138

Amundsen C[1], Parsons M[2], Tissot W [3], Diokno A[3], Cardozo L[2]
1. Duke University Medical Center, Department of Obstetrics and Gynecology, 2. Kings College Hospital, Department of Urogynaecology, 3. William Beaumont Hospital, Department of Urology

RELATIONSHIP OF VOIDING FREQUENCY AND BLADDER CAPACITY TO TOTAL URINE OUTPUT

Hypothesis / aims of study

Voiding diary measurements of bladder capacity and voiding frequency are widely felt to be useful in the evaluation of lower urinary tract symptoms. Underlying the clinical interpretation of these measurements is an assumption that bladder capacity remains relatively constant regardless of total urine output and that, therefore, the primary mechanism of compensating for increased output is to increase voiding frequency. However, recently published data[1,2,3] suggest that, in asymptomatic men and women, an increase in total urine output is associated with an increase in bladder capacity as measured by maximum and average volumes voided. The purpose of our study was to compare bladder capacity and voiding frequency relationships with total urine output and to investigate the strength and shape of the relationship. Our study's objective was to provide data that would contribute to a test of the hypothesis that the sole or primary response of the lower urinary tract to increased urine output is an increase in voiding frequency.

Study design, materials and methods

Three independent research sites collected voiding diaries from 161 women under institutional review board or ethics committee approval. The subjects were without any urinary tract symptoms or previous urologic surgery as determined by a screening questionnaire. The subjects' median age was 47 (range 20-82) years. A computerized diary reader (Life-Tech, Inc., Texas, U.S.A.) read the diaries and calculated the diary variables. We used regression analysis to investigate the relationships between 24-hour volume (V_{24}) and average and maximum volumes (V_{max} and V_{avg}) and between V_{24} and 24-hour frequency (F_{24}). We used analysis of variance (ANOVA) to select between linear and quadratic models. The criterion for selecting the quadratic model was reduction of variance by a significance level of $P <= 0.20$.

Results

Figure 1 and Table I summarize our results and compare them with previously published data. Our study shows that there is a strong tendency for bladder capacity to increase with increased V_{24} ($r = 0.67 – 0.73$). There is also a significant ($r = 0.47$) tendency for frequency to increase with increased V_{24}. However, the correlation between bladder capacity and V_{24} is significantly ($Z = 3.35$, $P < 0.001$) stronger than the correlation between frequency and V_{24}. As shown by the previously published correlation coefficients listed in Table I and the previously published V_{avg} versus V_{24} curve shown in Fig. 1, these results agree quite closely with previously published data. In addition, the quadratic model significantly ($P = 0.004 - 0.034$) improves the correlation between bladder capacity and V_{24}, and the curvilinear shape of the regression curve is concave downward. Also, inspection of the scatter plot (Fig. 1) shows a significant skew to the right of the residual distribution.

Interpretation of results

Our data suggest that an adaptive mechanism adjusts bladder capacity to 24-hour volume to hold voiding frequency relatively constant. Clinical experience with bladder training regimen, that include water loading to increase urine output, supports the existence of such an adaptive mechanism. We cannot rule out the possibility that, at least over the low end of the urine output range, a tendency, in an asymptomatic population, to reduce fluid intake to compensate for a small bladder capacity contributes to the V_{24} versus bladder capacity relationship. A study relating fluid intake to bladder capacity should help elucidate the mechanisms underlying the bladder capacity versus urine output relationship.

Concluding message

The strong relationship between V_{24} and bladder capacity in asymptomatic persons may have to be incorporated into the clinical interpretation of bladder diaries. For example, referencing bladder capacity to V_{24} would reduce the variability of the reference population and thus might increase the precision with which normal and abnormal bladder capacity can be separated. An investigation of the behavior of the V_{24} vs. bladder capacity relationship in patients with lower urinary tract abnormalities would help elucidate this possibility.

Table I. Regression Analysis Results and Literature Comparison **All P values <0.005**

Variable	**Linear vs. Quadratic ANOVA**		**Regression Results**				**Published Correlations Coefficients**	
Frequency	**P**	**Model**	β_0	β_1	β_2	**r**	**(2)**	**(3)**
F_{24} vs. V_{24}	0.884	L	+4.90	+0.00129	-	0.47	0.42	0.34
Bladder Capacity								
V_{max} vs. V_{24}	0.034	Q	+84.51	+0.3213	-3.6E-5	0.67	0.71	NR
V_{avg} vs. V_{24}	0.004	Q	+14.40	+0.1780	-2.2E -5	0.71	0.67	0.71

"L" = Linear; "Q" = Quadratic; "NR" = Not Reported

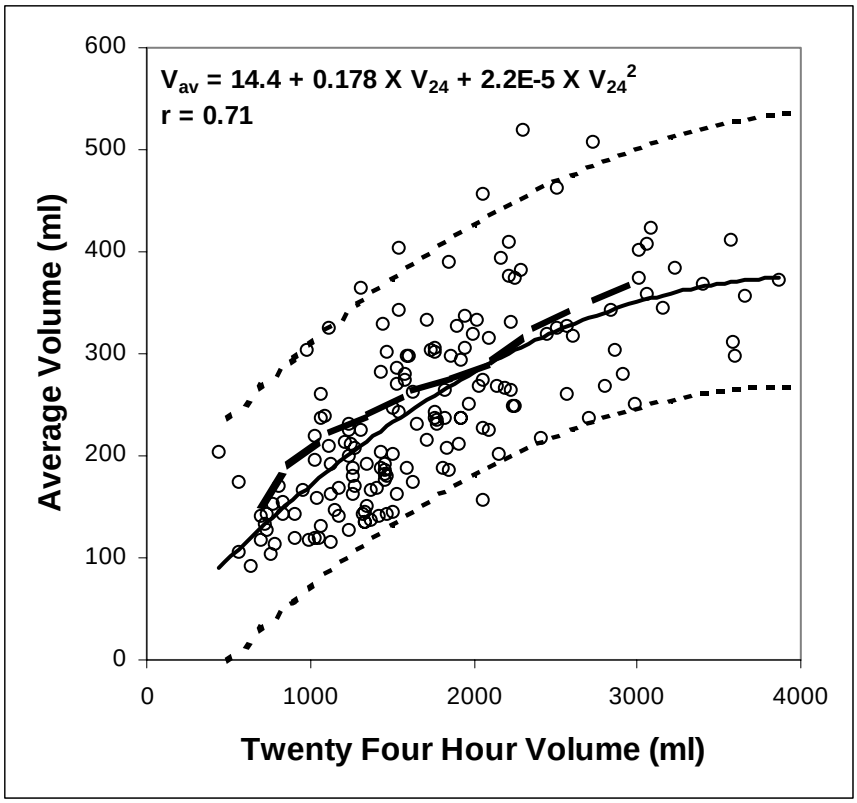

Figure 1
Scatter plot of our average volume versus 24-hour volume data points from asymptomatic females (open circles) with superimposed regression curve (solid line) and 95% confidence limits adjusted for skew (short dashed lines). The regression equation and correlation coefficient are shown at the top. The line with long dashes is taken from a previously published study[1] of men and women combined.

References

1. The 24-h frequency-volume chart in adults reporting no voiding complaints: Defining reference values and analyzing variables, BJU International, 93, 1257-1261, 2004.
2. Micturition patterns in a healthy female population, studied with a frequency / volume chart, Scand. J. Urol. Nephrol., suppl. 114, 53-57, 1988.
3. Voiding frequency, volumes and intervals in healthy schoolchildren, Scand. J. Urol. Nephrol., 28, 1-11, 1994.

FUNDING: Life-Tech, Inc.