From cognitive MR-targeted fusion prostate biopsy to radical prostatectomy: Incidence and predictors of Gleason Grade Group upgrading in a Chinese cohort

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Abstract

Purpose: To access the incidence and predictors of Gleason grade group upgrading from cognitive MR-targeted fusion prostate biopsy to radical prostatectomy in a Chinese cohort.

Materials and Methods: We included 199 patients in our institution between January 2016 and June 2021. Multivariable logistic regression model and nomograms was utilized to analysis the collected data.

Results: The concordance rate of biopsy Gleason grade group and radical prostatectomy was. Upgrading occurred in 80 (40.2%) patients and 37 (68.5%) patients have an upgrading Gleason grade group when the biopsy Gleason grade group was 1. Multivariable logistic regression models were established to analyze the incidence and predictors of Gleason grade group upgrading from cognitive MR-targeted fusion prostate biopsy to radical prostatectomy. Biopsy Gleason grade group, PV and patient year were confirmed to be individual predictors of upgrading. Based on the logistic regression models, nomograms for predicting probability of prostate Gleason grade group upgrading were generated.

Conclusions: The incidence and predictors associated with Gleason grade group upgrading may help physicians improve the accuracy of prostate cancer diagnosis and provide a more precise treatment for patients.

1. Introduction

Prostate cancer (PCa) is a common malignant cancer in elderly men with the highest incidence rate and second death rate in the United States. [1]According to estimates, there are 248530 new prostate cancer cases and 34130 deaths in 2021. [1]On account of the high prevalence of PCa worldwide, it is important to diagnose PCa early and evaluate the conditions of prognosis. The diagnosis of PCa before surgery relies on prostate biopsy. After diagnosing, PCa patients may undergo watchful waiting, active surveilling, external beam radiotherapy, brachytherapy and radical prostatectomy.

The Gleason grade group (GG) of prostate biopsy plays a critical part in the decision making of treatment. Especially for patients who may not undergo surgery, the GG of prostate biopsy remains the most significant part for treatment decision and prognosis. Besides, the GG of prostate biopsy plays a key role in surgical operation such as intra-fascial prostatectomy and pelvic lymph node dissection. However, GG inconsistency accounting for upgrades still remains an important clinical issue. It is reported that only 40%-60% of prostate biopsy GGs were consistent with the final prostatectomy.[2–9] Due to the high discrepancy rate from biopsy to prostatectomy, it is urgent for physicians to predict prostate biopsy GG upgrades before surgery.

Recent years, MR-targeted prostate biopsy was reported to be superior to standard transrectal ultrasonography-guided biopsy for detecting clinically significant prostate cancer[10]. Meanwhile, MRI test was recommended for patients before prostate biopsy. We noticed that previous studies rarely focus on the GG inconsistency of patients who underwent MRI before biopsy. So, we aimed to evaluate the

incidence and predictors associated with Gleason grade group upgrading from cognitive MR-targeted fusion prostate biopsy to radical prostatectomy using logistic regression model in a Chinese cohort. This may help physicians improve the accuracy of PCa diagnosis and provide a more precise treatment for patients.

2. Materials And Methods

Patient data was acquired from a prospectively collected database of PCa patients in The Ningbo Medical Center Lihuili Hospital. The following information was collected and involved in the analysis: the age of patient when diagnosing PCa; the GG (or Gleason score) of prostate biopsy and radical prostatectomy; the last tPSA before biopsy (≤ 1month); number of positive cores and total cores; prostate volume; clinical stage; the existence of MRI-visible prostate lesions. All patients underwent a prostate MRI test before biopsy. The exclusion criteria of our study were as following: a) not enough clinical data; b) hormonal therapy or neoadjuvant chemotherapy before surgery; c) a history of TURP. Thus, we included a total of 199 patients between January 2016 and June 2021.

The cognitive MR-targeted fusion prostate biopsy was conducted with the guidance of transrectal ultrasonography. The prostate biopsy Gleason score (GS) was confirmed by the pathology experts in The Ningbo Pathology Center according to 2005 ISUP (International Society of Urologic Pathology) Gleason score system. We further edited the old Gleason score to new 2014 ISUP Gleason grade group (GG): GS ≤ 6(GG1), GS3 + 4 (GG2), GS4 + 3 (GG3), GS8 (GG4) and GS ≥ 9 (GG5).[11,12] Immunohistochemistry was done in the histopathological examination.

The upgrading was defined: the GG of radical prostatectomy was higher than prostate biopsy; conversely was the downgrading. The clinical stage was evaluated according to AJCC Eighth Edition of the Tumor-Node-Metastasis Staging Classification. [13]

Multivariable logistic regression model and nomograms was utilized to analysis the collected data. First, all variables were included in the initial model. Then, the variables that were not significant ($P > 0.05$) were removed individually to reach the final model. Hosmer-Lemeshow test was conducted to examine the goodness of fit and $p > 0.05$ was regraded to be acceptable. The ROC curve and AUC were generated for the final model. Finally, nomograms were developed from the logistic regression models. The traditional statistical analysis was performed by IBM SPSS Statistic 24 and the nomograms were achieved by R version 3.5.3 (R foundation for Statistical Computing, Vienna, Austria).

3. Results

The baseline data of included patients were given in Table 1. The concordance rate of biopsy GG and radical prostatectomy GG was 50.3% (100 in 199). Upgrading occurred in 80 patients (40.2%) and detailed data of GG was provided in Table 2. Particularly, 68.5% (37 in 54) patients have an upgrading GG when the biopsy GG was 1.

Table 1
Baseline characteristics of included patients

Age, mean ± SD (years)	**68.82 ± 6.45**
PSA, mean ± SD (ng/ml)	19.00 ± 23.72
Prostste volume, mean ± SD (ml)	38.55 ± 22.06
PSAD, mean ± SD	0.67 ± 1.28
Percent of posivive cores, mean ± SD	0.42 ± 0.29
Patients with MRI-visible prostate lesions, n (%)	182 (91.5)
Clinical Stage, n (%)	
T1c	12 (6.0)
T2a	23 (11.6)
T2b	64 (32.2)
T2c	77 (38.6)
≥T3	23 (11.6)

Table 2
Gleason grade groups on prostate biopsy and radical prostatectomy

Gleason grade group at biopsy	**Gleason grade group at radical prostatectomy**					**Total**
	3 + 3 (GR1)	**3 + 4 (GR2)**	**4 + 3 (GR3)**	**8 (GR4)**	**9–10 (GR5)**	
3 + 3 (GR1)	17	25	8	4	0	54
3 + 4 (GR2)	2	24	11	6	2	45
4 + 3 (GR3)	0	5	22	6	4	37
8 (GR4)	0	1	8	14	14	37
9–10 (GR5)	0	0	2	1	23	26
Total	19	55	51	31	43	199

Multivariable logistic regression models were established to analyze the incidence and predictors of GG upgrading from prostate biopsy to radical prostatectomy. Biopsy GG, PV and patient year were confirmed to be individual predictors of GG upgrading (details in Table 3). The result of Hosmer-Lemeshow test was p = 0.403. The ROC curve was drawn and the AUC was 0.775 with 95%CI 0.712–0.839 (Fig. 1). Based on the logistic regression models, nomograms for predicting probability of prostate GG upgrading were generated (Fig. 2).

Table 3
Multivariable logistic regression models to predict prostate Gleason grade group upgrading

Predictors	Upgrade		
	OR	95% CI	P
Biopsy GR			
GR1	1.000(reference)		
GR2	0.288	0.122–0.681	0.005
GR3	0.159	0.061–0.414	< 0.001
GR4	0.223	0.088–0.564	0.002
GR5	0	0	0.998
PV	0.985	0.970-1.000	0.043
Patient year	1.068	1.013–1.125	0.015
AUC: 0.775 (0.712–0.839)			

4. Discussion

Our study was aimed to evaluate the prostate grade group concordance of cognitive MR-targeted fusion biopsy with radical prostatectomy and predict the probability of upgrading in a Chinese cohort. For patients diagnosed with PCa via prostate biopsy, the GG of biopsy is critical for physicians to evaluate the condition of cancer and make decisions for the subsequent treatment, especially for patients who may not undergo surgery. Our study also helps clinicians to reduce the probability of underestimation of PCa and establish a more accurate surgery scheme such as intra-fascial prostatectomy and pelvic lymph node dissection.

We successfully constructed a multivariable logistic regression model for accurately predicting the probability of upgrading from prostate biopsy to radical prostatectomy and the final model was acceptable (AUC > 0.7, the Hosmer-Lemeshow test p > 0.05). This result indicated that our model has the potential for improving the accuracy of PCa diagnosis and provide a more precise treatment for patients. We also did nomograms to help clinicians evaluate the risk of upgrading in a specific patient (Fig. 2).

The result of prostate biopsy may not be accurate mainly because of sampling error, heterogeneity of tumor and pathology error. In our study, the GG inconsistency rate from biopsy to radical prostatectomy was 49.7%. In particular, 68.5% of GG1 patients upgrades to higher GGs. Previous studies indicated that 30–50% of GG1 patients may upgrades.[2,7,14–16] Though the inconsistency rate was high, the risk factors of upgrading remain controversial: age, PSA, PSAD, prostate volume, number of positive cores and a series of variables were predicted to be independent risk factors in different studies. Our study used the

logistic regression model to include and analyze all available variable to achieve a more accurate model predicting upgrading. Provided the 9 variables mentioned in our Method part, our model can calculate the probability of upgrading with high reliability and will be available for providing personalized prognostic information.

There are some deficiencies in our study: a) Our study was a retrospective, single-institution study which means that selection bias was unavoidable and this study type has some inherent disadvantages; b) Some variables, for example, total core percentage and the digital rectal examination result of patient, were not included in our model because these clinical data was missing. Meanwhile, some patients may take 5α deductase inhibitor and some patients may have urinary catheterization. We could not eliminate the influence of these conditions because of the lack of data.

5. Conclusion

We established a logistic regression model to predict the accuracy of prostate biopsy GG and provide the probability of upgrading. Future studies should expand the sample size and include more variables to improve the accuracy of predicting upgrading.

Declarations

Ethics approval and consent to participate

This study involving human participants was in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study has obtained ethics approval from The Ningbo Medical Center Lihuili Hospital (KY2021PJ207). All patients received normal standard of care treatment and informed consent was obtained from all subjects or their legal guardians. All methods were performed in accordance with the relevant guidelines and regulations. No identifiable patient information is included in this publication.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available due to a series of unfinished studies but are available from the corresponding author on reasonable request.

Competing interests

The authors have declared no conflicts of interest.

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Authors' Contribution

Yan Huaqing and Li Rubing designed this study. Wu Yiming and Cui Xiaobo collected the data. Zheng Sinian and Peng Zhang performed the statistical analyses. Yan Huaqing drafted the manuscript. Li Rubing provided critical comments, suggestions, and revised the manuscript.

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Not applicable.

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Figures

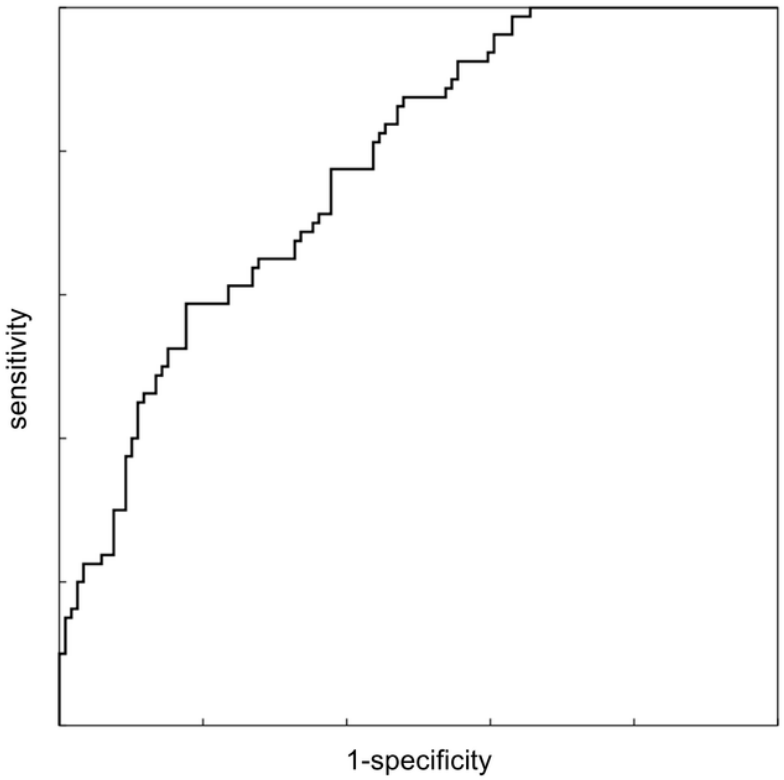

Figure 1

The ROC curve of the logistic regression model. The AUC of the model was 0.775 (95%CI 0.712-0.839).

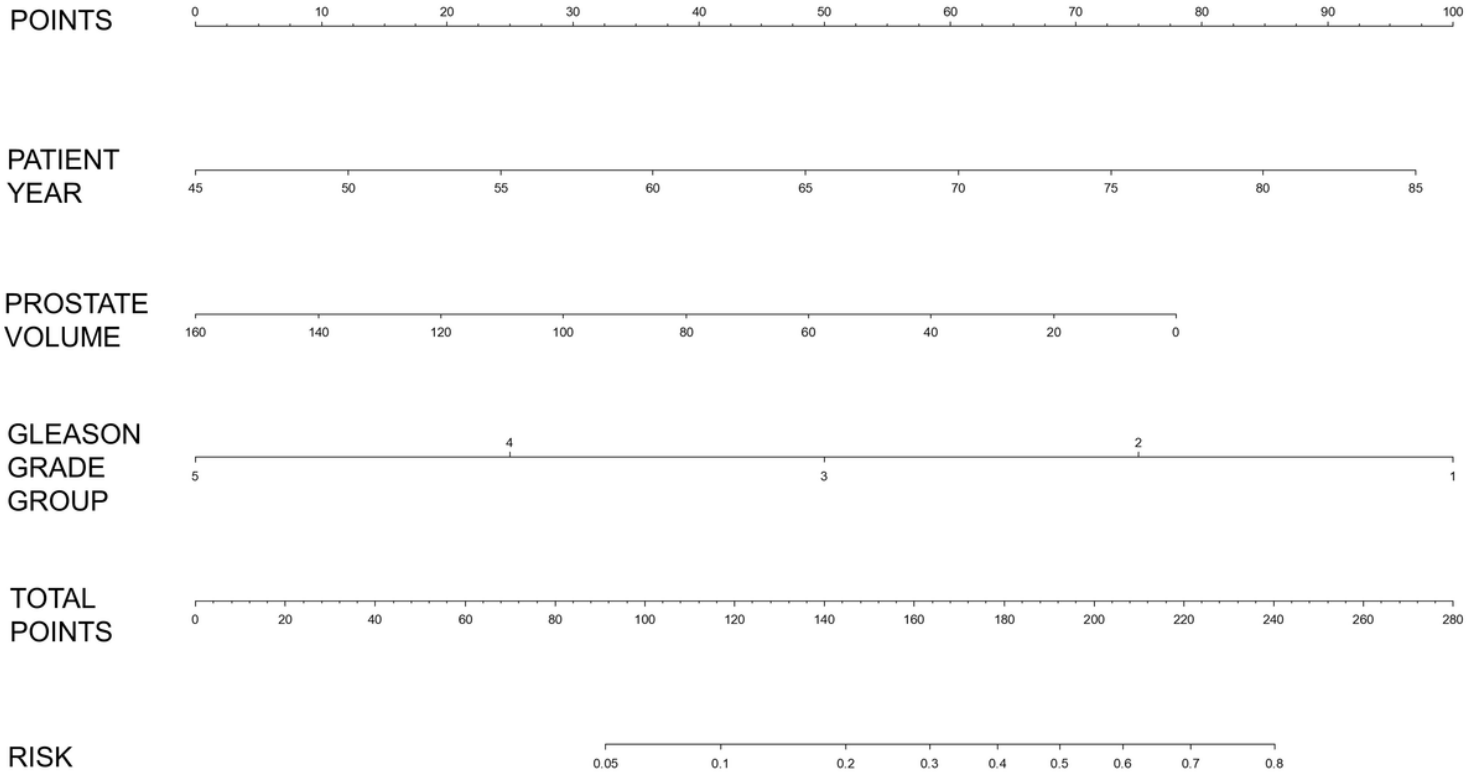

Figure 2

Nomograms for predicting prostate Gleason grade group upgrading. Instructions: To reach the predicted probability, locate the patient data at each axis and draw a vertical line to the “Points” axis and read the values. Sum all the points. Locate the sum to the “Total Points” axis and to draw a vertical line to the “Risk” axis to obtain the probability of upgrading or downgrading.