

MORPHOLOGICAL AND FUNCTIONAL EVALUATION OF PROSTATIC URETHRA USING SONOURETHROGRAPHY WITH RETROGRADE JELLY INJECTION

Hypothesis / aims of study

Previous reports suggested that lower urinary tract symptoms (LUTS) due to benign prostatic hyperplasia (BPH) associate with not only prostatic volume but also morphological characteristics of prostatic urethra (1). However, adequate modalities have been needed to evaluate urethral morphology precisely. On the other hand, sonourethrography (SUG) is an infrequently used modality to observe male urethra under urinary micturition or retrograde injection of saline (2). Since its introduction in the mid-1980s, several studies have suggested its higher degree of sensitivity and specificity in anterior urethral stricture evaluation (3). However, inadequate evaluation of posterior urethra and need for technical expertise are major limitations of this method. In addition, visual technology of ultrasonography in the 1980s to 1990s was insufficient to observe male urethra precisely and to share the obtained results objectively. Recently the development of visual technology and the ability to save obtained videos to hard-disk have improved the objectivity of SUG. Moreover, we modified SUG with retrograde injection of jelly under transrectal ultrasonography (TRUS) to measure morphological characteristic of prostatic urethra easily. This modified SUG might have possibility to assess mechanisms of prostatic obstruction in the aspect of urethral morphology. The aim of this study is to investigate morphological characteristics of prostatic urethra using modified SUG, and to assess correlation between obtained SUG findings and LUTS.

Study design, materials and methods

Patients of BPH and localized prostatic cancer (PC) were enrolled in this study before surgery. Written informed consent was obtained from all patients for being included in the study. Under general anesthesia, SUG was performed just before surgery. Observing prostatic urethra sagittally under TRUS, 20 ml of jelly was manually injected to urethra. All of the obtained images including video were reserved in the hard-disk in the US system, and the images were analyzed after the procedure. As shown in Figure (A), each angle (A and B) and length (a, b, and c) of urethral parts were measured. Basic clinical characteristics (age, prostatic volume under TRUS, international prostatic symptoms score (IPSS), QOL-score, voided volume, Qmax, and residual urine) were also evaluated in all of the cases. Each parameter was compared between BPH and PC patients statistically (Unpaired t-test). And as sub-analysis, all of the enrolled patients were separated into severe IPSS group (≥ 20) and mild IPSS group ($20 >$), and into large prostate group ($\geq 50\text{g}$) and moderate prostate group ($50\text{g} >$). Characteristics of patients with history of urinary retention were analysed separately. Moreover, we evaluated Spearman's rank correlation coefficient between the basic clinical characteristics and the morphological urethral parameters.

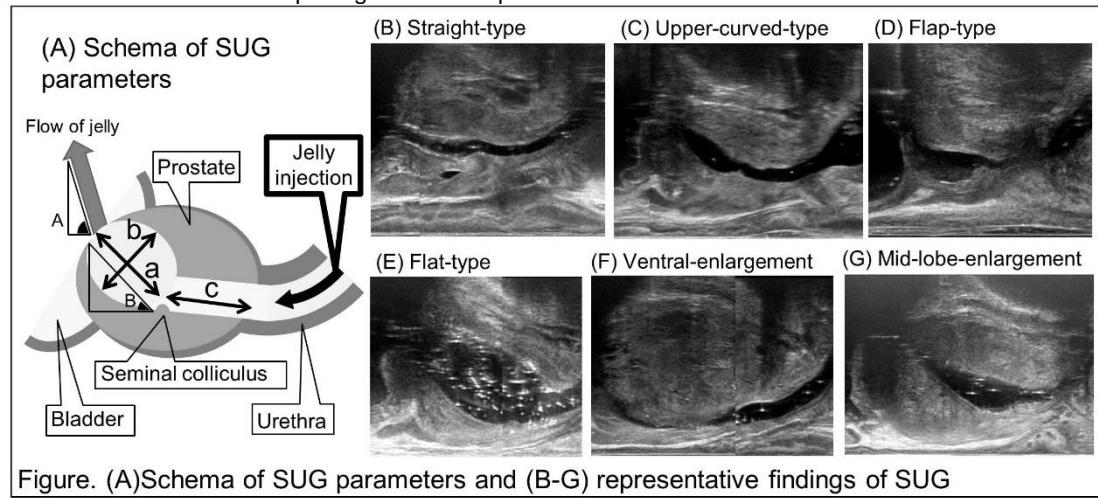


Figure. (A) Schema of SUG parameters and (B-G) representative findings of SUG

Results

In total, 55 patients underwent SUG (35 of PC and 20 of BPH). Nine of BPH patients had history of urinary retention before surgery. The summarized results of basic clinical characteristics are shown in Table 1. Using SUG, the prostatic urethras were clearly observed in all of the patients without any adverse events. SUG can identify some types of prostatic urethra. Representative findings of normal size prostate were shown in Figure (B-D), and those of BPH were shown in Figure (E-G). SUG urethral parameters were summarized in Table 2. And, correlation between basic clinical characteristics and SUG parameters were summarized in Table 3. Moderate correlation among basic clinical characteristics and SUG parameters was revealed statistically. Especially, A, a, and b showed strong correlation with IPSS.

Table 1. The basic clinical characteristics of the enrolled 55 patients. (Mean ± SD)

	N	Age	Prostate volume	IPSS	QOL-score	Voided volum	Qmax	Residual urine
PC group	35	65.4 ± 7.0	28.7 ± 9.9	9.0 ± 6.4	3.0 ± 1.7	305.8 ± 187.2	16.6 ± 8.5	47.1 ± 79.3
BPH group	20	69.3 ± 6.4	n.s.	53.7 ± 24.1 **	22.1 ± 6.7 **	5.2 ± 1.0 **	154.1 ± 74.1 **	7.5 ± 4.0 **
Severe IPSS group (≥20)	15	67.5 ± 7.4	48.8 ± 22.6	25.6 ± 3.7	5.6 ± 0.5	205.7 ± 158.8	7.0 ± 3.9	144.6 ± 114.8
Mild IPSS group (20+)	40	66.6 ± 6.9	n.s.	33.7 ± 17.9 *	9.4 ± 5.9 **	3.1 ± 1.6 **	278.9 ± 178.5 n.s.	16.1 ± 8.5 **
Large prostate group (≥50ml)	13	69.1 ± 4.1	68.9 ± 15.2	21.8 ± 7.3	4.9 ± 1.3	211.5 ± 105.8	8.9 ± 4.9	80.0 ± 98.7
Moderate prostate group (50ml >)	42	66.1 ± 7.6	n.s.	28.2 ± 9.1 **	11.3 ± 8.0 **	3.5 ± 1.8 **	273.9 ± 187.3 n.s.	15.2 ± 8.8 n.s.
Urinary retention group	9	70.3 ± 7.1	65.4 ± 20.2	23.3 ± 6.1	5.1 ± 0.7			
Total	55	66.8 ± 7.0	37.8 ± 21.3	13.8 ± 9.0	3.8 ± 1.8	262.5 ± 148.9	14.0 ± 9.1	66.1 ± 93.5

Six cases of BPH group present urinary retention, and excluded from the data of voided volume, Qmax, and residual urine. Three cases of BPH group had history of urinary retention. In total, 9 cases were enrolled in Urinary retention group. t-test (two-way analysis) n.s.: not significant, * : p<0.05, ** : p<0.01

Table 2. Results and comparision of the SUG urethral parameters (Mean ± SD)

	N	A (degree)	B (degree)	a (mm)	b (mm)	c (mm)
PC group	35	28.4 ± 16.3	26.0 ± 12.1	25.3 ± 5.9	7.8 ± 4.1	14.3 ± 3.4
BPH group	20	49.8 ± 19.1 **	38.8 ± 13.7 **	35.5 ± 10.9 **	14.2 ± 6.9 **	15.4 ± 5.4 n.s.
Severe IPSS group (≥20)	15	53.7 ± 15.6	42.3 ± 13.0	34.8 ± 10.0	13.4 ± 6.3	15.0 ± 5.1
Mild IPSS group (20+)	40	29.6 ± 17.6 **	26.3 ± 11.8 **	26.9 ± 8.3 **	8.9 ± 5.5 *	14.6 ± 4.0 n.s.
Large prostate group (≥50ml)	13	53.8 ± 19.8	39.2 ± 14.8	40.8 ± 9.8	17.1 ± 6.3	16.7 ± 5.7
Moderate prostate group (50ml >)	42	30.7 ± 16.9 *	28.0 ± 12.8 *	25.4 ± 5.6 **	8.0 ± 4.1 **	14.1 ± 3.5 n.s.
Urinary retention group	9	57.8 ± 14.7	43.9 ± 9.9	38.6 ± 9.7	16.5 ± 5.8	17.7 ± 6.8
Total	55	36.2 ± 20.2	30.6 ± 14.1	29.0 ± 9.5	10.1 ± 6.1	14.7 ± 4.3

t-test (two-way analysis) n.s.: not significant, * : p<0.05, ** : p<0.01

Table 3. Results of Spearman's rank correlation coefficient between the basic clinical characteristics and the urethral paraeters. (N = 55)

	A	B	a	b	c	Prostate volume
Total IPSS	0.6015	0.4992	0.5288	0.5210	0.0630	0.4475
QOL-score	0.5304	0.4634	0.5088	0.4493	0.0108	0.4104
Voided volume	-0.2449	-0.1841	-0.2083	-0.1776	-0.1641	-0.3370
Qmax	-0.5308	-0.4655	-0.3573	-0.3538	-0.0579	-0.4057
Residual urine	0.4109	0.2682	0.3108	0.1461	-0.1369	-0.0561

Interpretation of results

Modified SUG can demonstrate morphological urethral characteristics precisely including seminal colliculus. And, modified SUG can be adequate modality to measure morphological urethral parameters easily, such as length of urethral parts and angle between urethra and axis. Besides c, the obtained length and angle parameters showed statistical difference among the groups in the aspect of diagnosis, symptoms, and prostatic volume. Therefore, SUG findings can predict lower urinary tract condition well. Especially, enlargement of A may influence on urinary retention due to BPH. Using Spearman's rank correlation coefficient, the obtained SUG parameters can be used to determine the severity of BPH as well as prostatic volume.

Concluding message

Modified SUG can demonstrate morphology of prostatic urethra precisely, and morphological characteristics obtained by SUG correlate with LUTS. Modified SUG can be useful modality to evaluate LUTS to assess the mechanism of prostatic obstruction.

References

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Disclosures

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