

Preoperative Nutritional Evaluation of Elderly Patients with Prostate Cancer Undergoing Laparoscopic Radical Prostatectomy

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Abstract

Objective

The purpose of this study is to evaluate the association and predictive value of geriatric nutritional risk index (GNRI) in elderly patients with prostate cancer(PCa) undergoing laparoscopic radical prostatectomy (LRP).

Methods

The clinical data of 72 elderly patients (aged ≥ 65 y) with PCa undergoing LRP in the Department of Urology, Affiliated Hospital of North Sichuan Medical College from January 2018 to December 2020 were retrospectively analyzed. The basic information, laboratory examination indexes, operation conditions, postoperative complications and postoperative recovery indexes of patients were included. Clavien-Dindo Classification System (CDCS) was used to assess the postoperative complications. T-test was used to analyze the grouping variables. ROC curve was drawn to study the predictive value of GNRI for postoperative complications.

Results

The body weight, BMI, preoperative HGB, ALB values of malnutrition group (MNg) and normal nutrition group (NNg) were significantly positively correlated ($P < 0.01$); the incidence and severity of postoperative complications of MNg were significantly higher than those of NNg ($P < 0.05$). The average hospitalization costs of MNg was higher, the duration of postanesthesia care unit (PACU), duration of antibiotic use was longer and the duration of indwelling drainage tube were longer than NNg ($P < 0.05$). The volume of indwelling drainage tube were more than NNg ($P < 0.05$).

Conclusion

GNRI is an effective and reliable tool to evaluate preoperative nutritional status of prostate cancer, which is closely related to postoperative recovery and complications, and has predictive value.

Introduction

Prostate cancer (PCa) is one of the most common malignant tumors in men [1], the incidence of PCa is 2.93/million in the world, ranking second in all male malignant tumors [2]. The incidence of PCa is closely related to age. The incidence of PCa is above in male urogenital system [3]. The European Urological Association recommends surgery as an important treatment for PCa. Laparoscopic radical prostatectomy (LRP) is the standard treatment for limited PCa, which is recommended as the first-line treatment by the major guidelines [4–5]. However, laparoscopic surgery in urology also has postoperative complications that can not be ignored, and the incidence increases with the difficulty of surgery.

Nutrition is the basis of maintaining the normal physiological function of the human body, and the nutritional status of patients has always been considered to be closely related to the prognosis of surgical operation [6]. The elderly (aged ≥ 65) have higher incidence of complications and mortality due to aging and the influence of cancer itself [7]. Some studies have pointed out that nutritional factors are closely related to the occurrence and progress of PCa [8].

Geriatric Nutritional Risk Index (GNRI) as an objective index for evaluating nutritional status of elderly people over 65 years old, has been shown to be effective in predicting the prognosis of patients with lung cancer, esophageal cancer,

soft tissue sarcoma, renal cancer and pancreatic cancer in previous studies [9–13]. However, there is no clinical study on GNRI in predicting complications and postoperative recovery of PCa patients undergoing LRP.

Objects And Methods

Objects

From January 2018 to December 2020, all 72 hospitalized patients with PCa undergoing LRP in the Department of Urology, Affiliated Hospital of North Sichuan Medical College were enrolled, all of them were Han male. Exclusion criteria: 1. Prostate biopsy was performed in our hospital before operation, and PCa was confirmed by pathology; 2. Age \geq 65 years old; 3. Only LRP was performed during this hospitalization. Exclusion criteria: 1. Patients with malnutrition caused by other serious diseases, 2. Patients with urinary calculi, other tumors and other urinary diseases, 3. Patients with infectious diseases (respiratory tract infection, pulmonary infection, etc.) or other chronic wasting diseases.

Methods

Research indicators

The height, weight, age, hospitalization costs, postoperative length of stay and other basic information of all patients were recorded; the operation duration, operation method, intraoperative blood loss, duration of postanesthesia care unit (PACU), duration of postoperative catheter indwelling, duration of indwelling drainage tube, volume of indwelling drainage tube, duration of antibiotic use were recorded. complications such as ileus, urethrorectal fistula, ureteral injury, cardio cerebral vascular accident, postoperative infection, postoperative massive hemorrhage, urinary retention, urinary incontinence were recorded. blood routine and liver function tests were used to record the hemoglobin value (HGB), total lymphocyte (TLC), white blood cell (WBC) and serum albumin (ALB) before and after operation.

Evaluation and grading standard of complications

Clavien Dindo classification system (CDCS) was used for the grading of complications [14]. Grade I: any postoperative abnormalities that do not require drug treatment, surgery, endoscopy or intervention; the following treatment regimens are given: antiemetics, antipyretics, analgesics, diuretics, electrolytes, physical therapy, etc. Grade II: in addition to the drugs listed in grade I above, other drug treatments include blood transfusion and total parenteral nutrition. Grade III: surgical, endoscopic or interventional intervention is required. Grade IIIa: no intervention under general anesthesia. Grade IIIb: intervention under general anesthesia is needed. Grade IV: life threatening complications requiring ICU treatment or intermediate care. Grade IVa: single organ dysfunction (including dialysis treatment). Grade IVb: multiple organ dysfunction. Grade V: death. When a single patient had multiple complications, only the most serious one was counted.

Urinary incontinence was evaluated by the International Consultation on Incontinence Questionnaire - Short Form (ICIQ-SF) [15]. Postoperative infection includes urinary tract infection, pulmonary infection, abdominal and retroperitoneal infection. Incision complications included hematoma, fat liquefaction, incision dehiscence or infection.

Nutritional status indicators

the nutritional status was evaluated by geriatric nutritional risk index (GNRI) [16]. All evaluation indexes were collected within one week before operation. The formula of GNRI was $GNRI = 1.489 \times ALB (g / L) + 41.7 \times (actual\ weight / ideal\ weight)$. Male ideal weight = $height (cm) - 100 - [(height (cm) - 150) / 4]$. When the preoperation actual weight \geq the ideal weight, the ratio is 1.

Statistical Method

all data were entered and analyzed by spss19.0 statistical software. The mean \pm standard deviation was used to describe the continuous data which obeyed normal distribution. T-test was used to analyze the nutritional indexes of patients, the general situation of patients, perioperative indexes and hematological indexes.

Results

General situation of research objects

72 patients were included, aged 65–83 years, with an average of 72.93 ± 5.05 years; height 150-177cm, with an average of 163.61 ± 6.22 cm; weight 45-90kg, with an average of 62.65 ± 8.78 kg; BMI 18.0-31.1, with an average of 23.42 ± 2.80 ; GNRI 89.6–118.0, with an average of 101.05 ± 6.26 .

26 Patients with $GNRI \leq 98$ were classified into malnutrition group (MNg); 46 patients with $GNRI > 98$ were classified into normal nutrition group (NNG) [17]. The comparison of age, height, weight, BMI, HGB, ALB, PSA, Intraoperative blood loss and intraoperative blood transfusion between the two groups is shown in Table 1. It can be seen from Table 1 that weight, BMI, preoperative HGB and ALB values were significantly positively correlated between the two groups ($P \leq 0.01$); there were no significant differences in age, height, PSA, intraoperative blood loss and intraoperative blood transfusion between the two groups ($P > 0.05$).

Table 1
general situation, preoperative laboratory indexes and intraoperative conditions of patients

indexes	Age	Height	Weight	BMI	HGB	ALB	PSA	Intraoperative blood loss	Intraoperative blood transfusion
NNG (N=46)	72.15 ± 4.51	164.15 ± 5.85	65.72 ± 7.48	24.42 ± 2.51	137.28 ± 13.09	42.61 ± 3.12	21.44 ± 21.63	345.65 \pm 267.05	59.78 \pm 166.54
MNg (N=26)	74.31 ± 5.71	162.65 ± 6.84	57.21 ± 8.36	21.64 ± 2.39	125.19 ± 11.28	37.41 ± 2.16	22.65 ± 25.55	425.00 \pm 343.29	107.69 \pm 246.45
t	-1.766	0.981	4.441	4.586	3.949	8.310	-0.215	-1.091	-0.982
P	0.082	0.330	0.000**	0.000**	0.000**	0.000**	0.830	0.279	0.329

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Comparison and predictive value of GNRI in postoperative complications between NMG and MMG

As shown in Table 2, the rates of urinary incontinence, infection and incision complications in MNg were significantly higher than those in NNG($P > 0.05$), and urethrorectal fistula, ureteral injury, cardio cerebrovascular accident and massive hemorrhage only occurred in MNg. The incidence of complications in MNg was significantly higher than that in NNG ($t = 3.618, P < 0.01$).

As shown in Table 3, the complication free percentage of NNg was significantly higher than that of MNg, the incidence of grade I and II complications was lower than that of MNg, and there were no grade III or above complications. There were no grade IV and V complications in both groups. The average grade of CDCS in NNg(0.63 ± 0.71) was significantly lower than that in MNg(1.31 ± 0.88) ($t = 3.553, P < 0.01$).

According to the occurrence of complications, 72 patients were divided into non complication group and complication group. ROC curve was used to judge the predictive value of GNRI for postoperative complications. According to Fig. 1: area under the curve (AUC) = 0.716, 95% CI = 0.598–0.834, we know that if the GNRI cutoff value is 100.75, the sensitivity is 0.741, the specificity is 0.667, the Youden index is the highest, 0.407; if the GNRI cutoff value is 98.85, the sensitivity is 0.852, the specificity is 0.633, the Youden index is the second highest, 0.385.

Table 2
comparison of postoperative complications between two groups (person-time)

Complications	NNg(N = 46)	MNg(N = 26)
Urinary incontinence	4(8.7%)	13(50.0%)
Urethrorectal fistula	0(0%)	1(3.8%)
Ureteral injury	0(0%)	1(3.8%)
Cardiovascular and cerebrovascular accident	0(0%)	1(3.8%)
Incomplete ileus	4(8.7%)	1(3.8%)
Infection	19(41.3%)	14(53.8%)
Massive hemorrhage	0(0%)	2(7.7%)
Incision complications	5(10.9%)	5(19.2%)
Total	32(69.6%)	38(146.2%)

Table 3
comparison of CDCS between two groups

CDCS	NNg(N = 46)	MNg(N = 26)
0(no complication)	23(50.0%)	4(15.4%)
I	17(37.0%)	13(50.0%)
II	6(13.0%)	6(23.1%)
III	0(0%)	3(11.5%)
IV	0(0%)	0(0%)
V	0(0%)	0(0%)
Total	46(100.0%)	26(100.0%)

Figure 1: ROC curve of GNRI in predicting postoperative complications

Comparison Of Postoperative Recovery Between Nmg And Mmg

As shown in Fig. 2a, the average postoperative hospital stay of MNg and NNg patients were 12.42 ± 7.04 and 10.89 ± 6.96 days respectively, and there was no significant difference between the two groups ($P > 0.05$). As shown in Fig. 2b,

the average hospitalization costs of MNg and NNg patients were 44752.70 ± 9620.31 and 38862.25 ± 8580.68 yuan respectively, and the average hospitalization costs of MNg were higher ($P < 0.01$). As shown in Fig. 2c, the average duration of PACU of MNg and NNg patients were 3.08 ± 0.80 and 2.58 ± 1.30 hours respectively, and the average duration of PACU of MNg patients was longer ($P < 0.05$). As shown in Fig. 2d, the average postoperative feeding time of MNg and NNg patients was 2.08 ± 1.41 and 2.48 ± 2.59 days respectively, and there was no statistical difference between the two groups ($P > 0.05$).

As shown in Fig. 2e, the average duration of antibiotic use in MNg and NNg patients was 10.04 ± 4.27 and 7.74 ± 4.34 days respectively, and the average duration of antibiotic use in MNg was longer ($P < 0.05$). As shown in Fig. 2f, the average duration of indwelling drainage tube in MNg and NNg patients was 11.12 ± 8.26 and 7.48 ± 5.14 days respectively, and the average duration of indwelling drainage tube in MNg patients was longer ($P < 0.05$). As shown in Fig. 2g, the average duration of indwelling catheter in MNg and NNg patients was 29.19 ± 7.95 and 26.33 ± 10.24 days respectively, and there was no statistical difference between the two groups ($P > 0.05$). As shown in Fig. 2h, the average volume of indwelling drainage tube in MNg and NNg patients was 953.46 ± 1122.04 and 445.43 ± 537.93 ml respectively, and the average drainage volume of MNg patients was more ($P < 0.05$).

Discussion

Selection Of Nutritional Indicators

There are more than 50 different nutrition assessment tools, and GNRI is one of the effective and reliable tools [18]. GNRI was proposed by bouillanne et al. in 2005 and is related to ALB level and the ratio of actual body weight to ideal body weight [16]. GNRI is suitable for elderly community patients and inpatients over 65 years old, and it is an effective way to evaluate the nutritional status. If the GNRI score of patients is lower, it indicates that the more serious malnutrition is. GNRI has high sensitivity, good specificity and low false positive rate [19], which is a simple and easy screening method with strong operability. GNRI has been applied to predict the prognosis and postoperative complications of many kinds of malignant tumors, but only the level of BMI or serum albumin is not closely related to the prognosis of cancer patients [17, 20].

The incidence and mortality of PCa increased with age. In 2017, more than 70% of PCa patients were over 64 years old in the world, and 80% of PCa deaths were more than 65 years old [21], which was in line with the applicable age range of GNRI.

In this study, we found that there were no significant differences in age, height, PSA, intraoperative blood loss, intraoperative blood transfusion and other baseline indicators between the two groups. Preoperative nutritional indicators such as weight, BMI, HGB, ALB of PCa patients were significantly positively correlated with GNRI, which fully indicated that GNRI could well reflect the nutritional status of patients, and was not interfered by other factors. So GNRI was selected to predict the postoperative recovery and complications of PCa patients undergoing LRP.

The relationship between nutritional status and postoperative complications in PCa patients

The average CDCS grade of MNg was significantly higher than that of NNg, and there were grade III complications in MNg. There were no grade IV and V complications in the two groups because of the small statistical samples. Zhou J and other scholars believe that malnutrition is an important factor leading to postoperative complications and higher CDCS grade [22]. In patients with malnutrition, the body is in a state of nutritional risk, and a series of compensatory changes will appear in the organs and tissues of the whole body to adapt to this state, such as decreased muscle strength, prolonged recovery time of the whole body and wound, decreased immunity, delayed wound healing,

weakened function of neutrophils, macrophages and lymphocytes [23]. This situation leads to more serious postoperative complications in patients with malnutrition.

As shown in Table 2, the incidence of complications of MNg was higher than that of NNg, especially the incidence of urinary incontinence, infection and incision complications was significantly higher than that of NNg.

The maintenance of urinary continence in men is mainly related to bladder function and urethral sphincter system. The key to reduce urinary incontinence is to dissect prostate and its surrounding tissues carefully during operation, protect the distal sphincter system and its innervating nerve and supporting tissue [24], but other related factors include the age and physical condition of the patients are also very important. This study shows that the incidence of urinary incontinence in malnutrition patients is higher than that in normal nutrition patients, which may be related to the weakening of urethral sphincter function and the decline of autonomic contraction of pelvic floor muscle.

Postoperative infection is the most common complication of LRP. According to the literature, malnutrition can lead to fluid overload, further leading to and aggravating postoperative infection [25]. This study shows that the incidence of postoperative infection of MNg is higher than that of NNg. The preoperative HGB and ALB of MNg patients are lower than that of NNg, and the im duration of munity is lower, which increases the risk of infection. At the same time, as shown in Fig. 2, the average duration of indwelling drainage tube and indwelling catheter in MNg was longer than that in NNg, so the normal physiological structure of abdominal cavity and urethra was destroyed, which reduced the function of mucosa to resist bacteria, resulting in infection.

MNg patients with low preoperative ALB can affect the body enzyme production ability, weaken the ability of tissue and organ self repair, resulting in delayed wound healing. In particular, hypoalbuminemia has a particularly significant impact on humoral immunity, which can cause pathogen translocation, conditional pathogen transformation, and fungal reproduction; in addition, the blood supply under the incision is reduced due to emaciation, thus increasing the probability of incision infection, tissue necrosis, and dehiscence [26].

In this study, we found that the best Youden value, sensitivity and specificity can be obtained if GNRI = 100.75 is taken as the cut-off value to determine whether there are complications, which can preliminarily predict the occurrence of postoperative complications. If GNRI = 98.85 is taken as the cut-off value to determine whether there are complications, it can obtain higher sensitivity and acceptable specificity; if GNRI < 98.85, the possibility of postoperative complications is very high. In line with the principle of operation safety first and adequate preoperative preparation, nutritional support should be actively given before operation to improve the nutritional level of patients. The sample size of this single center study is small, resulting in the ROC curve is not smooth enough, only a preliminary cut-off value can be obtained. In the future, we plan to carry out a large sample study of multi-center study to find a more accurate cut-off value, which can be used to guide the preoperative nutritional status evaluation of pre PCa patients undergoing LRP.

the relationship between nutritional status and postoperative recovery in patients with PCa

In this study, we observed that duration of PACU in MNg is longer, which is consistent with foreign research results [27]. The decreased ALB level and lower body weight of MNg prolong the metabolism time of sevoflurane and other anesthetics [28], resulting in slower anesthesia recovery of patients. Anesthesiologists need to observe patients for a longer time, so the duration of PACU in MNg is also longer.

In this study, ALB in MNg is lower than that in NNg, resulting in more intra-abdominal fluid leakage, higher infection and incision complications, also lead to more inflammatory exudate, and then the duration of indwelling drainage tube is longer, volume of indwelling drainage tube is more. The higher incidence of infection complications and incision complications of MNg, as well as its unique complications of urethrorectal fistula, ureteral injury and massive

hemorrhage, make the postoperative recovery time of MNg patients longer, and also force doctors to use antibiotics for a longer time.

At the same time, there was no significant difference between the two groups in WBC values (MNg: 8.60 ± 2.40 mg / L, NNg: 8.59 ± 2.82 mg / L) on the 3rd postoperative day ($P > 0.05$), but the WBC values in MNg(7.80 ± 1.64 mg / L) on the 7th postoperative day were significantly higher than those in NNg(6.51 ± 1.88 mg / L) on the 7th postoperative day ($P < 0.05$). This also shows that longer duration of antibiotic use in MNg is necessary.

The low levels of ALB and HGB of MNg lead to a significant increase in the use of enteral and parenteral nutrition preparations, albumin and blood products during hospitalization; the low immunity of MNg and a series of infection related complications lead to the use of longer and higher level antibiotics; the longer duration of PACU treatment leads that the hospitalization costs of MNg higher than NNg significantly, increased the burden of patients.

Conclusions

To sum up, GNRI is an effective and reliable tool to evaluate the preoperative nutritional status of PCa, which is closely related to the postoperative recovery and complications; preoperative GNRI examination and effective preoperative nutritional support may benefit PCa patients undergoing LRP.

Ethics Approval and Consent

The study was approved by the medical ethics committee of Affiliated Hospital of North Sichuan Medical College, Nanchong, China. The study has received the informed consents from all patients and followed the guidelines outlined in the declaration of Helsinki.

Consent for publication

All patients have been informed suitably, and we've asked for their verbal consent.

Data Availability Statement:

All relevant data are in the paper and Supporting Information files.

Declarations

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Competing Interests

The authors declare that they have no competing interests.

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Author Contributions

Conceptualization: Xie Liang, Fan Jie.

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Investigation: Fan Jie, Liu Yuan, Xu Yan, Zhang Huan

Project administration: Hu Chunyan

Resources: Xie Liang ,Wu Tao.

Writing – original draft: Wang Shu.

Writing – review & editing: Xie Liang

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Figures

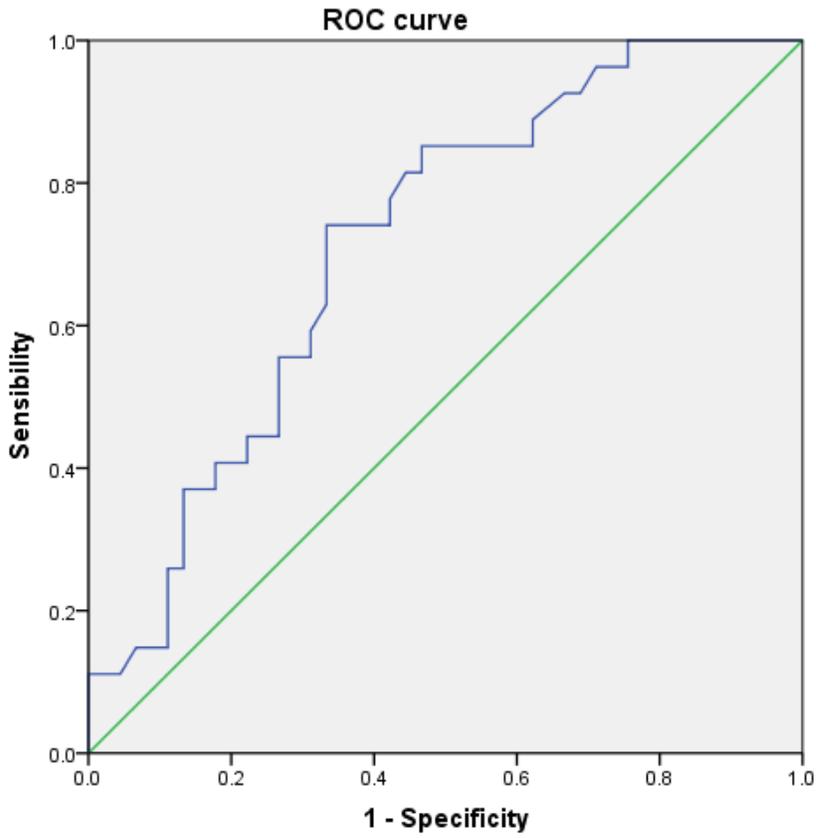


Figure 1

ROC curve of GNRI in predicting postoperative complications

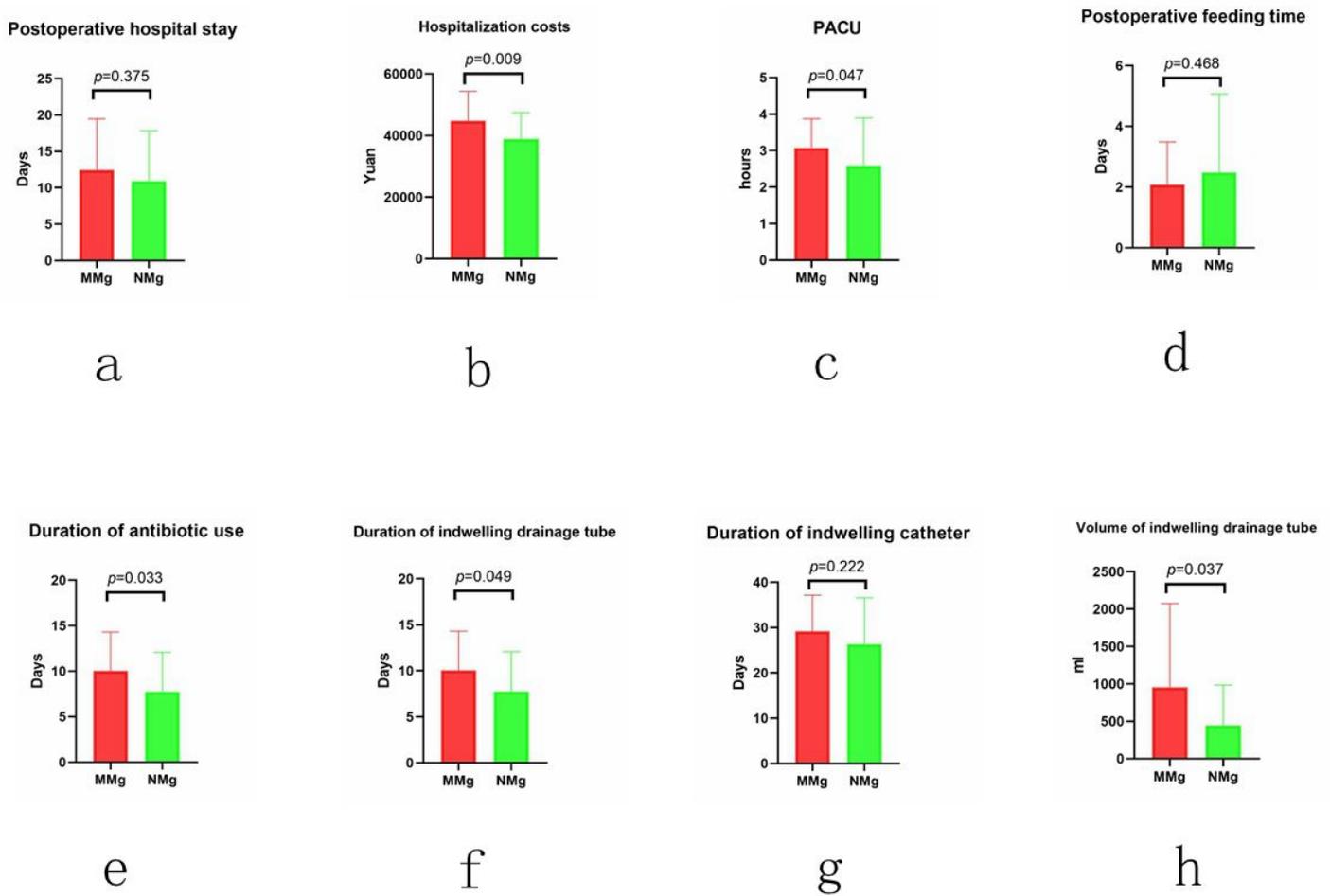


Figure 2

comparison of postoperative recovery between two groups

Supplementary Files

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