherwise healthy cyclist and unwittingly initiate an unnecessary workup if there is a true association between the PSA level and the amount of time the rider spends on the bicycle seat. For these reasons, we believed that we should undertake a study to determine if the PSA level increases in normal, healthy, relatively young exercisers who completed a prolonged bicycle ride.

SUBJECTS AND METHODS

Healthy male volunteers were sought through a local cycling club newsletter, word of mouth, and an advertisement in a local newspaper. Participants were eligible for enrollment if they planned to ride at least 45 minutes in a local, recreational ride. Cyclists could choose to ride any distance from (51-160 km). Cyclists were excluded if they had any symptoms of prostatitis (fever, chills, dysuria, frequency of urination, painful defecation, or penile discharge) or had a history of prostate cancer, surgery, or instrumentation of any type.

Twenty subjects were enrolled after a screening telephone call and a brief physical examination. The baseline (preride PSA) value was obtained after an entrance genitourinary tract examination and an International Prostate Symptom Score (IPSS) determination. The requirement for a baseline PSA level was that the cyclist did not ride 48 hours prior to drawing a preride blood sample. Immediately on completion of the ride, blood samples were obtained from all participants for the postride PSA level measurement. Rider mileage and time elapsed were recorded and were self-reported by all riders. The final measurement of the PSA level was performed 48 to 72 hours after the ride. The riders were instructed not to ride again before the postride PSA value was obtained. All participants indicated that they complied with the preride and postride restrictions. All specimens were handled in the manner suggested by the manufacturer and were analyzed by the the monoclonal PSA assay (IMX, Abbott Park, Ill), using a method described by Kuriyama et al.[14] There were no dropouts from the study. Additional survey data were collected, including the percentage of riders with perineal numbness, and symptoms of prostate enlargement were documented by the IPSS. Statistical methods used included calculation of means, SDs, and ranges of the following variables: age, preride and postride PSA levels, time spent riding the bicycle, and distance.

The Student *t* test was used to assess the statistical difference between preride and postride PSA values. A $P<.05$ was considered significant.

Summary of Results Ranked by IPSS*

Patient No./Age, y	PSA Concentration		Ride		IPSS†
	Baseline, ng/mL	Change	Time	Length, km	
1/43	0.6	−0.1	4 h 30 min	99	16
2/48	0.4	0.4	4 h 32 min	90	15
3/50	0.6	0.0	5 h 54 min	162	13
4/53	0.3	0.0	6 h	91	11
5/33	0.9	0.0	1 h 50 min	51	10
6/36	0.8	0.0	7 h	162	7
7/42	0.1	0.0	3 h 15 min	99	7
8/43	0.2	0.0	4 h 7 min	85	7
9/53	0.6	0.1	2 h 7 min	91	7
10/29	0.5	0.0	3 h 30 min	90	6
11/32	0.7	0.0	5 h 54 min	162	5
12/54	0.3	0.1	5 h 36 min	106	4
13/28	0.7	−0.1	4 h 43 min	91	3
14/49	0.6	−0.2	5 h 20 min	91	3
15/39	0.6	0.0	4 h 40 min	104	2
16/27	0.6	−0.2	4 h 40 min	91	1
17/41	1.1	0.1	3 h 58 min	91	1
18/31	0.5	0.0	5 h 26 min	162	1
19/39	0.7	0.0	4 h 52 min	96	1
20/45	0.6	0.0	4 h 40 min	91	0
Mean 40.7	0.57	0.005	4 h 37 min	103	6

**IPSS indicates International Prostate Symptom Score; PSA, prostate-specific antigen.*

†IPSS scale: 0 to 7, mild; 8 to 19, moderate; and 20 to 35, severe benign prostatic hyperplasia.

RESULTS

Prostate-specific antigen test results, age, IPSSs, and time and length of ride are given in the **Table**. All 20 subjects completed the study protocol. Those with any abnormal results of prostate examination would have been excluded and referred to a urologist, but none were identified with the digital rectal examination. We excluded 2 volunteers for history of prostatitis, 1 for a previous prostate surgery, and 1 for a serious concurrent illness (lymphoma).

Essentially, we found no significant changes in PSA levels despite long periods spent on a bicycle seat during the tour (mean change, +.005; range, −0.2 to +0.4; $P=.99$). Levels of PSA were remarkably consistent for all riders.

A few findings were interesting. Seventy-five percent of the riders intermittently experienced numbness in the perineal area. Several riders (5 [25%] of 20) had complaints in the moderate range on the IPSS despite having normal results of prostatic examinations. This groups' ages ranged from 33 to 53 years (median age, 45.4 years) and baseline PSA levels were similar to those of other riders (mean PSA of riders with moderate IPSSs, 0.56 ng/mL; mean PSA of riders with lower IPSSs, 0.57 ng/mL). A comparison of means, using the Student *t* test, showed no significant difference ($P=.67$). A Pearson product moment correlation coefficient was calculated to determine if the IPSSs were related to PSA value differences, and they were not ($P= .45$).

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COMMENT

Screening tests for cancer are generally desirable because of the lower costs associated with treating early cancer cases compared with late, metastatic stages. While knowledge of elevated PSA levels has not been shown to reduce mortality and morbidity from prostate cancer, there is considerable interest in the PSA test. One problem is what to do about borderline elevations in PSA levels. Recent evidence has suggested that, at levels above 10.0 ng/mL, the PSA is a relatively good test result for prostatic carcinoma.[15] We attempted to answer whether the PSA level would be elevated after a long bicycle ride in normal, healthy subjects with no evidence of either benign prostatic hyperplasia or prostate cancer. If true, further confusion would result if screening does become commonplace. However, we found no such elevations. Although our study population was small, all the PSA levels obtained on each subject were remarkably similar. Therefore, it is doubtful that a larger study population would have revealed any significant changes. The case reported by Rana and Chisholm[11] may have resulted in the mistaken impression that PSA levels would increase in anyone riding a bike for prolonged periods. However, this may be true only in patients who ride and have prostatic carcinoma, as in their reported case. Therefore, an extreme elevation in the PSA level should still be investigated. It is unknown what effect bicycle riding may have in a patient with benign prostatic hyperplasia and what this might do to his baseline PSA levels.

Another interesting finding is that the few riders had moderate IPSSs and most of male cyclists reported perineal numbness. Does long-term long-distance riding interfere with urinary flow through the prostate? One report[16] showed that long-term symptoms in 2 long-distance cyclists resolved slowly after 4 and 7 weeks, respectively.[16] This was coined the "Alcock syndrome" and, although to our knowledge this is the only report available in the literature, it seems to be consistent with the results in our study population. Further prospective studies may be needed to elucidate the possibility of bicycling causing restrictive urinary symptoms, and if this may result from posttraumatic stricture at the level of the prostatic urethra.

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