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DEVELOPMENT OF ANDROID PLATFORM BPH PROBABILITY CALCULATOR® USING BIG DATA FOR PREDICTION OF SURGERY NECESSITY IN PATIENTS WITH LUTS/BPH AND ITS VALIDATION

Hypothesis / aims of study

There is growing number of patients with LUTS/BPH as aged population increases. Surgical treatment is commonly necessary when patients have urinary retention, renal insufficiency, recurrent UTIs, bladder stones, or gross hematuria due to enlarged prostate. Surgery is additionally needed when patients do not have adequate relief from LUTS with medical treatments. If there is sufficient evidence of bladder outlet obstruction (BOO) in patients with bothersome LUTS, surgery should be considered. We have prospectively accumulated big data electronically as the Urodynamic Study (UDS) Database Registry since 2004 in our institution. We strictly followed ICS standard in performing UDS. Based on the UDS Database and clinical parameters, we tried to establish BOO-based decision support formulas for surgery necessity. Ultimately we implemented them in smart phone system to create app for clinical use to support treatment decision of the urologists after validation of the formulas.

Study design, materials and methods

Of patients in prospectively registered UDS Database Registry between Sep 2004 and May 2014, patients with an age of 45 or over with non-neurogenic LUTS/BPH were retrieved. All datasets of the three cohorts (development, Internal, and external) were constructed in the same manner. Any patients who do not have at least one of the following clinical information were excluded: IPSS, free flow less than voided volume of 120ml, PVR, transrectal ultrasound measured total prostate volume (TPV), and pressure-flow study. Finally, 1179 male patients with LUTS/BPH were included as a development cohort for formula. Surgery necessity was based on the clinical judgement of urologists, not based on the actual performance of surgery. Using linear regression analysis, relevant clinical variables were drawn to build formulas to calculate probabilities of both having BOO and surgery necessity. A total of five formulas were developed to provide probabilities of having BOO and surgery necessity even in cases where TPV and/or BOOI were not available. When the calculated probability for surgery necessity was 50% or more, it was regarded that surgery was necessary. Internal validation of the formula was carried out using a prospectively collected consecutive database between Jun 2014 and Dec 2015. The prediction formula was also tested for external validation using dataset collected in two other independent centres. The area under the curve (AUC) of ROC and the calibration plot were used to validate the predictive accuracy. We implemented these formulas as an android platform application. Five young urologists were enrolled for usability test to evaluate if there is any human factor issue.

Results

Age, Qmax of free flow, PVR, TPV, IPSS voiding subscore, IPSS storage subscore, IPSS QoL, and BOOI were identified as independently significant variables to predict surgery necessity. These variables were used to build prediction formula for surgery necessity. Internal validation revealed an AUC of 0.873 (0.827-0.919), and good correspondence with calibration plot. There were differences in age, IPSS voiding subscore, Qmax, TPV, and BOOI between the development cohort and the external validation cohort (Table). External validation of the prediction formula revealed an AUC of 0.854 (0.815-0.893). However, the calibration plot tended to overestimate at smaller TPV. After we developed an application program in the android platform smart phone to provide probabilities for surgery necessity (BPH Probability Calculator®), usability test was performed. It demonstrated that the application was user-friendly and there was no major human error in using it (Figure).

Interpretation of the results

Most patients with LUTS/BPH we encounter in real clinical practice are those who do not fall on the absolute indication. Sometimes this is a challenge in making decision for surgical intervention in patients with borderline clinical parameters. Since this condition of LUTS/BPH is not a life-threatening condition, true value for surgery necessity is not known in a given individual patient case scenario. It is well known that there is no significant correlation among patient LUTS, BOO and prostate volume. Therefore, surgical decision based on the prostate volume or subjective LUTS might not always be right. In our institution, surgical decision in patients who did not meet absolute indication was made more based on the presence of urodynamic BOO rather than the patient request or TPV. We do not commonly recommend surgery to patients when they do not have significant BOO even though the patient have enlarged prostate. In this dataset, the patients with absolute indication were also included. This means that the clinical parameters of these patients were incorporated in this formula. In case patients did not agree to get surgery when the clinician recommended it, we still classified these patients as 'surgery necessity'. Our classification in this study was solely based on the decision made by urologist.

This app provides 2 interrelated probabilities: first one is the probability of having BOO predicted by clinical parameters with age, Qmax, PVR with/without TPV. The second one is the probability of surgery necessity where it is calculated from age, Qmax, PVR, with/without TPV or BOOI. When BOOI is not available, it can still be calculated by predicted BOO probability obtained from the first part. We hope this smart phone based app will help clinicians to make treatment decision. We believe further validation in other ethnic population is necessary as this formula is based on the Asian population.

Concluding message

Our study demonstrated that our big data-based prediction formula predicted surgery necessity very well. The application was user-friendly for clinical use.

Table. Patient demographics

	Development cohort (N=1179)	Internal validation cohort (N=253)	P	External validation cohort (N=416)	P
Age	66.1±7.2	69.1±6.8	<0.001	65.1±7.2	0.014
Total prostate vol.	48.5±27.5	60.7±31.0	<0.001	36.6±19.1	<0.001
IPSS Voiding	10.6±5.5	10.6±5.5	0.200	11.3±5.3	0.040
IPSS Storage	7.0±3.4	7.1±3.4	0.539	7.3±3.4	0.065
IPSS QoL	3.9±1.1	3.8±1.3	0.293	4.0±1.0	0.447
Qmax	12.0±5.1	11.7±4.7	0.296	14.6±5.9	<0.001
PVR	57.1±79.2	63.9±31.0	0.199	56.2±101.9	0.851
BOOI	33.4±23.6	38.9±25.1	0.001	22.5±24.0	<0.001

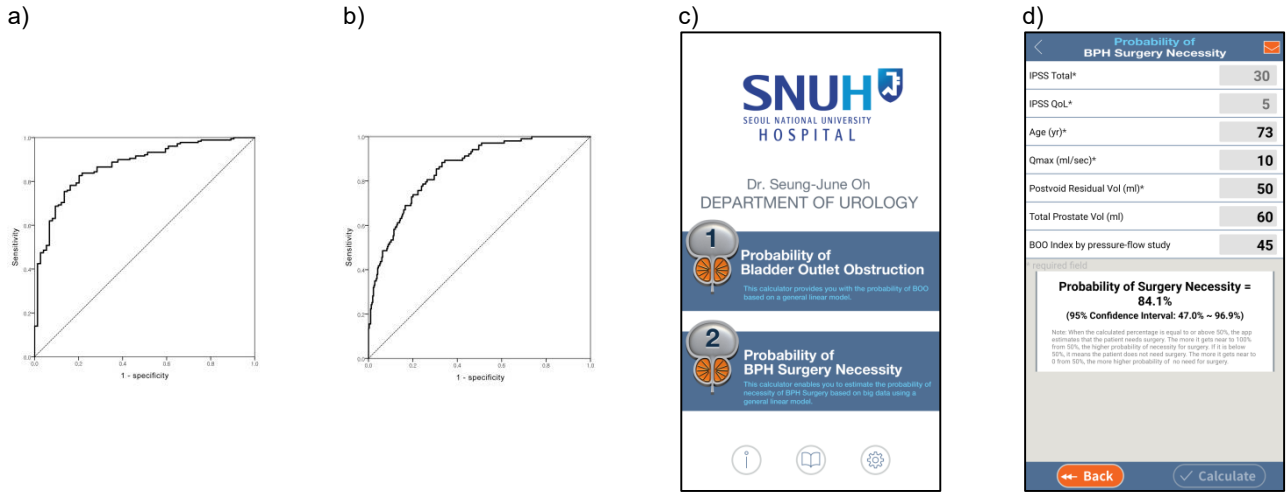

Figure. Internal and external validation of the prediction formula. a) ROC curve of internal and b) external validation. c) and d). User interface starting screen of the **BPH Probability Calculator®**

Disclosures

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