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Original Article

A nomogram predicting re-operation due to secondary hemorrhage after monopolar transurethral resection of prostate

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Abstract We aim to develop a nomogram to predict re-operation due to secondary hemorrhage after Monopolar transurethral resection of the prostate (M-TURP). We identified patients undergoing M-TURP at Peking University First Hospital from 2000 to 2013. Univariate and multivariate logistic regression models were developed to predict the occurrence re-operation due to secondary hemorrhage. The discriminatory ability of the nomogram was tested using the area under the receiver operating characteristic curve (ROC), and internal validation was performed via bootstrap resampling. Of the 1901 patients who underwent M-TURP during the study period, 9.1% (173 patients) experienced hemorrhage after M-TURP, and they had a 22.0% re-operation rate (38 patients). Benign prostatic hyperplasia (BPH)-related complications (odds ratio, 0.386; 95% CI, 0.177—0.841), percent of resected prostate (OR, 0.156; 95% CI, 0.023—1.060) and suprapubic cystostomy (OR, 0.298; 95% CI, 0.101—0.881) were independently associated with re-operation. The nomogram accurately predicted re-operation (area under the ROC curve 0.718). The negative predictive value was 88.0%, while the positive predictive value was 47.9%. Re-operation due to secondary hemorrhage after M-TURP was associated with no BPH-related complications, lower percent of resected prostate and no suprapubic cystostomy and was accurately predicted with using the nomogram.

Conflicts of interest: All authors declare no conflicts of interests.

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Introduction

Benign prostatic hyperplasia (BPH) often causes chronic and progressive lower urinary tract symptoms (LUTS) or complications, which drives numerous men to seek treatment [1–3]. Monopolar transurethral resection of the prostate (M-TURP) has long been considered as the "gold standard" for BPH surgical intervention [4], in spite of many challenges including medical therapy as a primary treatment and better tolerated, minimally invasive surgical procedures [5]. The possibility that a patient requires TURP increases by 6, 14, and 18 times with each decade after age 59 [6]. TURP remains clinically cost-effective and continues to have a critical role in the treatment of patients with LUTS secondary to BPH or BPH related complications, particularly after medical therapy intolerance or failure [7].

Because BPH is associated with increased age and age predisposes individuals to an increased risk of medical conditions, BPH treatment usually occurs in patients with one or more comorbidities. It has been reported that TURP can be associated with significant morbidity and even mortality, as comorbidities and increased age predispose patients to adverse surgical outcomes, including those for TURP [8–10], and complications and surgical revision rates increase with growing prostate size [11]. Traditionally, it has been reported that transfusion rates during TURP can be as high as 20%, and higher weights of resected prostates have previously been associated with greater blood loss [12,13]. Improved technology, better preoperative patient optimization, more experience, greater resection efficiency, and preoperative use of 5α-reductase inhibitors (5-ARIs) have caused the transfusion rate to fall [14]. In a previously published study, we found that bleeding decreased from 12.9% to 4.7%, while re-operation due to secondary hemorrhage, which was also known as postoperative hemorrhage, significantly increased from 0.4% to 2.7% over the past two decades [15].

Knowledge regarding the diagnosis of postoperative bleeding, bedside management techniques and ultimately, return to the operating room, are paramount for any urologist. However, little is known about the effect of clinical features on re-operation due to secondary hemorrhage after M-TURP. Thus, in the present study, we sought to reveal how demographic, preoperative status, surgical details, and surgeon experience affect the incidence of re-operation due to secondary hemorrhage and to develop a nomogram to predict re-operation due to secondary hemorrhage after M-TURP.

Methods

In this study, we retrospectively reviewed the database for data on patients who underwent M-TURP between 2000 and 2013 and identified all patients treated with M-TURP who experienced bleeding requiring blood transfusion or (and) re-intervention after surgery during the study period. Permission was granted from the Institutional Review Board of Peking University First Hospital for the review of medical records and retrospective clinical materials. The data were gathered in accordance with the Declaration of Helsinki. No informed consent was needed, as the data were studied in anonymous isolation.

At our institution, we prefer to use a Reuter's suprapubic trocar and cannula for establishing continuous flow when trying to resect larger prostates (>80 g), according to the technique described by Dr. Paul O. Madsen of Madison, Wisconsin. And the choice to perform M-TURP with or without cystostomy was determined by the surgeon based on patients demographics, preoperative prostate size, estimated surgical time, and their practical experience on M-TURP. Electroresection and coagulation for M-TURP were performed by a monopolar, high-frequency current with a maximum cutting power of 200 W and a coagulating power of 80 W. A microprocessor-controlled electrical unit with an active electrode that transduces permanent signals to the processor allows for real-time power adjustment. 24 Urologists who had more than 1 year of surgical experience with 30 or more cases of M-TURP were responsible for all the operations. This operative study did not include patients with open prostatectomy. None of the patients received previous therapy for prostate cancer, such as radical prostatectomy, radiation therapy or hormonal therapy of any type. Additionally, patients were only eligible if their primary reason for TURP was BPH. If prostate cancer was diagnosed preoperatively, or if their postoperative pathology was not compatible with a BPH diagnosis, the patient was also excluded.

The recorded data included the age, body mass index (BMI), data on *International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM)*, American Society of Anesthesiologists (ASA) Physical Status Classification System (ASA grade), preoperative anticoagulant or antiplatelet therapy, previous medication for BPH, International Prostate Symptom Score (IPSS), BPH-related complications (e.g., recurrent urinary retention, recurrent hematuria, recurrent UTI, bladder stones, and dilation of upper urinary tract with/without renal insufficiency), prostate size estimated by preoperative ultrasonography, weight of resected prostate, and surgical time. The ICD-10 diagnostic codes were converted into Charlson comorbidity index (CCI) scores, which features 19 conditions (Table 1) under which scores equal to 1, 2, 3 or 6 were determined according to the severity of the condition. Prostate size, weight of resected prostate and surgical time were used to calculate the percent of resected tissue (resected prostate/prostate size) and resection efficiency (resected prostate/surgical time).

A univariate logistic regression analysis was performed with each covariate to identify factors predictive of re-operation due to secondary hemorrhage. We then developed a multivariate logistic regression model, excluding insignificant factors at a <5% significance level from the univariate model. To maximize the predictive ability of the model, all variables in the multivariable model were used to develop a prognostic nomogram using the linear predictor method. The accuracy of the nomogram was quantified using the area under the receiver operating characteristic (ROC) curve (AUC). Calibration was performed for the constructed nomogram, and a bias-corrected c-index, which is similar to AUC, was estimated using a 100-sample bootstrap method to calculate the discrimination of the model as a method of internal validation. A high risk of re-