

## STUDY OF LOW BLADDER VOLUME MEASUREMENT USING 3D ULTRASONOGRAPHIC DEVICE

### Hypothesis / aims of study

The aim of this study is to examine the efficacy of a non-invasive 3D ultrasonographic device to measure low bladder volume, and improvement in measurement accuracy through training.

### Study design, materials and methods

A total of 160 patients (male: 89, female: 71) were enrolled in the study with their consent. Using a 3D ultrasonographic device, BVI 6100 (Diagnostic Ultrasound Corp.), we measured the bladder volume of 150ml or less (mid-value: last year 71.5, this year 70.2 ml), and made a comparison study between the measured values of this year and those of the previous year for the same patients with the same examiners. We conducted three measurements after a trial in each male and female mode, and adopted the averages of each of the three measurements. After the use of BVI, we measured the actual bladder volume by catheterization. In advance, we excluded the patients with symptoms such as distinguished irregular bladder shape, thickened bladder wall, active urinary tract infection, urinary tract malignancy and cystic diseases around the bladder. By comparing the BVI measurements with the actual measurements, we examined their correlation, the error rate of BVI, error rate factors, and changes in measured values after a year.

### Results

The error rate of BVI measurement in male mode in all patients this year was  $-2.0 \pm 13.8$  (average value  $\pm$  standard deviation; last year:  $-2.8 \pm 22.0$ ) %, the Pearson Correlation Coefficient (R) in male mode in all patients was 0.967 (last year: 0.941) and the Coefficient of Variation (CV) was 7.6 (last year: 12.4,  $p < 0.0001$ ), which were all excellent results and proved that training was effective in improving measurement accuracy. The error rate of BVI measurement in female mode in all patients was high,  $-42.8 \pm 52.3$  (last year:  $-45.5 \pm 50.6$ ) %. R was also poor, 0.820 (last year: 0.854). Through the bladder examination using 3.5 MHz B-mode transabdominal ultrasonography, the following factors in the high the error rate (20% or over) were found.

#### 1) Patient-side factors

- a) extracted edges of the bladder wall ( $p < 0.0001$  both last year and this year)
- b) thickened bladder wall (last year:  $p < 0.0001$ , this year:  $p = 0.0028$ )
- c) irregular bladder wall ( $p < 0.0001$  both last year and this year)
- d) flattened bladder wall (last year: 0.0379, this year:  $p = 0.0029$ )
- e) mistaking the prostate for the bladder in male mode (last year:  $p < 0.0001$ , this year:  $p = 0.0005$ )
- f) mistaking the uterus for the bladder in female mode (last year:  $p = 0.0057$ , this year: no significant differences)

#### 2) Examiner-side factors

- a) angle between BVI and the abdominal wall
- b) compatibility between the BVI probe and the abdominal wall
- c) controlling deflection while using the BVI probe

It was found that if we choose appropriate patients and provide examiners with proper training, the influence of the above factors can be reduced and measurement accuracy can be improved. Through the bladder observation using transabdominal ultrasonography and the comparison study between BVI measurements and actual values in daily practice, measurement accuracy has obviously improved. BVI measurement in male mode in female patients was also more accurate than in female mode. The bladder was often mistaken as the uterus in female mode when the bladder volume was 50 ml or less.

### Interpretation of results

The result of this study clearly showed the effectiveness of BVI measurement. However, to obtain such a result, it is essential to exclude those patients with a poor correlation of measurements, and acquire the BVI operation skills to minimize the examiner-side error rate. Measurement reliability can be improved to a sufficient level through training. Even when the bladder volume is relatively small, if BVI is used in an appropriate way, BVI enables more accurate measurement than traditional methods that use horizontal and vertical planes of the bladder.

### Concluding message

As a non-invasive measurement of the bladder volume in daily practice, BVI 6100 is an extremely useful and effective portable ultrasonographic device, and its accuracy can be improved through training.

**FUNDING:** NONE

**DISCLOSURES:** NONE

**CLINICAL TRIAL REGISTRATION:** This clinical trial has not yet been registered in a public clinical trials registry.

**HUMAN SUBJECTS:** This study did not need ethical approval because this study was clinical routine exam. but followed the Declaration of Helsinki Informed consent was obtained from the patients.