Peyronie's Disease Following Radical Prostatectomy: Incidence and Predictors

Raanan Tal, MD,* Matthias Heck, MD,* Patrick Teloken, MD,* Timothy Siegrist, MD,* Christian J. Nelson, PhD,† and John P. Mulhall, MD*

*Male Sexual & Reproductive Medicine Program, Urology Service, Department of Surgery, Memorial Sloan-Kettering Cancer Center, New York, NY, USA; †Department of Psychiatry and Behavioral Sciences, Memorial Sloan-Kettering Cancer Center, New York, NY, USA

DOI: 10.1111/j.1743-6109.2009.01655.x

ABSTRACT

Introduction. Both prostate cancer and Peyronie's disease (PD) are prevalent in men after their fifth decade of life. The evidence to support or refute a link between radical prostatectomy (RP) and PD is limited.

Aims. To define the incidence of PD in men who had RP and determine possible predictors of PD development after RP.

Methods. A review of a prospectively built sexual medicine database, years 2002–2008, looking at subjects who had RP as a monotherapy for localized prostate cancer. We identified and characterized subjects who developed PD within 3 years after RP and compared them with subjects who did not.

Main Outcome Measures. The incidence of PD among men who attended a sexual medicine clinic after they had RP, predictors of PD development after RP.

Results. The study population included 1,011 subjects, and PD incidence in this population was 15.9%. Mean time to develop PD after RP was 13.9 ± 0.7 months. Mean curvature magnitude was 31 + 17 degrees. On univariate analysis, younger age (mean age of 59 + 7 in men with PD vs. 60 + 7 years in men without PD, $P = 0.006$) and white race (vs non-white, 18% vs. 7%, $P < 0.001$) were predictive of PD development after RP, but post-op erectile function was not a predictor of PD development. On multivariate analysis, younger age (odds ratio (OR) = 1.3, for 5-year decrease in age) and white race (OR = 4.1, vs. non-white) remained independent significant predictors.

Conclusions. Men presenting with sexual dysfunction after RP have higher PD incidence then the general population. Therefore, they should be routinely evaluated for PD. Younger men and men of white race are at increased risk for PD. Prospective controlled studies are needed to elucidate the incidence of PD following RP and to conclude if RP has a causative role in the pathogenesis of PD. **Tal R, Heck M, Teloken P, Siegrist T, Nelson CJ, and Mulhall JP. Peyronie's disease following radical prostatectomy: Incidence and predictors. J Sex Med 2010;7:1254–1261.**

Key Words. Peyronie's Disease; Radical Prostatectomy; Incidence; Predictors; Risk Factors for Peyronie's Disease

Introduction

Prostate cancer is the most common non-skin cancer among men. It is estimated that 192,280 new cases will be diagnosed in the United States in 2009, accounting for 25% of all male cancer cases, and it is commonly diagnosed in men after their fifth decade of life. With advances in diagnosis and treatment, most men (91%) are diagnosed at the stage of localized disease, at younger age, and have excellent long-term survival [1]. Treatment of localized prostate cancer is commonly surgical, specifically, radical prostatectomy (RP). Peyronie's disease (PD) prevalence, however, is not as well defined, and the literature on this condition is rather inconsistent. While earlier studies reported an incidence

Supported by: The Sidney Kimmel Center for Prostate and Urologic Cancers.

of only 0.3–0.7%, more recent publications reported a higher overall incidence of 3.2–8.9%, increasingly common among men age 50 years or older [2–4]. Clinically, it is believed that PD is commonly under-diagnosed, especially in men incapable of achieving a good enough erection to allow the PD-associated deformity to become evident.

Beside the fact that RP and PD occur in men of the same age group, the existing evidence in the literature to support or refute a link between RP and the occurrence of PD is remarkably limited. Iacono et al. described fibrotic penile changes after radical prostatectomy, but their pathogenetic role in the development of a clinically evident PD was never established [5]. Bjekic et al. and Carrieri et al. have shown a higher PD incidence after genital trauma or penile surgery, but not specifically after RP [6,7]. Ciancio et al. found a 41% incidence of fibrotic changes among men presenting with erectile dysfunction (ED) following RP and calculated the fibrotic changes incidence among the whole group of RP patients to be 11%; however, they could not find any risk factors associated with or suggest that predictors of fibrotic changes occurrence following RP [8].

The present study was conducted to define the incidence of PD in men who attended a sexual medicine practice after having RP as monotherapy for localized prostate cancer and to look at possible predictors of PD development after RP.

Methods

Study Design

The present study is an Institutional Review Board-approved analysis of a prospectively built sexual medicine database. The sexual medicine database at the Memorial Sloan-Kettering Cancer Center was established in 2002 and is used to record information on subjects attending the sexual medicine clinic. The database information includes both demographic data and clinical data, and is updated continuously.

Study Population

For the purpose of the present study, the study population consisted of men who (i) underwent RP for prostate cancer; (ii) who were evaluated for sexual dysfunction in the years 2002–2008; (iii) had a baseline penile examination by a urologist prior to RP, specifically assessing the penis for PD plaque presence; and (iv) had sexual medicine evaluation within 3 years after RP. Exclusion criteria included (i) RP as a salvage intervention after another primary prostate cancer treatment (e.g., brachytherapy, external beam radiotherapy), (ii) use of adjuvant treatment (androgen deprivation, radiotherapy), (iii) PD diagnosis prior to RP and, (iv) unavailability of PD evaluation data. Retrieved and analyzed data included: age at first evaluation in sexual medicine clinic, race, cardiovascular comorbidities (hypertension, hypercholesterolemia, diabetes mellitus, ischemic heart disease, and peripheral vascular disease) date of first evaluation for sexual dysfunction, date of RP, date of last sexual medicine follow up visit, nerve status preservation at RP, pre- and post-RP erectile function data, diagnosis of PD, duration of PD, and penile deformity data. Time interval from RP to first evaluation for sexual dysfunction was calculated. A nerve sparing grading system was utilized in which the neurovascular bundle (NVB) preservation (on each side) is scored individually on a 1–4 scale: 1—fully preserved NVB, 2—possible damage, 3—definite damage, and 4—complete NVB resection.

Sexual Function Assessment

Erectile function prior to and at first visit post-RP was assessed by a single question aimed at subjective patient-perceived rigidity on a 0–10 scale, where 0 is the absence of any penile engorgement or rigidity, 6 is the first rigidity level allowing vaginal penetration, and 10 is a fully rigid erection. Nerve sparing status was assessed by the RP surgeon at the time of surgery. PD was evaluated in all patients by direct questions asking about any new penile curvature, other penile deformity, or penile pain. All patients, as a part of their physical exam, had focused penile exam looking for PD plaques. The diagnosis of PD was based on the finding of a penile plaque on physical examination. Curvature measurement was performed in all patients who reported a new penile curvature or in whom a PD penile plaque was found on penile examination after RP, as previously described by our group [9]. Briefly, the intracavernosal injections (ICI) agents utilized was a trimix (papaverine/phentolamine/PGE 1) and up to three doses were administered in an effort to induce a rigid erection. A goniometer was utilized to measure the degree of curvature. The center (fulcrum) of the goniometer was positioned over the point of maximum curvature and the limbs were positioned along the shaft proximal to and distal to this point. The custom-made goniometer has an arrow on the proximal end of the distal limb

so that when aligned along the center of the shaft proximally and through the center of shaft distally, the arrow pointed to the degree of curvature.

Statistical Analysis

Descriptive statistics included frequencies for discrete variables and mean, standard deviation (SD), and range for continuous variables. We used comparison statistical tests (chi-squared test for discrete variables and an independent measures *t*-test for continuous variables) to characterize subjects who developed PD following RP and to compare them with those who did not. A multivariable logistic regression model was constructed to search for possible independent predictors for the development of PD following RP. Based on the current available limited literature on PD as well as PD following RP and our clinical experience, our study hypotheses were: (i) PD incidence is higher in men of white race compared with non-white race; (ii) PD incidence is higher in older subjects compared with younger; (iii) subjects with poorer nerve sparing have higher incidence of PD; (iv) cardiovascular co-morbidities are associated with higher incidence of PD; and (v) poor erectile function is associated with higher PD incidence following RP [4,6,10,11]. All of these variables were included in the logistic regression model, regardless of their univariate significance, to guard against model overfitting [12].

Results

Study Population

The potential study group included 1,237 men who had RP and presented for sexual function evaluation between January 2002 and November 2008. Based on our selection criteria, 126 subjects were excluded from the analysis (20 had salvage RP following another prostate cancer treatment, 31 had additional prostate cancer treatment following RP, 12 were diagnosed with PD prior to RP, 50 had their first sexual medicine evaluation more than 3 years after RP, and 13 had missing PD diagnosis data), yielding a final study population of 1,011 subjects. Median time interval from RP to first sexual medicine evaluation was 5.8 months (mean ± SD: 8.4 ± 7.7, interquartile range [IQ]: 3.0–11.2). Demographic data, RP data, and sexual function data are presented in Table 1.

Table 1 Study population characteristics

	n (%)	Mean ± SD	Range
Age (years)	1,011 (100)	60.2 ± 7.1	37–89
Race	984 (100)		
White	816 (82.9)		
African-American	88 (8.9)		
Hispanic	42 (4.3)		
Asian	20 (2.0)		
Other	18 (1.8)		
Cardiovascular comorbidities	1,009 (100)		
Hypertension	393 (39.0)		
Hypercholesterolemia	449 (38.8)		
Diabetes mellitus	65 (6.4)		
Ischemic heart disease	59 (5.8)		
Peripheral vascular disease	13 (1.3)		
Nerve sparing status at RP (Sum of grades, right + left)	879 (100)		
2	428 (48.7)		
3	128 (14.6)		
4	131 (14.9)		
5	95 (10.8)		
6	39 (4.4)		
7	13 (1.5)		
8	45 (5.1)		
Time interval from RP to sexual medicine evaluation (Months)*	1,011 (100)	8.4 ± 7.7	0.3–35.5
Evaluation ≤1 year after RP	735 (72.7)		
Evaluation 1–3 years after RP	225 (22.3)		
Erection rigidity (0–10 scale)			
Prior to RP	996 (100)	8.3 ± 1.9	0–10
At first visit after RP	960 (100)	1.8 ± 2.3	0–10

*Patients presenting after RP.
SD, standard deviation; RP, radical prostatectomy.

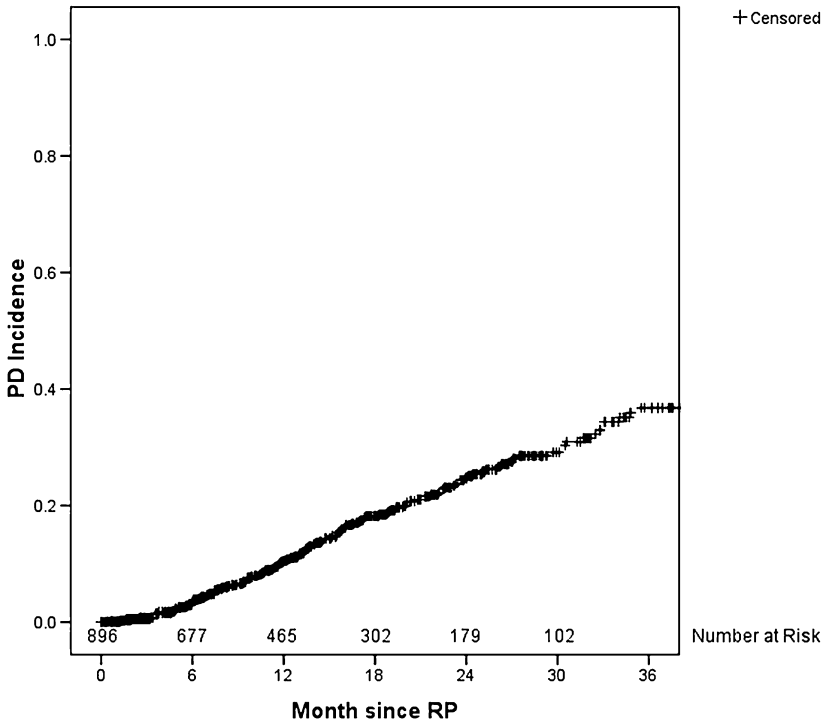

Figure 1 A Kaplan–Meier curve depicting the time-dependent incidence of Peyronie's disease among men attending sexual medicine clinic following radical prostatectomy. RP, radical prostatectomy; PD, Peyronie's disease.

PD Incidence

1,011 patients fulfilled the inclusion criteria and were available for analysis. Of the 1,011 men, 77 developed PD after RP within 1 year, 139 within 2 years, and 161 within 3 years, yielding an overall PD incidence of 15.9% in our study group, within 3 years. Mean follow up for the whole group was 17.3 ± 14.2 months, from RP to the last evaluation. The temporal occurrence of PD is depicted in Figure 1. Mean ± SD curvature magnitude was 31 ± 17 degrees. Mean time to develop PD after RP was 13.9 months, among those who developed PD within 3 years of RP (median: 12.5 months, SD: 0.7).

Predictors of PD Occurrence after RP

Results of univariate analysis for possible predictors of occurrence of PD after RP are as follows: subjects who developed PD compared with those who did not were younger, mean ± SD age of 58.8 ± 6.6 years vs. 60.5 ± 7.1 years ($P = 0.006$). There was no significant mean age difference between subjects who developed PD within 1 year after RP and more than a year, 58.2 ± 7.5 vs. 59.0 ± 6.2 years. Caucasians were associated with a higher PD incidence compared with a non-Caucasians, 17.9 vs. 7.3%, $P < 0.001$. Analysis of the role of cardiovascular comorbidities as possible predictors of PD revealed that patients with PD (vs without PD) did not have a higher incidence of hypertension (32.5% vs. 32.3%), hypercholesterolemia (43.8% vs. 38.1%), ischemic heart disease (4.4% vs. 6.1%), or peripheral vascular disease (1.3% vs. 1.3%), $P > 0.05$ for all comparisons. However, patients with PD had a lower incidence of diabetes mellitus, 1.9 vs. 7.3%, $P = 0.01$. The results of univariate analysis for possible predictors of PD following RP are depicted in Table 2. Nerve sparing status was a predictor with a marginal statistical significance when nerve sparing (score = 2–4) was compared with others scores (5–8), PD incidence of 14.3% vs. 8.9, $P = 0.049$. Erection quality, assessed either prior to RP or at the first visit after RP, was not associated with PD incidence: pre-op rigidity score among subjects with PD was 8.3/10 vs. 8.2/10 among subjects without PD, and post-op rigidity score was 1.9/10 among subjects with PD vs. 1.7/10 among subjects without PD, $P > 0.05$ for both comparisons.

A multivariable logistic regression model was constructed including the variables: age, race (Caucasian vs. other), cardiovascular comorbidities, nerve-sparing status, pre-op and post-op erectile function, and year of RP. This analysis showed that younger age and white race were independent predictors of PD occurrence after RP (Table 3).

Table 2 Predictors of PD following RP on univariate analysis

Variable	PD incidence *n/N* (%)	Value	*P* value
Age (years)			0.006
Mean age for subjects with PD		58.8 ± 6.6	
Mean age for subjects without PD		60.5 ± 7.1	
White race			<0.001
Yes	146/816 (17.9)		
No	13/178 (7.3)		
Hypertension			0.955
Yes	52/326 (16.0)		
No	108/683 (15.8)		
Hypercholesterolemia			0.178
Yes	70/393 (17.8)		
No	90/615 (14.6)		
Ischemic heart disease			0.387
Yes	7/59 (11.9)		
No	153/950 (16.1)		
Peripheral vascular disease			0.961
Yes	2/13 (15.4)		
No	158/995 (15.9)		
Diabetes mellitus			0.01
Yes	3/65 (4.6)		
No	157/944 (17.2)		
Number of vascular comorbidities			0.627
0	67/430 (15.6)		
1	58/361 (16.1)		
2	29/157 (18.5)		
3	6/55 (10.9)		
4	0/4 (0.0)		
Nerve sparing score			0.049
2–4	98/687 (14.3)		
5–8	17/192 (8.9)		
Nerve sparing score			0.213
2	61/428 (14.3)		
3–8	100/583 (17.2)		
Nerve sparing score			0.392
2–7	111/834 (13.3)		
8	4/45 (8.9)		

RP, radical prostatectomy; PD, Peyronie's disease.

Discussion

PD incidence in the general population is ill defined and rather inconsistent; while earlier studies reported an incidence of 0.3–0.7%, more recent publications reported a higher incidence. Schwarzer et al., in a mailed questionnaire-based study in Germany, found an overall incidence of 3.2% with a steep age-related increase with an incidence of 3% in the sixth decade of life. Rhoden et al., in a Brazilian analysis, reported an incidence of 3.7% in a population of men age >50 years presenting for prostate cancer screening [13]. A study by La Pera et al. found a PD incidence of 7.2% among Italian men aged 50–69 years and a strong association with cigarette smoking (OR: 7.2), but no association with cardiovascular disease, diabetes, hypertension, and alcohol consumption [3]. Among men presenting with ED of various severities, PD was reported in 7.9%, with significant association between PD and age, obesity, smoking, diabetes, and dyslipidemia [11]. The greatest PD incidence, 8.9% in a population of men presenting for prostate cancer screening, was reported by Mulhall et al. who also found a significant association with older age, hypertension, and diabetes. The incidence of sub-clinical PD tissue changes in an autopsy study was found to be as high as 23% [14].

Table 3 Predictors of PD following RP on multivariate analysis

Variable	Beta	OR	95% CI	*P* value
Age (5-year decrease)	0.24	1.28	1.24–1.32	0.003
Race (white vs. non-white)	1.41	4.08	1.73–9.58	0.001

RP, radical prostatectomy; PD, Peyronie's disease; CI, confidence interval; OR, odds ratio.

A causative role of RP in the pathogenesis of PD has never been established. Though cavernosal smooth muscle alterations have been described as early as 2 months after RP, they have never been linked to the development of clinically evident PD [5]. Ciancio et al. described their clinical observation of prior RP surgery among men presenting with new penile deformity, and performed an analysis to learn the incidence of these deformities following RP among men presenting for ED evaluation after RP. In the study, patients were considered to have "fibrotic changes" if they reported a new narrowing and/or curvature. Patients then had penile physical examination and the presence of Peyronie's plaque was documented [8]. They found that 41% of their study group (45/110 men) reported new fibrotic changes (narrowing and/or curvature), which developed at a mean time of 10 months after surgery. A palpable plaque on physical examination was found in only 69% of the patients reporting new fibrotic changes (narrowing and/or curvature). A total of 409 men had undergone RP at their institution during the study period, hence they calculated the incidence of fibrotic changes after RP to be 11% (45/409). This may represent an underestimation of the true incidence, as the incidence of fibrotic changes among men who did not present for ED evaluation cannot be assumed to be non-existent. Ciancio et al. also looked at factors including the use of intracavernosal injection therapy, use of vacuum device, tobacco use, degree of neurovascular bundle preservation, duration of surgery, estimated blood loss, post-operative anastomotic strictures, and tumor grade and stage, but they did

not find any predictors of penile fibrotic changes after RP.

It has also been our clinical experience that men presenting for sexual function evaluation after RP have a significant incidence of PD. Not uncommonly do we encounter a patient who did not have PD prior to his RP, presenting for ICI therapy after failing to achieve erections with PDE5i, and with the first in-office injection, while having his first erection since his RP, a curvature is evident. Though PD has been linked to ICI therapy, the evidence to support this link is weak, the causative role of ICI in the development of PD has never been established, and certainly not with the first ICI [15]. In the present study, we present the largest reported series of men who had undergone RP and were also assessed for PD. In this series, the mean time to develop PD after RP was 13.9 months among those who developed PD within 3 years of RP and the incidence of PD was 15.9%. This incidence is markedly higher than the highest reported incidence in the general population, implying a possible association between RP and PD; however, despite this apparent association, causality cannot be proven.

To identify patients at risk for developing PD after RP, we looked at various predictors including: age, race, cardiovascular comorbidities, nerve-sparing score, EF before and after surgery, and year of surgery. Interestingly, we found that younger age was associated with a higher incidence of PD, in contrast to previous publications showing increased risk of PD in older subjects [2]. Our hypothesis to account for this finding may be acceleration of PD development among younger men who are destined to have this condition later on in their lives, while older individuals would have developed PD prior to RP had they had the predisposition, therefore, they are less likely to develop PD afterward. Obviously, the present study cannot provide the reasoning for this important finding. Moreover, the clinical significance of this small age difference is yet to be defined. In the reported series, white race was also found to be associated with an increased risk of PD after RP. Although there are no PD epidemiologic studies addressing the impact of race as a risk factor, our findings are consistent with our clinical observation in men who did not have RP, that is, that PD is more common among Caucasians.

Looking at the role of cardiovascular comorbidities as predictors of PD after RP, we could not find an association, beside a lower incidence of PD among diabetic patients that did not hold on multivariate analysis. Indeed, data in the published literature support the role of diabetes as a risk factor for PD: Schwarzer et al. and Bjekic et al. reported a three-fold increased diabetes prevalence in men with PD; El-Sakka reported higher prevalence of diabetes in patients with ED and PD (87.7%, although even in his non-PD control group of men with ED but no PD, diabetes prevalence was remarkably high, 77.9%); and Mulhall et al. found an OR of 2.6 for diabetes as a PD risk factor among men attending a prostate cancer screening program [2,4,6,11] Deveci et al. conducted a study to characterize young patients presenting with PD and reported that while the prevalence of diabetes was 18% among men over 40 years of age presenting with PD, it was as high as 50% among patients under 40 years of age [10]. Interestingly, others have failed to demonstrate such an association [3,7]. Agrawal et al. have found that men with PD have endothelial dysfunction, even without vascular risk factors, suggesting a possible link between PD and cardiovascular conditions [16].

In our study, we looked also at the impact of nerve sparing status at surgery as well as that of erectile function, before and after surgery, on the risk of developing PD. On univariate analysis, we found a marginally statistically significant higher rate of PD diagnosis in patients who had nerve-sparing RP, however this impact of nerve sparing status did not hold on multivariate analysis. It is important to remember that erectile function, nerve sparing status and PD evaluation and diagnosis are not unrelated. Patients with poor nerve sparing are at increased risk of severe refractory ED and patients with ED are less likely to notice a PD curvature. It is however unknown if these patients are more or less likely to opt for sexual function evaluation and if they are over- or under-represented in our study group.

However, the present study is not devoid of limitations. We did not have any information on the occurrence of PD among subjects who had RP in our institute but never presented for sexual medicine evaluation. Possible reasons for not seeking sexual medicine attention after RP at our institute in men with or without PD may include low sexual interest, infrequent sexual activity, shame and embarrassment, PD manifestations that are not bothersome enough to seek treatment, ED precluding PD to be manifested as a deformity, cancer recurrence and other significant health

concerns overriding sexual health issues, seeking treatment elsewhere, and other causes.

In the present study, we did not have a control group of age and medical co-morbidity–matched men; therefore, we could not compare PD incidence between men who had and who did not have RP and we can only compare with available data in the literature. However, the PD incidence reported in the present study is approximately two-fold greater than the highest reported PD incidence in the literature and suggestive of being increased after RP [4].

Another limitation of the present study is the low incidence of cardiovascular comorbidities of significant severity, which likely reflects the excellent health status of the patients undergoing RP at our institution. Finally, the date of the onset of PD is difficult for any man to define. This issue is made even more complicated by the fact that many post-RP patients, at least early after surgery, do not experience enough erectile rigidity to permit them to identify penile deformity. Thus, in some men we relied on physical examination at first sexual medicine evaluation to define the time of PD onset.

Despite these limitations, this study clearly portrays the role of PD evaluation in the care of men treated with RP for prostate cancer, presenting to a sexual medicine practice. Regardless of the unresolved question of the causative role of RP in the pathogenesis of PD, men with PD after RP are commonly encountered, and good clinical practice should include a comprehensive PD evaluation, starting with history and physical examination, for every man after RP, as the incidence of this condition may be as high as one in every six men.

Conclusions

Men who seek sexual medicine evaluation within 3 years after RP have a high incidence of PD, higher than the reported PD incidence in the general population. PD in this population occurs especially among men of younger age and white race. While this study was retrospective in nature and a large prospective analysis is necessary, the data suggest that evaluation of PD, including examination for penile plaque, is prudent for all men who have undergone RP.

Corresponding Author: John P. Mulhall, MD, 353 East 68th Street, New York, NY 10065, USA. Tel: 646-422-4359; Fax: 212-988-0768; E-mail: mulhalj1@mskcc.org

Conflict of Interest: None.

Statement of Authorship

Category 1

(a) Conception and Design
John P. Mulhall

(b) Acquisition of Data
Raanan Tal; Patrick Teloken; Matthias Heck; Timothy Siegrist

(c) Analysis and Interpretation of Data
John P. Mulhall; Christian J. Nelson; Raanan Tal

Category 2

(a) Drafting the Article
John P. Mulhall; Raanan Tal; Christian J. Nelson

(b) Revising It for Intellectual Content
John P. Mulhall; Raanan Tal; Christian J. Nelson

Category 3

(a) Final Approval of the Completed Article
John P. Mulhall

References

1 Jemal A, Siegel R, Ward E, Hao Y, Xu J, Thun MJ. Cancer statistics, 2009. CA Cancer J Clin 2009;59:225–49.
2 Schwarzer U, Sommer F, Klotz T, Braun M, Reifenrath B, Engelmann U. The prevalence of Peyronie's disease: Results of a large survey. BJU Int 2001;88:727–30.
3 La Pera G, Pescatori ES, Calabrese M, Boffini A, Colombo F, Andriani E, Natali A, Vaggi L, Catuogno C, Giustini M, Taggi F. Peyronie's disease: Prevalence and association with cigarette smoking. A multicenter population-based study in men aged 50–69 years. Eur Urol 2001;40:525–30.
4 Mulhall JP, Creech SD, Boorjian SA, Ghaly S, Kim ED, Moty A, Davis R, Hellstrom W. Subjective and objective analysis of the prevalence of Peyronie's disease in a population of men presenting for prostate cancer screening. J Urol 2004;171:2350–3.
5 Iacono F, Giannella R, Somma P, Manno G, Fusco F, Mirone V. Histological alterations in cavernous tissue after radical prostatectomy. J Urol 2005;173:1673–6.
6 Bjekic MD, Vlajinac HD, Sipetic SB, Marinkovic JM. Risk factors for Peyronie's disease: A case-control study. BJU Int 2006;97:570–4.
7 Carrieri MP, Serraino D, Palmiotto F, Nucci G, Sasso F. A case-control study on risk factors for Peyronie's disease. J Clin Epidemiol 1998;51:511–5.
8 Ciancio SJ, Kim ED. Penile fibrotic changes after radical retropubic prostatectomy. BJU Int 2000;85:101–6.
9 Ohebshalom M, Mulhall J, Guhring P, Parker M. Measurement of penile curvature in Peyronie's disease patients: Comparison of three methods. J Sex Med 2007;4:199–203.
10 Deveci S, Hopps CV, O'Brien K, Parker M, Guhring P, Mulhall JP. Defining the clinical characteristics of Peyronie's disease in young men. J Sex Med 2007;4:485–90.
11 El-Sakka AI. Prevalence of Peyronie's disease among patients with erectile dysfunction. Eur Urol 2006;49:564–9.
12 Babyak MA. What you see may not be what you get: A brief, nontechnical introduction to overfitting in regression-type models. Psychosom Med 2004;66:411–21.

13 Rhoden EL, Teloken C, Ting HY, Lucas ML, Teodosio da Ros C, Ary Vargas Souto C. Prevalence of Peyronie's disease in men over 50-y-old from Southern Brazil. Int J Impot Res 2001;13:291–3.
14 Smith BH. Subclinical Peyronie's disease. Am J Clin Pathol 1969;52:385–90.
15 Tal R, Mulhall JP. Intracavernosal injections and fibrosis: Myth or reality? BJU Int 2008;102:525–6.
16 Agrawal V, Ellins E, Donald A, Minhas S, Halcox J, Ralph DJ. Systemic vascular endothelial dysfunction in Peyronie's disease. J Sex Med 2008;5:2688–93.