CROSS VALIDATION OF AN UPDATED PREDICTIVE ANALYTIC MODEL WHICH PREDICTS SUCCESS AND COMPLICATIONS OF SHOCKWAVE LITHOTRIPSY IN THE TREATMENT OF URINARY STONES

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INTRODUCTION & OBJECTIVES

Precision medicine in treating nephrolithiasis is based on delivering the optimal treatment for a specific patient and stone profile. We have previously described a model using only preoperative parameters to predict the outcomes of shockwave lithotripsy (SWL). We now expand on that by modeling both preoperative and intraoperative parameters on current data. We cross validated a new predictive model comprising multiple variables that predicts the likelihood of treatment success and complications for a given patient and stone profile.

MATERIALS & METHODS

We performed a random 67/33 split of 3,894 SWL treatment records for renal and ureteral stones from 2016-2017 to train and validate a generalized linear mixed model (GLMM) using statistical software (melogit in Stata 13.0). This model uses 30 parameters including stone size, stone location, anesthesia type, SWL machine type, anticoagulant use, age, sex, BMI average power level, maximum power level, total shocks, total shocks delivered at maximum power, average shock rate, x-ray time, and titration shocks delivered to predict treatment success, defined as stone free or fragments ≤ 4mm, and to predict treatment complications. Actual treatment success and complications were obtained from self-reported physician follow-up surveys tied to the original SWL treatment record. Both treatment and follow-up data are housed in the Stone Disease Registry.

RESULTS

The training model was significantly related to treatment success, Likelihood Ratio (LR) $\chi^2 = 205.83$, $p < .0001$, Area under the curve (AUC) = .83. This model was in turn a good predictor of success in the validation dataset, AUC = .83. The training model was also significantly related to complications, LR $\chi^2 = 10.84$, $p = .004$, AUC = .89. This model was a good predictor of complication rate in the validation dataset, AUC = .81.

CONCLUSION

This updated predictive analytic model builds on our previous work and provides accurate prediction of treatment success and complications for SWL. Given the robust model fit to the validation data, this model can prospectively predict success for the treatment of urinary stones based on detailed patient and stone characteristics, and intraoperative treatment parameters. This algorithm can be used in interactive software to help urologists prospectively make evidence-based decisions on which treatment modality will be most effective overall and which elements in the delivery of this modality are most effective in maximizing success and minimizing complications.

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