Original Article

A radiomics nomogram for preoperative prediction of nephron-sparing surgery in patients with bilateral Wilms tumor

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Background: Bilateral Wilms tumor (BWT) is a relatively rare malignant renal tumor in children. Nephron-sparing surgery (NSS) is the preferred surgical approach for treating BWT, but lacks uniform surgical indications worldwide. This study aimed to summarize the clinical and imaging features of BWT children, establish a radiomics nomogram, and predict the feasibility of NSS for improving outcomes.

Methods: A 12-year retrospective single-center review was conducted on clinical data and preoperative imaging features of BWT patients. The tumor kidneys were divided into NSS and non-NSS groups. Logistic regression analysis was performed to identify independent predictors and develop a prediction model of the feasibility of NSS in BWT patients. A radiomics nomogram was constructed and internally validated by the parametric bootstrapping method.

Results: A total of 58 BWT patients (115 renal units) were included in this study. After evaluations based on preoperative imaging and clinical data, 94 renal units underwent NSS with negative resection margins and were included in the NSS group, whereas 16 renal units with positive resection margins, macroscopic residual, or total nephrectomies were included in the non-NSS group. Tumor size [odds ratio (OR): 0.540, 95% confidence interval (CI): 0.308–0.945], relationship with the collecting system (OR: 0.013, 95% CI: 0.0004–0.370), and remaining renal parenchyma (RRP) proportion (OR: 71.23, 95% CI: 1.632–3108.8) were identified as independent predictors for NSS. A nomogram was constructed based on these factors, which demonstrated great consistency between the predicted and observed feasibility of NSS. The model presented with good discriminative ability [area under the curve (AUC), 0.982]. The decision curve analysis (DCA) revealed the clinical usefulness of the model.

Conclusions: This study analyzed the clinical and preoperative imaging data of BWT patients and identified three independent predictors for the feasibility of NSS, including tumor size, relationship with the collecting system, and residual renal parenchyma proportion. The radiomics nomogram established in this study can provide individualized predictions to assist clinicians in making better decisions and improving patient outcomes.

Keywords: Bilateral Wilms tumor (BWT); nephron-sparing surgery (NSS); radiomics; nomogram

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Introduction

Wilms tumor (WT) is the most common malignant renal tumor in childhood, with an incidence of approximately 1/10,000 in children under 15 years old. Bilateral Wilms tumor (BWT) accounts for approximately 5–7% of all WT, with synchronous BWT being the most prevalent form. Synchronous BWT also tends to occur at a younger age than unilateral WT (1,2). In recent decades, advances in treatment concepts and techniques have led to significant improvements in the overall survival (OS) and event-free survival (EFS) rates of children with WT (3). As the preferred surgical approach for treating BWT, nephron-sparing surgery (NSS) aims to resect tumor tissue while preserving as much normal renal parenchyma as possible to maximize residual renal function and reduce the risk of end-stage renal disease (ESRD) and other complications. However, due to the relative rarity of BWT and the high experience and technical requirements of performing NSS, there is currently no unified indication for NSS. The current Children's Oncology Group (COG) protocol, AREN0534, set the target for bilateral NSS success rate at 50%, while the actual success rate was only 39%. Previous studies have shown that in experienced centers, the success rate of bilateral NSS could be as high as 92% (4,5). The success rate of NSS varies significantly among different centers, demonstrating the importance of the operator's experience and the lack of unified surgical indications for NSS in BWT patients. Although preoperative scoring and prediction models for adult renal tumors are available to assist in the individualized assessment of the anatomical relationship between the tumor and the kidney to help determine whether NSS surgery can be performed, there is no similar scoring system for children with BWT (6).

The purpose of this study is to analyze and summarize the clinical and preoperative imaging data of BWT children admitted to our hospital, and to identify predictors for successful NSS surgery. A prediction model and a radiomics nomogram will be developed based on these predictors to provide a visualized tool for individualized prediction of the feasibility of NSS in BWT patients. This tool will help clinicians make better decisions and improve patient outcomes. We present this article in accordance with the TRIPOD reporting checklist (available at https://qims.amegroups.com/article/view/10.21037/qims-22-1129/rc).

Methods

Study design

This retrospective study enrolled patients with a pathological diagnosis of BWT who were treated at our hospital from January 2008 to December 2019. The study collected and analyzed the patients' clinical data, including baseline characteristics and follow-up information, as well as their preoperative imaging data. Patients with incomplete general information or missing preoperative imaging data were excluded from the study. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by our institutional ethical review board (No. 2021-[E]-154-R) and individual consent for this retrospective analysis was waived.

The clinical data of the patients enrolled in the study included baseline characteristics such as age, gender, and clinical stage, as well as information on the chemotherapy regimen administered. Follow-up information such as postoperative OS and EFS rates were also collected. Preoperative imaging data, obtained through computed tomography (CT) or magnetic resonance imaging (MRI) after chemotherapy, were analyzed for various features. Continuous variable data such as tumor size (measured by maximal diameter), location relative to the polar line (defined as entirely above the upper or below the lower polar line, lesion crossing the polar line, or more than 50% of the mass being across the polar line), exophytic/endophytic properties (classified as ≥50%, <50%, or entirely endophytic), residual renal parenchyma proportion (<25%, 25–50%, 50–75%, or >75%), number of masses (solitary or multiple), and tumor embolus (present or absent) were categorized. The proportion of remaining renal parenchyma (RRP) was estimated by analyzing preoperative CT reconstruction images. For example, in *Figure 1*, the proportion of residual kidney on the left side of the child is estimated to be more than 75%, while the proportion of residual kidney on the right side is between 50% and 75%.

In accordance with the COG treatment protocol, neoadjuvant chemotherapy [vincristine and actinomycin

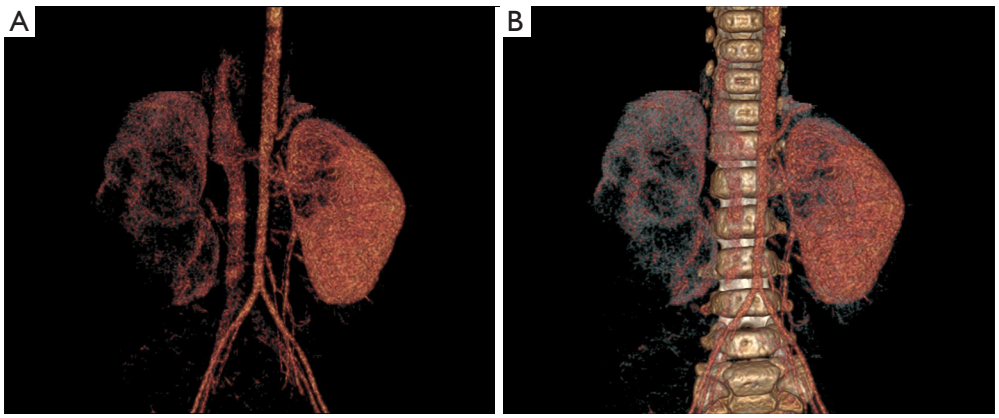

Figure 1 The proportion of RRP was derived based on preoperative CT reconstruction images. (A) The proportion of residual renal parenchyma of this patient is estimated to be more than 75%. (B) The proportion of residual renal parenchyma is 50% to 75%. RRP, remaining renal parenchyma; CT, computed tomography.

D (VA) or VA plus doxorubicin (VAD) regimen] was administered for 6 to 12 weeks to reduce tumor size before surgery (4). A surgical plan was developed by a team consisting of pediatric urologists and radiologists, and the surgery was performed by three experienced pediatric urologists based on comprehensive evaluations of preoperative imaging and clinical data. Our institution's general principle for treating BWT is to perform NSS whenever possible. The adjuvant chemotherapy regimen was determined postoperatively based on the highest histological type and local tumor stage. The study subjects were tumor kidneys, which were divided into two groups based on whether NSS was successfully performed. NSS group included tumor kidneys that underwent NSS with no macroscopic residual and negative resection margins on postoperative pathological examination, whereas non-NSS group included kidneys that did not undergo NSS after preoperative evaluation and those underwent NSS with macroscopic residual or positive resection margins.

Construction, validation, and evaluation of the prediction model

In this study, the endpoint event was whether NSS was successfully performed in the tumor kidneys of the enrolled patients, which were considered as the study subjects. Univariate logistic regression analysis was used to identify preoperative imaging features of the kidneys associated with the feasibility of NSS. Factors with a significance level of $P<0.2$ in univariate analysis were incorporated into a multivariate logistic regression model to build a clinical prediction model. The prediction model was output as a nomogram, which calculated the total score of each patient by analyzing scores corresponding to each predictor variable, and predicted the probability of NSS feasibility.

The model was internally validated using the Bootstrap method with B=2,000. The performance of the model was evaluated from calibration, discrimination, and clinical benefit. The calibration curve was plotted to assess the agreement between predicted and observed probabilities. The receiver operating characteristic (ROC) curve was used to evaluate the model's discriminative ability, and the area under the curve (AUC) was calculated. Decision curve analysis (DCA) was conducted to evaluate the clinical usefulness of the model by comparing the net benefit of using the model to different threshold probabilities.

Data statistics

To estimate the required sample size, we used PASS software version 15.0.5. Statistical analyses were conducted using R software version 4.0.3. Normality of measurement data was assessed using the Shapiro-Wilk test, and homogeneity of variance was tested using the Levene method. Normally distributed data with homogeneous variance were analyzed using the *t*-test and presented as mean ± standard deviation (SD), while non-normally distributed data or those with unequal variance were analyzed using the Mann-Whitney U test and reported as median [interquartile range (IQR)]. Categorical data were analyzed using the chi-square or Fisher's exact test and presented as number (percentage). All P values were two-tailed, and $P<0.05$ was considered

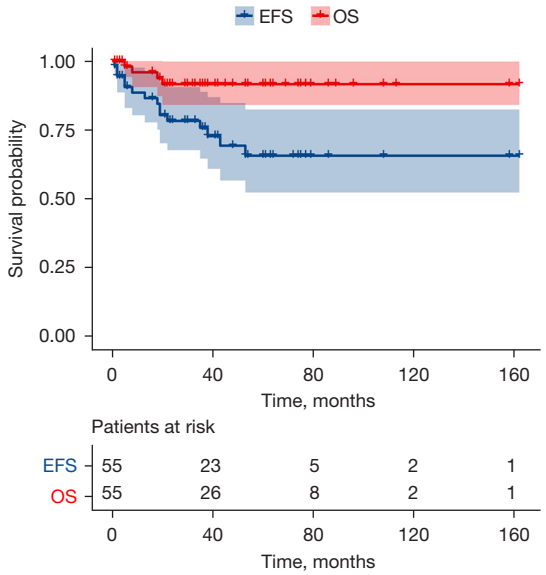

Figure 2 Kaplan-Meier curve of EFS and OS for all patients. The 4-year EFS and OS rate were 65.6% and 91.6%, respectively. EFS, event-free survival; OS, overall survival.

statistically significant.

Results

Clinical outcomes

In our study, a total of 71 BWT patients were initially included, but 6 of them had missing imaging data, and 7 patients were lost to follow-up or had missing general data, leaving 58 patients for the final analysis. Among them, there were 33 males (56.9%) and 25 females (43.1%), with a median age of 13.0 (10.0, 22.0) months at the time of primary surgery. After comprehensive evaluations based on preoperative imaging and clinical data, bilateral NSS were performed in 43 patients (74.1%), and all resection margins were negative according to pathological diagnosis. One patient underwent total nephrectomies on one side in another hospital and received NSS on the other side in our institution, but macroscopic residual was observed. Additionally, 2 patients underwent bilateral NSS (4 renal units), but macroscopic residual was observed. The median follow-up duration was 39.5 (22.8, 66.0) months, ranging from 16 to 162 months. Among the patients, 15 were diagnosed with relapse, and five of them died. The 4-year EFS and OS rates were 65.6% and 91.6%, respectively, as shown in *Figure 2*.

Imaging features of renal units

Of the 58 BWT patients enrolled in the present study, 1 patient underwent total nephrectomy on one side in another hospital and was excluded, leaving 115 renal units for analysis. After preoperative imaging and clinical evaluations, 94 renal units (81.7%) underwent NSS with negative resection margins on pathological diagnosis, and were included in the NSS group. The non-NSS group consisted of 16 renal units (13.9%) that underwent total nephrectomy and 5 renal units (4.35%) that underwent NSS but had residual tumor mass intraoperatively. The imaging characteristics of the renal units are summarized in *Table 1*.

Development and validation of the prediction model for NSS

The imaging features of renal units in *Table 1* were utilized to develop a univariate logistic regression model, and variables with P<0.20 were selected, including tumor size, exophytic rate, relation with collecting system, RRP proportion, and tumor embolus (*Table 2*). These five variables were then included in the multivariate logistic regression model. Results showed that tumor size [odds ratio (OR): 0.540, 95% confidence interval (CI): 0.308–0.945], relation with collecting system (OR: 0.013, 95% CI: 0.0004–0.370), and RRP proportion (OR: 71.23, 95% CI: 1.632–3,108.8) were independent predictors (P<0.05) for NSS. These three factors were used to create a prediction model and a nomogram (*Figure 3A*).

Internal validation of the nomogram was performed using 2,000 bootstrap sample corrections. The calibration curve of the nomogram demonstrated strong agreement between the predicted and observed NSS probability (*Figure 3B*). The ROC curve showed an AUC of 0.982 (95% CI: 0.963–0.999) for the prediction of NSS, indicating excellent discrimination by the nomogram (*Figure 3C*). Additionally, the DCA curve of the nomogram demonstrated its strong clinical utility (*Figure 3D*).

Nomogram performance in individual patients

To demonstrate the practical application of the nomogram, we selected a 22-month-old male patient with BWT (involving 2 renal units) associated with Wilms tumor-aniridia-genitourinary malformation-mental retardation (WAGR) syndrome who was admitted to our hospital due to an abdominal mass. Preoperative biopsy was not

Table 1 Imaging characteristics of renal units

Variables	Non-NSS group (n=21)	NSS group (n=94)	P value
Side, n (%)			0.357
Left	13 (61.9)	45 (47.9)	
Right	8 (38.1)	49 (52.1)	
Tumor size (cm), median (P_{25}, P_{75})	9.70 (7.80, 13.50)	5.70 (2.90, 8.35)	<0.001
Longitudinal location, n (%)			<0.001
Entirely upper/below polar line	0 (0.0)	23 (24.5)	
Cross polar line	1 (4.8)	29 (30.9)	
>50% tumor across polar line	20 (95.2)	42 (44.7)	
Exophytic rate, n (%)			0.330
≥50%	3 (14.3)	12 (12.8)	
<50%	6 (28.6)	43 (45.7)	
Endophytic	12 (57.1)	39 (41.5)	
Relation with collecting system, n (%)			<0.001
Not involved	0 (0.0)	28 (29.8)	
Unknown	2 (9.5)	54 (57.4)	
Involved	19 (90.5)	12 (12.8)	
RRP proportion, n (%)			<0.001
>75%	1 (4.8)	33 (35.1)	
50–74%	2 (9.5)	33 (35.1)	
25–49%	3 (14.3)	18 (19.2)	
<25%	15 (71.4)	10 (10.6)	
Tumor number, n (%)			1.000
Solitary	14 (66.7)	61 (64.9)	
Multiple	7 (33.3)	33 (35.1)	
Tumor embolus, n (%)			0.019
No	18 (85.7)	93 (98.9)	
Yes	3 (14.3)	1 (1.1)	

NSS, nephron-sparing surgery; RRP, remaining renal parenchyma.

performed, and the patient received 8 weeks of neoadjuvant chemotherapy (using VAD regimen) before surgery. The imaging features were extracted from the previous preoperative CT (as shown in *Figure 4*).

The left-side renal unit had a tumor size of 11.6 cm (corresponding to about 42 points on the nomogram) and involved the collecting system (0 points). The RRP proportion was less than 25% according to the CT reconstruction images (0 points). The total points of the renal units were 42, and the predicted probability of NSS was less than 10%. During the operation, the mass was found to be closely adhered to the collecting system, and the patient underwent total nephrectomy. For the right-side renal unit, the tumor size was 5.4 cm (corresponding to about 70 points on the nomogram). However, it was not possible to precisely assess the relationship between

Table 2 Univariate and multivariate logistic regression analysis on variables for the prediction of NSS

Variables	Univariate analysis		Multivariate analysis	
	OR (95% CI)	P value	OR (95% CI)	P value
Tumor size (cm)	0.684 (0.572–0.819)	<0.001	0.540 (0.308–0.945)	0.031*
Exophytic rate (≥50%/<50%/endophytic)	0.509 (0.209–1.244)	0.139	2.134 (0.175–26.09)	0.553
Relation with collecting system (not involved /unknown/ involved)	0.031 (0.006–0.148)	<0.001	0.013 (0.0004–0.370)	0.011*
RRP proportion (<25%/25–50%/50–75%/>75%)	16.463 (3.842–70.535)	<0.001	71.23 (1.632–3108.8)	0.027*
Tumor embolus (yes/no)	0.049 (0.005–0.504)	0.011	0.037 (0.0005–2.918)	0.139

*, factors included in the nomogram. NSS, nephron-sparing surgery; OR, odds ratio; CI, confidence interval; RRP, remaining renal parenchyma.

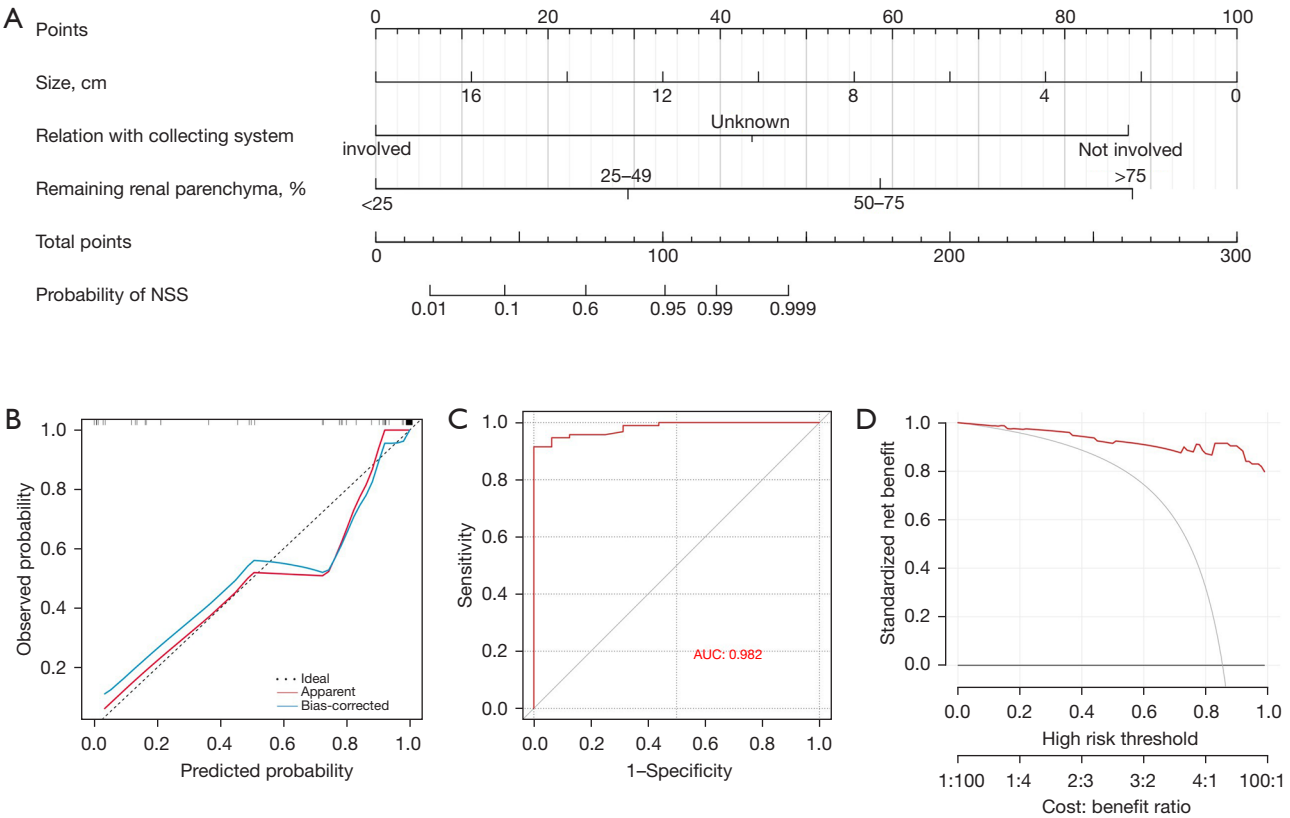

Figure 3 Development and validation of the nomogram predicting NSS. (A) Nomogram predicting the feasibility of NSS in BWT. The nomogram was constructed with three factors (tumor size, the relationship between the tumor and the collecting system, and the proportion of residual renal parenchyma) identified by univariate and multivariate analyses. (B) Calibration curve of the prognostic nomogram model. The Y-axis scale represents the actual value probability of performing NSS and the X-axis scale represents the predicted value calculated by the model. The dotted grey line represents an ideal model while the red line represents the nomogram's prediction performance. (C) ROC curve of the prognostic nomogram model, the AUC value reflected the discrimination performance of the model. (D) The DCA curve of the model calculating the net benefit at different threshold probabilities. AUC, area under the curve; NSS, nephron-sparing surgery; BWT, bilateral Wilms tumor; ROC, receiver operating characteristic; DCA, decision curve analysis.

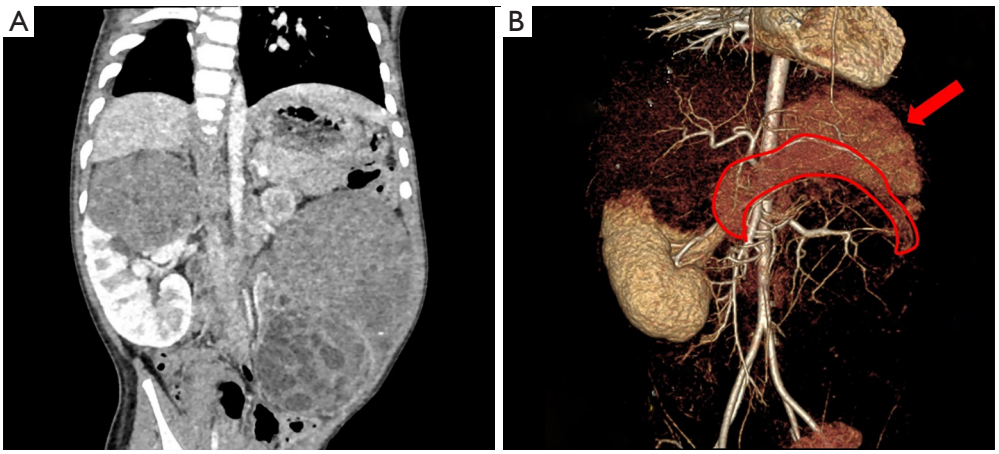

Figure 4 The previous preoperative CT and reconstruction images of a BWT patient. (A) Preoperative CT scan. (B) The CT reconstruction image shows the spleen (red arrow) and the residual renal parenchyma (red circle). CT, computed tomography; BWT, bilateral Wilms tumor.

the tumor and the collecting system (unknown, 44 points). The RRP proportion was between 50–75% according to the CT reconstruction images (58 points). The total points of the renal units were 172, and the predicted probability of NSS was more than 99%. During the operation, NSS was performed and the resection margins were negative according to postoperative pathological diagnosis.

Discussion

Compared with unilateral WT, children with BWT tend to have a younger age at diagnosis and are often accompanied by genetic syndromes such as Denys-Drash syndrome (DDS) or WAGR, resulting in a poor overall prognosis (7). The National Wilms Tumor Study (NWTS-5) reported a 4-year EFS rate of 56% (95% CI: 44.8–66.6%) in children with BWT, with 4-year EFS rates of 65%, 76%, and 25% in children with good histology, focal interstitial degeneration, and diffuse interstitial, respectively (8,9). The AREN0534 study included 189 children with BWT, and their 4-year EFS and OS rates were 82.1% (95% CI: 73.5–90.8%) and 94.9% (95% CI: 90.1–99.7%), respectively (4). In our study, the OS and EFS rates of the 58 patients 4 years after surgery were 91.6% and 65.6%, respectively, which is similar to what has been reported in the literature. Furthermore, patients with BWT have a higher risk of multiple foci and recurrence, and a significantly higher risk of progression to ESRD compared to those with unilateral WT (4,10,11). The AREN0534 study showed that the 20-year cumulative incidence of ESRD was less than 1% in patients with unilateral WT and 0.6% in children without genetic syndromes, whereas the incidence of ESRD was 12% in children with BWT and even higher in those with genetic syndromes (75% in those with DDS and 50% in those with WAGR) (4). The treatment protocol for BWT patients differs between the COG and the International Society of Paediatric Oncology (SIOP). The SIOP recommends that BWT patients receive preoperative chemotherapy with VA until NSS is deemed feasible, with response evaluations performed every 4 weeks. The UMBRELLA protocol limits preoperative chemotherapy to a maximum of 12 weeks, with fixed time intervals for evaluation at 6 weeks (12). The prognosis of BWT patients treated with either protocol is comparable. Radical nephrectomy is a significant cause of progression to ESRD within 5 years after surgery in BWT patients (13). Therefore, it is crucial to perform NSS in patients with BWT to preserve the maximum amount of renal parenchyma and improve their prognosis (14,15).

NSS was initially used for treating adult renal tumors, and its application in pediatric WT has been gradually accepted in recent years. The feasibility and indications of NSS in unilateral WT have been studied extensively. However, in unilateral WT, NSS poses an increased risk of tumor rupture, leading to intensive postoperative chemotherapy, and the possibility of incomplete resection, resulting in postoperative recurrence. Given the favorable oncologic prognosis, the decision to perform NSS in unilateral WT must be evaluated against the pros and cons. As a result, the indications for conducting NSS in unilateral WT are more stringent (16). In children with BWT, the

primary objective is to maximize the preservation of renal parenchyma, save renal function, and minimize the risk of ESRD and renal transplantation. However, due to the relative rarity of BWT and the high technical demands of NSS, there is a lack of clearly defined and universally accepted surgical indications. As a consequence, there is a wide variation in the success rate of NSS across different centers (12,17). A 15-year cohort study conducted in Japan found that only 36% of patients completed bilateral NSS successfully after preoperative chemotherapy, and 40% of patients developed renal insufficiency during follow-up (16). An Italian cohort study of BWT with a 21-year follow-up showed that 53.3% of children with BWT underwent successful bilateral NSS, with a 5-year OS rate of 80% and an EFS rate of 66.5% (18). However, the AREN0534 study showed a bilateral NSS success rate of only 39% (4). In this study, we included 58 children with BWT, of which 43 (74.1%) were successfully treated with bilateral NSS, and postoperative pathological findings indicated negative resection margins, which is higher than the majority of previous literature.

A systematic review has highlighted the importance of developing a quantifiable scoring system to evaluate the feasibility of NSS in children with BWT (19). Moreover, the use of three-dimensional (3D) models has been a significant advancement in performing NSS in complex WT. Lee *et al.* (20) developed a personalized 3D renal model to enhance understanding of the correct renal anatomy in patients with renal tumors. Wellens *et al.* (21) assessed the added value of personalized 3D kidney models derived from conventional imaging data in preoperative surgical planning and found that 3D kidney models improved anatomical understanding among surgeons and could aid in future preoperative planning of NSS for WT. In the field of adult renal tumor research, numerous scoring scales and predictive models are available to assist in assessing the ability to perform NSS. These models are mostly constructed by extracting and quantifying features between the tumor and the kidney from preoperative images (6,22,23). However, due to differences between BWT and adult renal tumors, there is currently no effective and quantitative preoperative scoring system for BWT in pediatric patients to aid in selecting surgical approaches. Using our center's large sample size of BWT patients and our rich clinical experience in China, we have constructed a prediction model based on the adult renal tumor scoring system. We extracted anatomical information about the tumor and kidney from preoperative imaging data of BWT patients, enabling us to assess the feasibility of NSS on an individual basis.

In our current study, we found that the NSS group had significantly smaller tumor size than the non-NSS group [5.70 (2.90, 8.35) *vs.* 9.70 (7.80, 13.5) cm, P<0.001], while the number of tumors did not differ significantly between the two groups (P>0.05). We also observed that the feasibility of NSS was higher when the tumor was located farther from the center of the kidney. Unlike studies related to adult renal tumors, our results showed that the exophytic nature of the tumor had little effect on the feasibility of NSS (P>0.05) (24). Consistent with previous studies, we found that whether the tumor invaded the collecting system and the proportion of the RRP had a greater impact on the feasibility of NSS (22,23). In our study, four kidneys were diagnosed with renal vein or inferior vena cava tumor embolus using preoperative imaging data. Of these, one case underwent successful NSS. Univariate and multivariate logistic regression analyses were performed to identify independent predictors of NSS feasibility. Tumor length, the relationship between the tumor and the collecting system, and the proportion of RRP were found to be independent predictors of NSS feasibility. A prediction model based on these three factors was constructed to evaluate the feasibility of NSS in children with BWT. The model was internally validated using Bootstrap (B=2,000) and demonstrated a strong discriminative ability with a relatively high AUC value (AUC, 0.992). The calibration curve indicated good agreement, and the DCA analysis curve demonstrated good clinical utility. We presented the prediction model in the form of a nomogram, which provides a powerful clinical decision-making tool for selecting treatment methods for BWT patients at the individual level and assists in preoperative evaluation of surgical approaches. This radiomics nomogram predicts the probability of achieving NSS, enabling surgeons to select cases in which total nephrectomy is unavoidable. While this nomogram does not necessarily improve the prognosis of children with BWT, we believe it will aid clinical decision-making.

here are two important considerations with regards to the radiomics nomogram. Firstly, in the treatment of BWT, preoperative chemotherapy is recommended by both COG and SIOP protocols to increase the feasibility of NSS (4,12). The radiomics nomogram developed in this study evaluates the feasibility of NSS after preoperative chemotherapy and is therefore applicable to patients treated with either COG or SIOP protocols. Secondly, the UMBRELLA protocol has proposed a formula [NSS-

surgical resection margins (SRM)-pathological resection margins (PRM)-RRP] to better define the different NSS parameters (12). According to the NSS formula, NSS technique includes partial nephrectomy (NSS A) or enucleation of tumors adjacent to the normal renal tissue (NSS B) (12). The radiomics nomogram developed in this study is recommended for evaluating the feasibility of NSS B (25,26). Partial nephrectomy (NSS A) is suitable for children with lesions located at the two poles of the kidney and relatively small tumor size, which can ensure negative resection margins to the greatest extent. However, if the lesion is located in the middle of the kidney or invades the collecting system, enucleation of the tumor (NSS B) should be conducted to minimize damage to the collecting system and the surrounding residual renal parenchyma, even though negative resection margins cannot be guaranteed. In this study, we performed tumor enucleation (NSS B) to maximize the preservation of effective nephrons and avoid postoperative renal insufficiency.

Among the patients included in this study, three had macroscopic residual tumors (SRM2-PRM2) after surgery, and the remaining 49 had negative margins confirmed by postoperative pathological examination (SRM0-PRM0). For tumors that invade the collecting system, although NSS is a contraindication to unilateral Wilms tumor, we believe that for BWT, clinicians should evaluate whether the kidney can be preserved based on the degree of adhesion of the tumor to the collecting system. For tumors that are closely adhered to the collecting system and cannot be easily separated, careful attention should be paid to repairing the damaged collecting system during surgery to prevent postoperative urinary fistula in case of NSS. In the case of a broken collecting system after tumor separation, the wound should be fully irrigated and exposed, 6-0 monofilament continuous sutures should be used, and the presence of exudate should be rechecked after suturing. The collecting system is relatively fragile and more sensitive to thermal damage, so methods such as bipolar coagulation are generally not preferred to stop bleeding. The renal cortex and parenchyma were sutured intermittently with absorbable sutures, and hemostatic materials were placed locally. A drainage tube was placed on the wound surface after surgery to monitor for postoperative complications such as urinary fistula.

To the best of our knowledge, this is the first study to develop a prediction model for preoperative assessment of the feasibility of NSS in children with BWT. However, this study has certain limitations. Firstly, it is a retrospective study, and thus there may be selection biases in the collection of information. Secondly, although a large number of cases have been included, the rarity of BWT may still result in instability of the prediction model due to an insufficient sample size. Thirdly, the estimation of the proportion of residual renal parenchyma was subjectively obtained by the surgeon by reviewing the imaging data before surgery, and therefore may have been subject to some bias. Additionally, this study only performed internal validation of the prediction model, and external validation based on other centers or prospective studies is necessary to confirm the model's predictive accuracy and enhance its generalizability. We hope that researchers worldwide will conduct external validation of this model with data from their centers to further improve its predictive performance. In future research, we will expand the sample size to increase the stability of the model, compare the prediction model with other scoring systems, and continually improve and enhance the quality of the model for eventual clinical application.

Conclusions

In this study, we retrospectively reviewed the clinical and imaging data of BWT children treated in our hospital. Using tumor kidneys as the study subjects, we developed a novel prediction model based on preoperative imaging features. The model consists of three factors: tumor size, the relationship between the tumor and the collecting system, and the proportion of residual renal parenchyma, and it demonstrated good predictive accuracy. The prediction model can provide individualized assessment of the feasibility of NSS for BWT patients preoperatively, which can improve clinical decision-making and aligns with the goal of precision medicine. We expect that the prognosis of BWT patients can be improved using our prediction model.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://qims.amegroups.com/article/view/10.21037/qims-22-1129/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by our institutional ethical review board (Ethical approval ID: 2021-[E]-154-R) and individual consent for this retrospective analysis was waived.

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