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EFFECT OF AGING ON STORAGE AND VOIDING FUNCTION IN WOMEN WITH STRESS–PREDOMINANT URINARY INCONTINENCE

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Abstract

PURPOSE—To investigate age related changes in urodynamic parameters in two large cohorts of women planning stress urinary incontinence (SUI) surgery.

MATERIALS AND METHODS—Using a standardized protocol, urodynamic parameters were obtained from participants in the SISTER and TOMUS trials undergoing baseline non-invasive flow (NIF), followed by filling cystometrogram (CMG) and pressure flow study (PFS). Bladder Contractility Index (BCI= $P_{det}Q_{max}+5Q_{max}$) and detrusor hypocontractility (defined as detrusor pressure @ maximum flow ($P_{det}@Q_{max}$) <10 cm H₂O) were also characterized. Excluded patients had prior SUI surgery or prolapse stage >2 . Propensity score analysis controlled for potential bias of combining participants from 2 clinical trials. Regression analysis (linear and logistic) adjusting for propensity score quintile assessed the association of age and an age cutoff value (<65 vs >65 years) with urodynamic parameters.

RESULTS—945 women (SISTER 468, TOMUS 477) were included. Mean age was 50 in SISTER (27–75 years) and 51 in TOMUS (24–82 years). NIF Q_{max} significantly decreased with age (26.2 ml/sec vs. 22 ml/sec, $p=0.002$); NIF voiding time increased 2.7 seconds for every 10 year age increment and $P_{det}@Q_{max}$ decreased 2.1 cm H₂O for each 10 year increase in age ($p=0.003$ for both). Hypocontractility was more likely in women ≥ 65 years (OR 2.89, 95% CI 1.59, 5.27). BCI and age were inversely related with BCI decreasing by 7.68 (1.96) cm H₂O for every 10 year age increase ($p<0.001$).

CONCLUSIONS—In these two cohorts, the changes in voiding parameters observed suggest that detrusor contractility and efficiency decrease with age.

Keywords

Aging; Stress urinary Incontinence; Urodynamic; Detrusor contractility

INTRODUCTION

Efficient voiding requires bladder outlet relaxation followed by a detrusor contraction that is sufficient to overcome the remaining resistance of the outlet. While many men develop

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increased outlet resistance with aging as a result of prostatic hypertrophy, no anatomic corollary exists in women. Women often present with symptoms commonly associated with voiding dysfunction such as a slow urine stream, straining to void, a feeling of incomplete bladder emptying, need to re-void and position-dependent micturition. In general, voiding symptoms have poor sensitivity and specificity for predicting an elevated post-void residual (PVR) in women (1, 2) and are poorly correlated to urodynamic evidence of obstruction (3-5).

Urodynamic studies, specifically non-instrumented uroflowmetry (NIF) and pressure-flow studies (PFS), can assist in the evaluation of women who present with symptoms of voiding dysfunction. Various characteristics of urinary flow are examined such as flow curve, voided volume, peak and average flow rates, time to maximum peak flow and voided time. Pressure-flow studies also measure the bladder volume voided (VV), the maximal detrusor pressure at the peak flow rate ($P_{det}Q_{max}$) and identify characteristic voiding patterns. NIF peak and average flow rates (Q_{max} and Q_{avg}) are dependent on VV and are independent of age in small studies involving asymptomatic (no prolapse, no incontinence) women (6, 7) while age-related changes are reported in men (8).

Recently published clinical trials from the Urinary Incontinence Treatment Network (UITN) have enrolled over 1,500 women who underwent urodynamic studies prior to surgical intervention for stress incontinence (9-11). We reviewed the NIF, cystometric and PFS parameters of these women who did not have advanced prolapse with the purpose of understanding the impact that aging has on bladder function. Several hypotheses were considered at baseline, including a reduction in voiding pressure with age, along with a decrease in maximum flow and an increase in voiding time. In addition, with increasing age, we expected to see no increase in residual and a decrease in total bladder capacity.

METHODS

This was a secondary analysis of data from the SISTEr and TOMUS trials conducted by the Urinary Incontinence Treatment Network (UITN) (12). The NIDDK-sponsored UITN consists of urologists and urogynecologists from nine clinical centers and a data-coordinating center. SISTEr (fascial pubovaginal sling vs. Burch bladder neck suspension) and TOMUS (retropubic vs. transobturator mid-urethral sling) were multi-center randomized surgical trials comparing the efficacy and morbidity of surgical procedures for treatment of SUI. In SISTEr, 655 women with stress predominant urinary incontinence were randomized between February 2002 and June 2004. In TOMUS, 597 women with stress predominant urinary incontinence were randomized between April 2006 and June 2008. Details of the enrollment criteria for both trials have been previously published (10, 12, 13). These studies were approved by the institutional review board at all participating clinical centers and the biostatistical coordinating center. All patients gave written informed consent before enrollment.

The primary aim of this secondary analysis was to assess whether age is associated with differences in urodynamic variables of voiding, using age either as a continuous variable or

by comparing women younger than 65 to those 65 and older. We chose 65 as the age cutoff as it is commonly referred to in the geriatric literature.

Exclusions

SISTER and TOMUS study exclusion criteria included an elevated post-void residual (PVR) volume (defined as greater than 100 ml for women with POP stage I or lower, and greater than 500 ml for POP stage II or higher), or a medical condition, previous pelvic surgery or cancer treatment known to affect bladder or urethral function. For this analysis, additional exclusion criteria were used to minimize the potential for mechanical obstruction confounding the urodynamic data and consisted of women with prolapse > stage 2 and those who had prior surgery for urinary incontinence.

Urodynamic Testing

Participants in the SISTER and TOMUS trials underwent preoperative urodynamic testing according to International Continence Society Guidelines (14) including NIF and PFS by a standardized urodynamic protocol(15). Tracings were centrally reviewed by a urodynamic committee for quality review(15). Specifically, the urodynamic study began with a NIF which required a minimum voided volume of 150 ml. Filling CMG was then performed in the standing position using a dual lumen urethral catheter (8Fr or less), at a fill rate of 50 ml per minute, with simultaneous abdominal pressure monitoring obtained through a fluid-filled rectal balloon catheter. Pressures were measured using external pressure transducers, which were zeroed to atmospheric pressure using the level of the symphysis pubis as the reference height. Following the filling phase, which included Valsalva leak point pressure (VLPP), PFS was performed in the sitting position after transducers were repositioned at the level of the symphysis pubis. Vesical pressures were measured at baseline, just prior to void, and at Qmax. The difference between the detrusor pressure prior to void and that noted at Qmax was calculated as the $p_{det}@Q_{max}$. Data collected included NIF Qmax, time to Qmax, voiding time, VV, PVR, and for the PFS: $p_{det}@Q_{max}$, PFS Qmax, time to Qmax, VV and voiding mechanism. In this study, specific calculations were added for detrusor hypocontractility taking $p_{det}@Q_{max}<10$ cm H₂O pressure as a cut-off value(15). Since voiding pressure is a reflection of outlet resistance as much as detrusor function, the Bladder Contractility Index ($BCI=P_{det}Q_{max}+5Q_{max}$) was also examined and compared between the 2 groups (16, 17).

As the eligibility criteria for the two studies differed, a propensity score analysis was used to aid in controlling for bias between the samples selected from the two studies (Thomas E. Love, PhD, Using Propensity Score Methods Effectively, ASA Cleveland chapter Fall Workshop October 11, 2004)(18). Briefly, using logistic regression we computed the “propensity” of the subjects to be in each study based on baseline UDS and clinical characteristics. These scores were divided into quintiles and the propensity score quintile was included in all analyses. First, the two study samples were compared with regard to select clinical and UDS characteristics at baseline and then we found that differences were mitigated after controlling for propensity score quintile. Finally, we used multivariable linear modeling methods (linear or logistic regression analysis, as appropriate) adjusting for the propensity score quintile to assess whether age as a continuous variable or categorized as

(< 65, ≥ 65) was related to each of the urodynamic parameters. For linear regression analysis we report the adjusted means or the slope of the regression equation and for logistic regression we report odds ratios (OR) along with associated confidence intervals. Adjusted mean change in urodynamic score for each increase in 10 years increment was calculated as well as adjusted mean score by the 65 year old groups.

RESULTS

Of the 1252 women enrolled in the SISTER and TOMUS trials, 945 (468 SISTER and 477 TOMUS) had plausible baseline urodynamic data in each of the parameter categories selected, and were included in the analysis. Among these women, 96 (10%) were aged 65 or older, and the urodynamic measures obtained in this group were compared to the 849 women younger than 65 years after a propensity score matching analysis was performed.

It was found that comparisons of nearly all of the baseline covariates, which initially differed between the studies, were no longer statistically significantly different once propensity quintile was controlled for (Table 1). Differences in NIF voided volume and VLPP, although statistically significant, did not appear to be clinically significant. This finding supports that grouping the urodynamic data of the two studies was valid.

Urodynamic findings were compared for each increase in 10 years of age and between women younger than 65 and those 65 and older (Table 2). NIF Qmax, PFS Pdet@Qmax and VLPP were all significantly lower in women 65 and older compared to younger women (22 ml/sec vs 26.2 ml/sec, $p=0.002$; 14.0 cm H₂O vs 19.5 cm H₂O, $p=0.003$; and 106.6 cm H₂O vs. 121.8 cm H₂O, $p=0.005$, respectively). Time to NIF Qmax, time to PFS Qmax, voiding time, and volume at first desire to void were all higher in the older cohort of women (16 seconds vs 12.5 seconds, $p=0.04$; 27.1 seconds vs. 18.8 seconds, $p=0.002$; 32.9 seconds vs. 28.6 seconds, $p=0.049$; and 165.4 ml vs. 126.3 ml, $p<0.001$, respectively). No other urodynamic parameters appeared to differ based on age of the patient. Similar findings were noted for changes in urodynamic values for each increase in 10 years, with a decrease over time for NIF Qmax, increase in voiding time, decrease in Pdet@Qmax, and no changes in PVR or volume at MCC.

Adjusting for trial and propensity score stratum, the odds of hypocontractility in women ≥ 65 years was nearly 3 times that of the younger cohort (OR 2.89, 95% CI 1.59, 5.27). These analyses were performed separately for both the SISTER and TOMUS trial participants and the results matched what was found for the propensity score analysis (data not shown). Average BCI for women older than 65 years was lower than for women younger than 65 (adjusted mean BCI (SE) 115 (6.5) versus 125.5 (2.2) cm H₂O respectively); however the difference did not reach statistical significance. As a continuous measure, BCI and age were inversely related with a drop in BCI of 8 cm H₂O ($se = 1.96$) for every 10 years of age ($p<0.001$).

DISCUSSION

The major finding of our study is that women over 65 years of age with stress urinary incontinence had significant decreases in non-instrumented maximum flow rate, detrusor

pressure at maximum flow, increases in time to maximum flow and non-instrumented voiding time. In addition, they also have lower VLPP's than their younger cohort. We did not observe differences in post void residual volumes, but this would not be expected since women with elevated post void residuals were excluded from study participation. Furthermore, to minimize any impact from outlet obstruction, women who had prior SUI surgery and those with advanced prolapse were excluded from this secondary analysis. The best overall interpretation of our results is that detrusor hypocontractility increases with age.

However, detrusor pressure during voiding may also be impacted by changes in outlet resistance. It is conceivable that the lower VLPP seen in the older women could also signify a decreased outlet resistance which would then potentially result in a lower measured voiding pressure. Assessment of detrusor hypocontractility would be best done using an isometric stop test (19); however such methodology was outside of the original scope of the UITN studies. Instead, we assessed the BCI which provides another means to evaluate detrusor contractility. In our comparisons, the BCI also trended lower in women in the dichotomized assessment of the group over 65. When examined as a continuous variable, the BCI demonstrated a significant inverse correlation with age thereby supporting the concept that detrusor contractility decreases with age.

There are no longitudinal studies that look at detrusor activity over a life span, but other cross-sectional studies have shown similar results. Malone-Lee found lower detrusor shortening velocities and more failure of isotonic detrusor function in older women (20). In a study of 85 ambulatory community dwelling volunteers detrusor contraction strength was found to decline significantly with age (21) The reason for this decline in detrusor function is not clear. Elbadawi proposed correlates between impaired detrusor contractility at the ultrastructural level based on studies of aging bladder using electron microscopy. Detrusor muscle cell de-differentiation along with depletion of caveolae could affect the excitation-contraction coupling mechanism of muscle cells(22). Caveolae are protected membrane regions that regulate signal transduction and are important for detrusor contractility. Rat studies have shown that aging significantly decreases bladder caveolae number and morphologic age-related alterations in caveolae and caveolin protein expression could alter bladder contractility (23).

A strength of our study was the large number (945) of well characterized women all seeking surgical treatment for symptomatic stress urinary incontinence in whom to evaluate bladder function. Women with advanced prolapse and previous SUI surgery were excluded and all had normal post-void residual volumes therefore bladder outlet obstruction should be exceedingly rare in this group. On the other hand, by excluding women with elevated PVR, it is possible that women with more advanced hypocontractility and associated emptying problems were filtered out though this would likely only further support our conclusion. Another strength is that all urodynamic studies used a standardized protocol that followed Good Urodynamic Practice Guidelines (14) with supervision by a urodynamics working group (15). A study limitation is that mainly clinically relevant cutoffs were considered in this analysis. Receiver operating characteristic (ROC) curves to consider different cutoffs were not obtained primarily because the sample size of 70+ year-olds was too small.

Therefore, we can only speculate that the difference between the two groups would have been even more significant with an older cutoff.

CONCLUSION

In two large cohorts of women who were planning on surgery for predominant SUI, the voiding phase parameters NIF Qmax and Pdet@Qmax significantly decreased and flow time increased with age. Detrusor hypocontractility was more present in older women. It is likely that detrusor function and efficiency decline with increasing age, which is important to consider when evaluating an older woman with lower urinary tract complaints.

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KEY OF DEFINITIONS

SUI	stress urinary incontinence SISTER TOMUS
NIF	non-invasive flos
CMG	filling cystometrogram
BCI	bladder contractility index
PVR	post-void residual
PFS	pressure-flow studies
VV	volume voided
UITN	Urinary Incontinence Treatment Network
VLPP	Valsalva leak point pressure

REFERENCES

1. Lowenstein L, Anderson C, Kenton K, Dooley Y, Brubaker L. Obstructive voiding symptoms are not predictive of elevated postvoid residual urine volumes. *Int Urogynecol J Pelvic Floor Dysfunct.* Jun; 2008 19(6):801–4. PubMed PMID: 18074067. [PubMed: 18074067]
2. Lukacz ES, DuHamel E, Menefee SA, Luber KM. Elevated postvoid residual in women with pelvic floor disorders: prevalence and associated risk factors. *Int Urogynecol J Pelvic Floor Dysfunct.* Apr; 2007 18(4):397–400. PubMed PMID: 16804634. [PubMed: 16804634]
3. Dwyer PL, Desmedt E. Impaired bladder emptying in women. *Aust N Z J Obstet Gynaecol.* Feb; 1994 34(1):73–8. PubMed PMID: 8053880. [PubMed: 8053880]
4. Clarke B. The role of urodynamic assessment in the diagnosis of lower urinary tract disorders. *Int Urogynecol J Pelvic Floor Dysfunct.* 1997; 8(4):196–9. PubMed PMID: 9449295. [PubMed: 9449295]
5. Groutz A, Gordon D, Lessing JB, Wolman I, Jaffa A, David MP. Prevalence and characteristics of voiding difficulties in women: are subjective symptoms substantiated by objective urodynamic data? *Urology.* Aug; 1999 54(2):268–72. PubMed PMID: 10443723. [PubMed: 10443723]

6. Jorgensen JB, Colstrup H, Frimodt-Moller C. Uroflow in women: an overview and suggestions for the future. *Int Urogynecol J Pelvic Floor Dysfunct*. 1998; 9(1):33–6. PubMed PMID: 9657176. [PubMed: 9657176]
7. Fantl JA, Smith PJ, Schneider V, Hurt WG, Dunn LJ. Fluid weight uroflowmetry in women. *Am J Obstet Gynecol*. Apr 15; 1983 145(8):1017–24. PubMed PMID: 6837677. [PubMed: 6837677]
8. Haylen BT, Ashby D, Sutherst JR, Frazer MI, West CR. Maximum and average urine flow rates in normal male and female populations--the Liverpool nomograms. *Br J Urol*. Jul; 1989 64(1):30–8. PubMed PMID: 2765766. Epub 1989/07/01. eng. [PubMed: 2765766]
9. Albo ME, Richter HE, Brubaker L, Norton P, Kraus SR, Zimmern PE, et al. Burch colposuspension versus fascial sling to reduce urinary stress incontinence. *N Engl J Med*. May 24; 2007 356(21): 2143–55. PubMed PMID: 17517855. Epub 2007/05/23. eng. [PubMed: 17517855]
10. Richter HE, Albo ME, Zyczynski HM, Kenton K, Norton PA, Sirls LT, et al. Retropubic versus transobturator midurethral slings for stress incontinence. *N Engl J Med*. Jun 3; 2010 362(22): 2066–76. PubMed PMID: 20479459. Pubmed Central PMCID: 2962585. Epub 2010/05/19. eng. [PubMed: 20479459]
11. Nager CW, Brubaker L, Litman HJ, Zyczynski HM, Varner RE, Amundsen C, et al. A randomized trial of urodynamic testing before stress-incontinence surgery. *N Engl J Med*. May 24; 2012 366(21):1987–97. PubMed PMID: 22551104. Epub 2012/05/04. eng. [PubMed: 22551104]
12. Tennstedt S. Design of the Stress Incontinence Surgical Treatment Efficacy Trial (SISTER). *Urology*. Dec; 2005 66(6):1213–7. PubMed PMID: 16360445. Epub 2005/12/20. eng. [PubMed: 16360445]
13. Albo M. (UITN) eafUITN. The trial of mid-urethral slings (TOMUS): Design and methodology. *Th Journal of Applied Research*. 2008; 8(1):1–13.
14. Schafer W, Abrams P, Liao L, Mattiasson A, Pesce F, Spangberg A, et al. Good urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn*. 2002; 21(3):261–74. PubMed PMID: 11948720. Epub 2002/04/12. eng. [PubMed: 11948720]
15. Nager CW, Albo ME, Fitzgerald MP, McDermott SM, Kraus S, Richter HE, et al. Process for development of multicenter urodynamic studies. *Urology*. Jan; 2007 69(1):63–7. discussion 7–8. PubMed PMID: 17270617. Pubmed Central PMCID: 1855147. Epub 2007/02/03. eng. [PubMed: 17270617]
16. Abrams P. Bladder outlet obstruction index, bladder contractility index and bladder voiding efficiency: three simple indices to define bladder voiding function. *BJU Int*. Jul; 1999 84(1):14–5. PubMed PMID: 10444116. [PubMed: 10444116]
17. Schafer W. Analysis of bladder-outlet function with the linearized passive urethral resistance relation, linPURR, and a disease-specific approach for grading obstruction: from complex to simple. *World journal of urology*. 1995; 13(1):47–58. PubMed PMID: 7773317. [PubMed: 7773317]
18. Love, TE. Using propensity score methods effectively.. *ASA Cleveland Chapter Fall Workshop*; October 11, 2004; 2004.
19. Tan TL, Bergmann MA, Griffiths D, Resnick NM. Stop test or pressure-flow study? Measuring detrusor contractility in older females. *Neurourol Urodyn*. 2004; 23(3):184–9. PubMed PMID: 15098212. [PubMed: 15098212]
20. Malone-Lee J, Wahedna I. Characterisation of detrusor contractile function in relation to old age. *Br J Urol*. Dec; 1993 72(6):873–80. PubMed PMID: 8306149. [PubMed: 8306149]
21. Pfisterer MH, Griffiths DJ, Schaefer W, Resnick NM. The effect of age on lower urinary tract function: a study in women. *J Am Geriatr Soc*. Mar; 2006 54(3):405–12. PubMed PMID: 16551306. [PubMed: 16551306]
22. Elbadawi A, Yalla SV, Resnick NM. Structural basis of geriatric voiding dysfunction. II. Aging detrusor: normal versus impaired contractility. *J Urol*. Nov; 1993 150(5 Pt 2):1657–67. PubMed PMID: 8411454. [PubMed: 8411454]
23. Lowalekar SK, Cristofaro V, Radisavljevic ZM, Yalla SV, Sullivan MP. Loss of bladder smooth muscle caveolae in the aging bladder. *Neurourol Urodyn*. Apr; 2012 31(4):586–92. PubMed PMID: 22374691. [PubMed: 22374691]

Table 1

Comparison of baseline urodynamic data in study participants from the SISTER and TOMUS surgical trials before and after controlling for propensity score.

Characteristic/ Variable	SISTER		TOMUS		Unadjusted p-value	p-value controlling for propensity score*
	N	Mean (SD)	N	Mean (SD)		
Age	468	50.6 (10.0)	477	51.1 (10.3)	0.44	0.58
BMI	464	30.1 (6.3)	473	30.5 (6.9)	0.28	0.58
NIF Qmax	428	26.2 (11.2)	444	25.6 (12.4)	0.43	0.47
NIF Qaverage	428	13.9 (6.4)	444	12.0 (5.7)	<0.001	0.80
NIF Time to max flow	428	11.6 (11.4)	444	14.4 (17.6)	0.006	0.57
NIF Voided volume	428	306.8 (127.6)	445	319.4 (142.8)	0.17	0.02
NIF Voiding time	428	26.5 (18.4)	444	31.9 (19.8)	<0.001	0.84
NIF PVR	428	21.7 (35.5)	405	23.5 (43.5)	0.51	0.73
First desire	465	140.2 (91.9)	469	118.7 (82.4)	<0.001	0.77
Strong desire	463	262.3 (133.2)	469	230.7 (116.9)	<0.001	0.82
Volume at MCC	464	393.9 (137.7)	472	354.5 (124.6)	<0.001	0.90
Compliance	371	53.9 (182.2)	394	57.8 (135.7)	0.73	0.43
PFS Qmax	450	22.3 (10.3)	445	22.7 (10.9)	0.54	0.91
PFS Voided volume	450	399.5 (160.6)	448	380.8 (146.8)	0.07	0.52
PFS Pdet at Qmax	275	18.4 (11.5)	320	19.4 (13.2)	0.34	0.22
BOOI	275	-24.2 (23.3)	320	-22.9 (25.1)	0.51	0.71
PFS Time to Qmax	447	18.2 (19.3)	441	22.8 (34.1)	0.01	0.62
VLPP	337	117.4 (37.6)	296	122.7 (42.3)	0.09	0.01
BCI	275	124.8 (49.4)	320	125.0 (48.1)	0.96	0.76

* Adjusted for propensity score quintile

Table 2

Urodynamic results in women analyzed by age.

Variable	Adjusted* mean change in urodynamic score for each increase in 10 years (standard error)	Adjusted* Mean score for <65 years	Adjusted* Mean score for 65+ years	Test of continuous age P-value	Test of age categories (<65 vs. 65+years) P-value
NIF Qmax	-1.9 (0.4)	26.2 (0.43)	22.0 (1.3)	<0.001	0.002
NIF time to max flow	1.6 (0.5)	12.5 (0.5)	16.0 (1.6)	0.001	0.04
NIF voided volume	-2.8 (4.5)	310.9 (4.8)	294.4 (14.0)	0.53	0.18
NIF Voiding time	2.7 (0.6)	28.6 (0.7)	32.9 (2.0)	<0.001	0.049
NIF PVR	-0.06 (1.4)	22.2 (1.5)	20.0 (4.4)	0.97	0.64
First desire	9.8 (2.9)	126.3 (3.1)	165.4 (9.1)	<0.001	<0.001
Strong desire	5.2 (4.2)	244.6 (4.5)	269.6 (13.1)	0.22	0.07
Volume at MCC	-1.7 (4.4)	375.6 (4.7)	371.8 (13.6)	0.69	0.80
Compliance	5.2 (6.2)	56.5 (6.8)	58.5 (19.8)	0.40	0.92
PFS Qmax	-1.2 (0.4)	22.7 (0.4)	20.7 (1.1)	<0.001	0.10
PFS voided volume	-7.3 (5.2)	392.9 (5.7)	376.6 (16.4)	0.44	0.35
PFS Pdet @Qmax	-2.1 (0.5)	19.5 (0.58)	14.0 (1.7)	<0.001	0.003
BOOI	0.12 (1.0)	-23.0 (1.1)	-26.3 (3.2)	0.91	0.33
PFS Time to Qmax	1.8 (0.8)	18.8 (0.9)	27.1 (2.5)	0.02	0.002
VLPP	-6.7 (1.6)	121.8 (1.8)	106.6 (5.1)	<0.001	0.005
BCI	-7.7 (2.0)	125.5 (2.2)	115.0 (6.5)	<0.001	0.12

* Adjusted for propensity score quintile