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# Value of metabolic parameters of primary lesions examined by $^{18}$F-FDG PET/CT for endometrial cancer in preoperative evaluation

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**Abstract. – OBJECTIVE: To evaluate metabolic parameters of primary lesions examined by $^{18}$F-FDG PET/CT ($^{18}$Fluorodeoxyglucose Positron Emission Tomography /Computed Tomography), including maximum standard uptake value (SUVmax), metabolic volume (MTV), and total lesion glycolysis (TLG).**

**PATIENTS AND METHODS: 79 patients with endometrial cancer were selected as the subjects. They were diagnosed by histopathology in our hospital for the first time from January 2016 to December 2018. All the patients were examined by $^{18}$F-FDG PET/CT. Retrospective statistical analysis was carried out to evaluate different expression of metabolic parameters examined by $^{18}$F-FDG PET/CT of different clinicopathologic factors in endometrial cancer. Spearman correlation analysis was also used.**

**RESULTS: SUVmax, TLG and MTV were correlated with FIGO staging, tissue grading, depth of myometrial invasion, and lymph node metastasis. SUVmax, TLG and MTV in lymph node metastasis group had high clinical staging, low differentiation and myometrial invasion depth >1/2, which were significantly higher than those in no lymph node metastasis group (low clinical staging, high differentiation and myometrial invasion depth ≤1/2). TLG had the greatest difference($p$<0.001). TLG and MTV were correlated with histopathological classification ($p$<0.05). The expression levels of SUVmax, MTV and TLG of primary lesions were negatively correlated with the positive expression of ER and PR in tumor tissues ($p$<0.05), and significantly positively correlated with positive expression of HER -2 and Ki-67 ($p$<0.01). The expression of ER, PR, HER-2 and KI-67 in tumor tissues was correlated with tissue grading, clinical staging, depth of muscular layer infiltration, cervical tissue involvement and lymph node metastasis ($p$<0.05).**

**CONCLUSIONS: Metabolic parameters of primary lesions examined by $^{18}$F-FDG PET/CT has a good correlation with its clinicopathological features. They can provide reference for the preoperative formulation of treatment plan for endometrial cancer, so as to reduce the risk of surgery and improve the prognosis of patients.**

*Key Words:*
Endometrial cancer, $^{18}$Fluorodeoxyglucose, Positron emission tomography, Preoperative assessment.

## Introduction

Endometrial cancer (EC) is a common gynecologic malignancy originating from the endometrial epithelial[1]. In recent years, the incidence of endometrial cancer is increasing, which seriously threatens the life and health of women[2,3]. Preoperative clinical staging, pathological type of tumor, histological grading, lymph node metastasis are[4] important factors to determine the surgery mode and prognosis of patients. However, these pathological factors can only be judged usually after the surgery[5], which affects the formulation of preoperative surgery program. Therefore, a non-invasive technique is needed to accurately detect the clinical and pathological factors before surgery to guide the clinical decision. Although routine imaging diagnosis has a certain value for EC preoperative evaluation, there are certain limitations[6]. The role of $^{18}$F-FDG PET/CT imaging in EC preoperative assessment has been gradually recognized. We can make use of the relationship between metabolic parameters of primary

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lesions examined by $^{18}$F-FDG and EC related factors to evaluate preoperative clinicopathological factors[7]. PET /CT can be used to effectively and accurately diagnose EC pelvic, lymph node metastasis and distant metastasis. It has great value in clinical staging, judging prognosis, diagnosing recurrence, etc. The maximum standard uptake value (SUVmax), metabolic tumor volume (MTV) and total glycolysis (TLG) of primary lesions are significantly correlated with pathological tissue grading and receptor expression[8]. Previous studies on metabolic parameters of primary lesions examined by $^{18}$F-FDG PET/CT for endometrial cancer mainly focused on SUVmax, which is the most widely used semi-quantitative index currently. However, SUVmax can only reflect the functional metabolic degree of the point. It cannot assess the overall metabolic situation of tumor. MTV and TLG, which represent the uptake of primary lesions of tumor examined by $^{18}$F-FDG, are the parameters for quantitative measurement of tumor cells with higher glucose metabolic activity. They can more comprehensively measure the glucose metabolic activity of tumor cells with more clinical value in reflecting the malignancy degree of tumor[9]. Based on a retrospective analysis of the relationship between the metabolic parameters SUVmax, MTV and TLG, this study evaluated the preoperative primary lesions of endometrial cancer examined by $^{18}$F-FDG PET/CT and clinical related pathological features of patients. We would like to provide a basis for preoperative comprehensive evaluation, operation strategy formulation and prognosis evaluation of patients with endometrial cancer and provide a reference for clinical diagnosis and treatment.

## Patients and Methods

### Patients

This study collected 79 patients with endometrial cancer who came to our hospital for the first time and were confirmed by histopathology from January 2016 to December 2018. The patients were all examined by $^{18}$F-FDG PET/CT before treatment. They were at the age of 35-78, with the mean age of (57.69±10.23). The 2009 Staging Criteria of Cintemational Fedcration of Gynccology and Obstrics (FIGO) was used[10]. There were 35 cases in Clinical Stage I, 21 cases in Stage II, 18 cases in Stage III and 5 cases in Stage IV. There were 10 cases of high differentiation (G1), 51 cases of middle differentiation (G2) and 18 cases of low differentiation (G3) according to tissue grading criteria. The 4th edition of the Classification Criteria for Female Genital Neoplasms by WHO was also referred to[11]. According to pathological classification, there were 55 cases of Type I (hormone-dependent) and 24 cases of Type II (non-hormone-dependent). There were different histopathological types, including 51 cases with endometrial adenocarcinoma, 12 cases with serous carcinoma, 9 cases with mucinous adenocarcinoma, 3 cases with mixed adenocarcinoma, and 4 cases with clear cell carcinoma. Inclusion criteria: (1) Patients examined by preoperative all-body inspection with $^{18}$FDG PET-CT; (2)The interval between PET-CT examination and the surgery <2 weeks; (3) Patients all confirmed EC by pathohistology; (4) Patients all accepted surgery treatment, without anti-tumor and hormone therapy before surgery. (5) Patients with complete study data. Exclusion criteria: (1) Patients with history of radiotherapy and chemotherapy; (2) Patients with other tumors; (3) Patients without histopathological confirmation. 79 patients with EC mainly manifested irregular vaginal bleeding, vaginal discharge or abdominal pain clinically. Among them, 4 cases were found by physical examination. This study was approved by the Ethics Committee of the hospital (Ethics Approval Number: Zlunlihao: 20151120), and the informed consent was signed with the patients.

### Methods

#### PET/CT Inspection

$^{18}$F-FDG PET/CT inspection instrument was GE Discovery 710 Clarity PET/CT provided by General Medical Corporation of the United States. $^{18}$F-FDG was provided by Guangzhou Isotope Center of China Atomic Energy Research Institute, with the chemical purity >95%. All patients were fasted for more than 6 h before examination, and blood glucose was controlled in normal range. $^{18}$F-FDG was injected to the elbow vein with the dose of 4.44~5.18 MBq/Kg according to body weight. Then, patients rested for 50~60 min. After discharge of urine, PET/CT inspection was performed. The scan was from the middle femur to the top of the skull. First, CT plain scan was performed, with the voltage of 140 kV and the current of 110 mA, the spherical tube one-ring rotation for 0.5 s, and the thickness of 3 mm. Then, the patients were scanned by PET at 3

min/bed, using 3D acquisition mode. The attenuation correction image was obtained through the Ramla 3D.

### Image Analysis and Data Processing

The images were first read by two experienced nuclear physicians in a blind manner. In case of disagreement, consensus was reached through discussion. The region of interest (ROI) was delineated according to the PET/CT fusion image. The PET and CT data were processed using MEDXE, the metabolic evaluation software of tumor. The SUVmax, MTV and TLG of primary lesions were automatically obtained. $^{18}$F-FDG PET/CT image of endometrial cancer is shown in Figure 1, Figure 1(A): CT image of primary lesions of endometrial cancer; Figure 1(B): PET image of primary lesions of endometrial cancer; Figure 1(C): PET/CT fusion image.

### Immunohistochemical Examination of Endometrial Cancer

Estrogen receptor (ER), progesterone receptor (PR), human epidermal growth factor receptor 2 (HER2) and proliferating nuclear antigen-67 (Ki-67) antibody and SP kits were purchased from Fuzhou Maixin Biotechnology Development Co., Ltd. Positive and negative controls were set, taking known positive sections as positive controls and PBS as a negative control instead of an antibody. The instructions of the kit was strictly followed, and the quality control met the requirements. The pathological specimens of endometrial cancer were fixed with 10% formaldehyde solution, embedded with paraffin, and sliced with the thickness of 5 μm. Then, the slices were spread and the paraffin was removed, and SP method was performed. And then, they were observed under an optical microscope. As a result, the positive expression of ER, PR and Ki-67 was yellow, distributed in nucleus. If the positive cells were < 1%, it was negative, if the positive cells were ≥ 1%, it was positive. The positive expression of HER-2 was yellow, distributed in cell membrane. If the positive cells were <10%, it was negative, if the positive cells were ≥10%, it was positive. ER positive is shown in Figure 2(A), PR positive is shown in Figure 2(B), HER -2 positive is shown in Figure 2C, and Ki -67 positive is shown in Figure 2D.

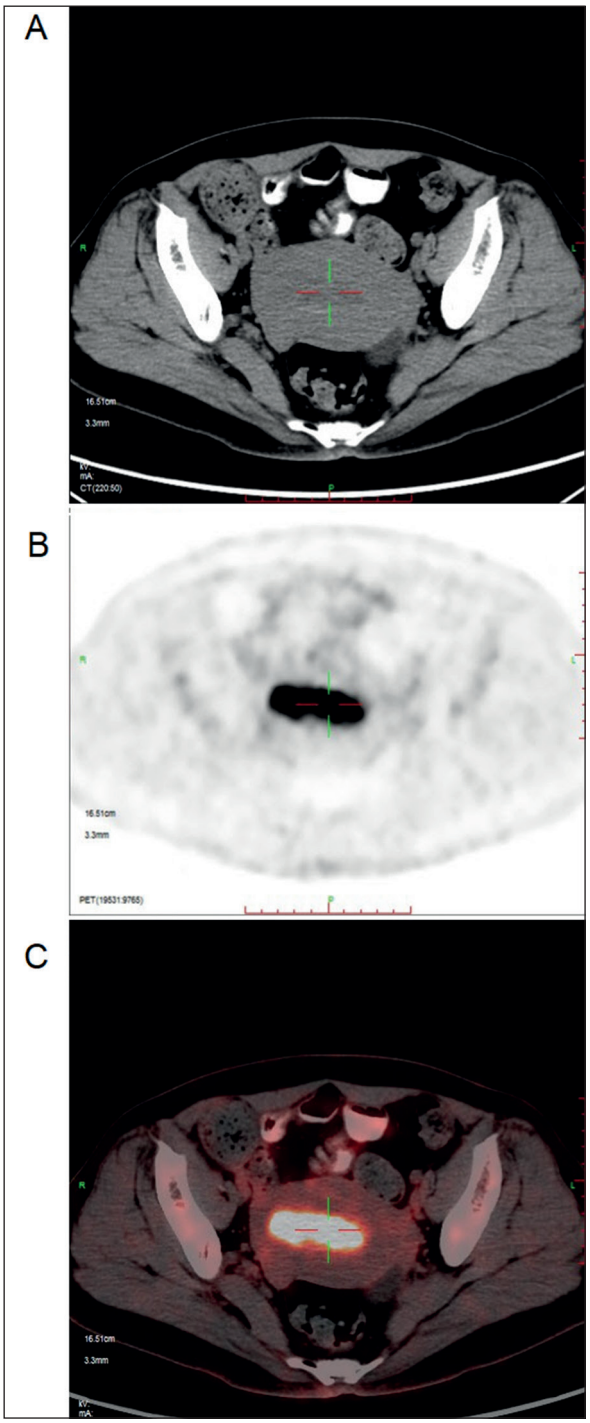


**Figure 1.** $^{18}$F-FDG PET/CT image of endometrial cancer. (**A**): CT Image of Primary Lesions of Endometrial Cancer; (**B**): PET Image of Primary Lesions of Endometrial Cancer; (**C**): PET/CT Fusion Image, there was a lesion with increased radiation uptake in the uterine cavity, with SUVmax of 15.31, MTV of 8.12 cm and TLG of 78.63 g.

### Analytical Indicators

The data of 79 patients with endometrial cancer examined by $^{18}$F-FDG PET/CT was obtained according to the cases. All the clinicopathological data was also collected, including age, tumor clinical staging, tissue grading,

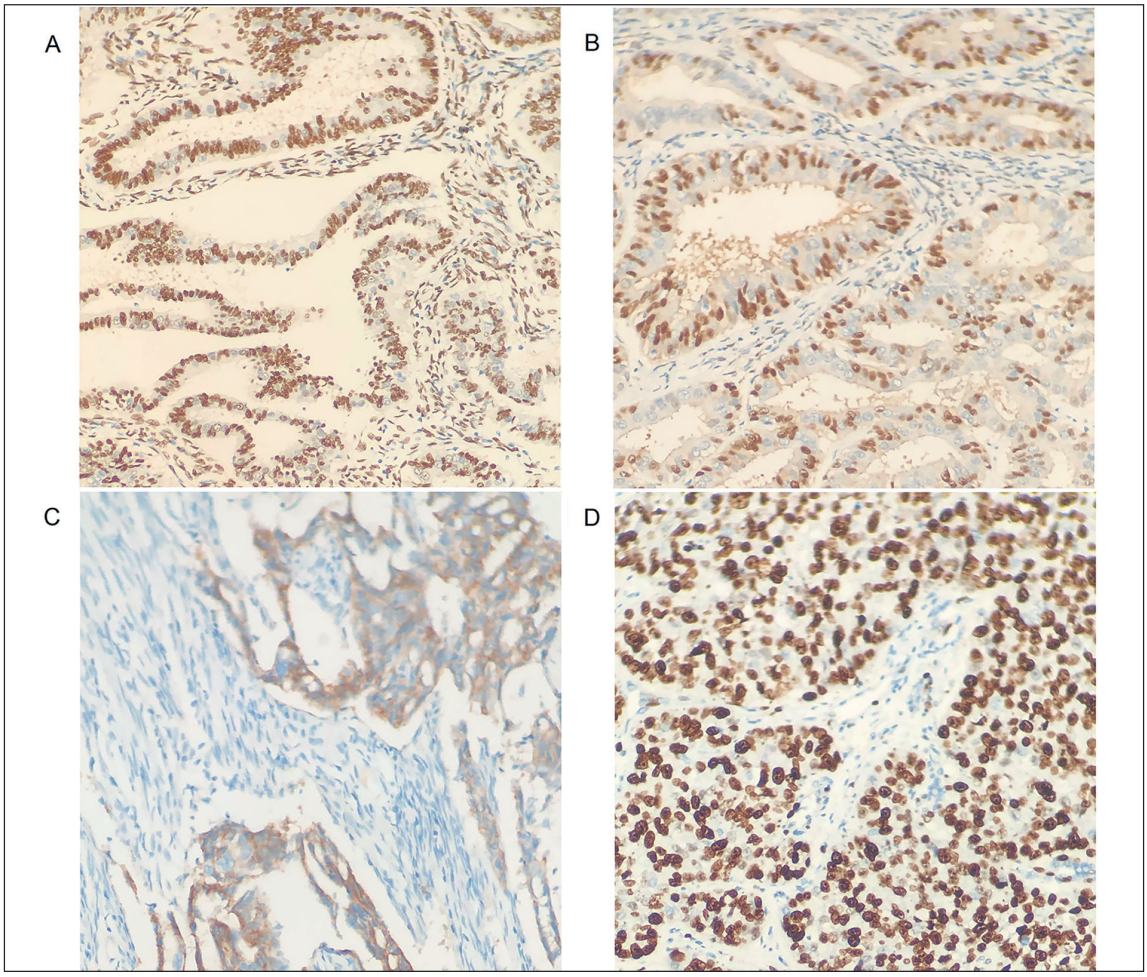


**Figure 2.** Immunohistochemical Examination of Endometrial Cancer. (**A**): ER (10×20) Positive; (**B**): PR (10×20) Positive; (**C**): HER-2 (10×20) Positive; (**D**): Ki-67 (10×20) Positive.

depth of tumor invasion, pathological type, pathological tissue grading, lymph node metastasis, ER, PR, HER-2 and Ki-67 of the patients. SUVmax, MTV and the relationship between TLG and clinicopathological features were statistically analyzed.

### Statistical Analysis

SPSS19.0 software was used to analyze all the data obtained. The data measured were non-normal distribution, with median and interquartile [M(25%,75%)] description. The inter-group differences were compared by Mann-Whitney non-parametric test. Counting data were expressed as cases (%). The $\chi^2$ test was used for inter-group comparisons. Spearman was used for correlation analysis. $p<0.05$ represented that the difference was statistically significant.

## Results

### Metabolic Parameters of Primary Lesion Examined by $^{18}$F-FDG PET/CT for Endometrial Cancer

All the 79 patients who were newly diagnosed endometrial cancer showed increased uptake of 18F-FDGPET/CT. The SUVmax, MTV and TLG of primary lesion were 13.75 (4.23, 21.45), 9.62 $cm^3$ (3.19 $cm^3$, 17.82 $cm^3$) and 75.73 g (18.72 g, 298.15 g), respectively.

### Correlation Analysis of Metabolic Parameters of Primary Lesion Examined by $^{18}$F-FDG PET/CT for Endometrial Cancer and Clinicopathological Factors

SUVmax, TLG and MTV were correlated with FIGO staging, tissue grading, depth of myometrial invasion, and lymph node metastasis. The

values of SUVmax, TLG and MTV in lymph node metastasis group had high clinical staging, low differentiation and myometrial invasion depth >1/2, which were significantly higher than those in the no lymph node metastasis group (low clinical staging, high differentiation and myometrial invasion depth ≤1/2). TLG had the greatest difference ($p$<0.001). There was no correlation between SUVmax and pathological type and histopathological classification ($p$>0.05). TLG and MTV had no correlation with pathological type ($p$>0.05), but they were correlated with histopathological classification ($p$<0.05). See Table I.

### Correlation Analysis of Metabolic Parameters of Primary Lesion Examined by $^{18}$F-FDG PET/CT for Endometrial Cancer and Positive Expression of ER, PR, HER-2 and KI-67 in Cancer Tissues

The expression levels of SUVmax, MTV and TLG of primary lesion were significantly negatively correlated with the positive expression of ER and PR in tumor tissue ($p$<0.05) and positively correlated with the positive expression of HER-2 and Ki-67 in tumor tissues ($p$<0.01). See Table II.

### Relationship Between Immunohistochemical Markers and Clinicopathological Features of Endometrial Cancer

The expression ER, PR, HER-2 and Ki-67 in tumor tissue was not significantly correlated with the age of patients ($p$>0.05), and was correlated with tissue grading, clinical staging, depth of myometrial invasion, involvement of extra-cervical tissue, and lymph node metastasis ($p$<0.05). See Table III.

## Discussion

The clinical curettage and hysteroscopy after pathological tissue examination are the gold standard for the diagnosis of EC, but they cannot be used to accurately judge the infiltration and invasion, and cannot stage EC. B-mode ultrasonography, CT and MIR are helpful in staging, but they have certain limitations and cannot duly reflect the biological behavior[12]. At present, $^{18}$F-FDG PET/CT has been widely used in preoperative evaluation of various malignancies. In recent years, the clinical application of metabolic parameters examined by $^{18}$F-FDG PET/CT (including SUVmax, MTV and TLG) is increasingly favored by clinicians. This technique plays an important role in the diagnosis, staging and efficacy judgment of many malignant tumors, such as breast cancer and gastric cancer[13]. Metabolic parameters of primary lesion of endometrial cancer are currently concerned for their value in the preoperative evaluation[14]. Kakhki et al[15] reported that metabolic and anatomical changes of combined carcinoma lesion examined by $^{18}$FDG PET-CT have high sensitivity and accuracy in the diagnosis of cancer lesion, especially in the diagnosis of primary tumor lesion, distant metastasis and recurrence. $^{18}$FDG PET-CT examination is particularly valuable in diagnosing the recurrence and metastasis of ovarian cancer[16].

Kitajima et al[17] showed that TLG and MTV were significantly correlated with depth of myometrial invasion, lymph node metastasis and FIGO staging. SUVmax was correlated with tumor size and depth of myometrial invasion. This study also showed that SUVmax, TLG and MTV were correlated with FIGO staging, tissue grading, depth of myometrial invasion, and lymph node metastasis. The values of SUVmax, TLG and MTV in lymph node metastasis group had high clinical staging, low differentiation and myometrial invasion depth >1/2, which were significantly higher than those in the no lymph node metastasis group (low clinical staging, high differentiation and myometrial invasion depth ≤1/2). TLG had the greatest difference ($p$<0.001). In the studies, Boonya-ussadorn et al[18] have found that the primary lesion of SUVmax of endometrial cancer was significantly correlated with the maximum tumor diameter, but they have no correlation with the pathological type of tumor, depth of uterine myometrium and lymph node metastasis. In this study, there was no correlation between SUVmax and pathological type and histologic classification ($p$>0.05). TLG and MTV were not correlated with pathological type ($p$>0.05), but they were correlated with histological classification ($p$<0.05). The reason may be that SUVmax value only represents some metabolic activity in the tumor, which is uneven, so it doesn't reflect the entire tumor metabolism. The application of MTV and TLG can better reflect the biological behavior of tumor. TLG is a comprehensive parameter combined with metabolic activity and tumor volume, which can more accurately reflect the biological behavior, prognosis and post-treatment response of tumors compared with SUVmax value. Kim et al[19] studied and found that

**Table I.** Correlation Analysis of Metabolic Parameters of Primary Lesion Examined by $^{18}$F-FDG PET/CT for Endometrial Cancer and Clinicopathological Factors [M (25%,75%)].

| Clinicopathologic feature Number of cases | | N. of cases | $SUV_{max}$ | *p*-value | MTV $(cm)^3$ | *p*-value | TLG (g) | *p*-value |
|---|---|---|---|---|---|---|---|---|
| Tissue grading | G1 | 10 | 8.22 (2.36, 8.54) | < 0.05 | 3.13 (1.69, 7.01) | < 0.01 | 16.25 (3.86, 53.42) | < 0.001 |
| | G2 | 51 | 12.31 (5.44, 15.36) | | 7.24 (3.25, 15.01) | | 43.25 (19.39, 112.34) | |
| | G3 | 18 | 17.63 (8.67, 23.69) | | 11.55 (8.69, 23.16) | | 88.85 (25.82, 257.6) | |
| FIGO staging | Stage I | 35 | 5.69 (2.01, 6.42) | < 0.01 | 2.74 (1.24, 8.09) | < 0.01 | 10.23 (2.95, 40.43) | < 0.001 |
| | Stage II | 21 | 10.31 (3.76, 12.37) | | 5.36(2.19, 10.53) | | 22.34 (6.59, 116.35) | |
| | Stage III | 18 | 16.39 (7.25, 22.34) | | 11.69 (5.88, 16.79) | | 70.40 (20.45, 140.89) | |
| | Stage IV | 5 | 25.46 (14.58, 30.04) | | 15.66 (10.78, 28.67) | | 150.23 (56.21, 336.47) | |
| Depth of tumor invasion | ≤ 1/2 Muscle layer | 63 | 10.69 (5.13, 16.59) | < 0.05 | 8.01 (2.67, 13.78) | < 0.01 | 60.56 (2.89, 101.36) | < 0.001 |
| | > 1/2 Muscle layer | 16 | 15.42 (10.31, 24.69) | | 12.34 (6.12, 25.78) | | 101.97 (24.87, 240.82 | |
| Pathological type | Endometrial adenocarcinoma | 51 | 11.69 (4.78, 13.39) | > 0.05 | 8.78 (3.10, 16.37) | > 0.05 | 80.23 (3.56, 178.24) | > 0.05 |
| | Non-endometrial adenocarcinoma | 28 | 13.16 (5.17, 15.31) | | 9.98 (2.7, 13.46) | | 75.32 (2.79, 181.23) | |
| Pathological classification | Type I | 55 | 9.78 (5.67, 19.20) | > 0.05 | 7.86 (2.15, 15.79) | < 0.05 | 66.79 (4.76, 213.56) | < 0.05 |
| | Type II | 24 | 15.67 (8.42, 28.64) | | 14.65 (7.13, 25.64) | | 96.23(38.23, 302.25) | |
| Lymph node metastasis | No | 64 | 11.31 (4.87, 18.36) | < 0.01 | 8.43 (2.01, 14.32) | < 0.01 | 70.23 (3.27, 256.38) | < 0.001 |

**Table II.** Correlation analysis of metabolic parameters of primary lesion examined by $^{18}$F-FDG PET/CT for endometrial cancer and positive expression of ER, PR, HER-2 and KI-67 in cancer tissues.

| Item | ER positive (n = 66) | | PR positive (n = 53) | | HER-2 positive (n = 42) | | Ki-67 positive (n = 47) | |
|---|---|---|---|---|---|---|---|---|
| | r | p | r | p | r | p | r | p |
| $SUV_{max}$ | -0.275 | 0.035 | -0.479 | 0.001 | 0.403 | 0.002 | 0.438 | 0.001 |
| MTV | -0.399 | 0.003 | -0.408 | 0.001 | 0.553 | 0.001 | 0.405 | 0.002 |
| TLG | -0.491 | 0.001 | -0.534 | 0.001 | 0.511 | 0.001 | 0.526 | 0.001 |

the SUVmax, TLG and MTV of primary lesion of patients with EC combined with lymph node metastasis were significantly higher than those without lymph node metastasis, which was also confirmed in this study.

Recent advances in molecular biology have provided important information for molecular typing and prognosis prediction of tumors[20]. Some scholars[21] have shown that tissue molecular immunochemical markers (ER, PR, HER2, Ki-67) of endometrial cancer affect the formation, development and prognosis of endometrial cancer. In 1983, Bokhman[22] first emphasized the important role of endocrine and metabolic disorders in the pathogenesis of endometrial cancer. Combined with clinicopathological features and disease prognosis, endometrial cancer was divided into two different subtypes. Endometrial cancer belongs to a hormone-dependent disease. The expression of ER and/or PR is correlated with tumor histological grading, pathological type, and surgical pathological staging[23]. The positive expression of ER and/or PR in tissue of endometrial cancer is classified as Type I with low malignancy, suggesting a response to hormone therapy[24]. HER2 is a protein gene distributed on the long arm of chromosome 17[25]. It can be activated by glycoprotein receptors, leading to abnormal cell cycle regulation, exacerbating the low differentiation of tumor cells, and affecting the infiltration of tumor cells into adjacent normal tissues to promote the progress of the disease. Ki67 is a nuclear antigen correlated with cell proliferation, which is currently considered as a marker reflecting cell proliferation activity[26]. The positive expression of ER, PR, HER2 and Ki-67 was correlated with the clinicopathological factors of endometrial cancer. The positive expression of metabolic parameters, such as SUVmax, TLG and MTV, of primary lesion examined by $^{18}$F-FDG PET/CT have significant negative correlation with the positive expression of ER and PR, with negative correlation with the positive expression of HER2 and Ki-67. Therefore, according to the metabolic parameters, the molecular immune markers of endometrial cancer can be predicted, which is helpful to guide the treatment before surgery.

## Conclusions

To sum up, metabolic parameters of primary lesion examined by $^{18}$F-FDG PET/CT for endometrial cancer before surgery are closely related to clinicopathological factors. According to the SUVmax, MTV and TLG of metabolic parameters of primary lesion, the biological behavior can be predicted, which can provide the basis for preoperative formulation of treatment plan and prognosis evaluation, so as to reduce the surgical risk of patients with EC and improve the quality of life after surgery.

PET-CT examination has its limitations, especially in judging lymph node metastasis, because $^{18}$F-FDG can be rapidly absorbed and metabolized by anti-inflammatory cells such as granulation tissue and macrophages during inflammation. Therefore, infectious lesions such as inflammation and tuberculosis can lead to false positives, combined with MRI comprehensive assessment if necessary. In the future, the multi-center and large sample clinical research needs to be further clarified in the efficacy of $^{18}$F-FDG PET/CT in EC preoperative evaluation.

### Conflict of Interest

The Authors declare that they have no conflict of interests.

## References

1) Sorosky JI. Endometrial cancer. Obstet Gynecol 2012; 120: 383-397.

**Table III.** Relationship between immunohistochemical markers and clinicopathological features of endometrial cancer (n).

| Clinicopathologic Features | | N. of cases | ER n = 55 | $X^2$/*p*-value | PR n = 46 | $X^2$/*p*-value | HER -2 n = 40 | $X^2$/*p*-value | Ki-67 n = 42 | $X^2$/*p*-value |
|---|---|---|---|---|---|---|---|---|---|---|
| Age (years) | ≤ 55 | 24 | 16 | 0.142/0.706 | 13 | 0.234/0.629 | 11 | 0.318/0.573 | 12 | 0.139/0.710 |
| | >55 | 55 | 39 | | 33 | | 29 | | 30 | |
| Tissue Grading | G1 | 10 | 9 | 24.992/0.000 | 8 | 17.000\/0.000 | 1 | 11.964/\0.003 | 1 | 17.060/0.000 |
| | G2 | 51 | 42 | | 35 | | 25 | | 25 | |
| | G3 | 18 | 4 | | 3 | | 14 | | 16 | |
| FIGO Staging | Stage I | 35 | 28 | 9.716/0.021 | 29 | 15.849/0.001 | 10 | 12.615/0.006 | 9 | 16.343/0.001 |
| | Stage II | 21 | 16 | | 10 | | 10 | | 12 | |
| | Stage III | 18 | 10 | | 6 | | 15 | | 16 | |
| | Stage IV | 5 | 1 | | 1 | | 5 | | 5 | |
| Depth of Myometrial Invasion | ≤ 1/2 | 63 | 50 | 13.966/0.000 | 40 | 7.974/0.005 | 27 | 7.524/0.006 | 28 | 9.499/0.002 |
| | > 1/2 | 16 | 5 | | 6 | | 13 | | 14 | |
| External Cervical Tissue Involved | No | 56 | 45 | 10.484/0.001 | 37 | 4.865/0.027 | 22 | 9.908/0.002 | 21 | 18.955/0.000 |
| | Yes | 23 | 10 | | 9 | | 18 | | 21 | |
| Lymph Node Metastasis | No | 64 | 53 | 10.789/0.001 | 45 | 9.271/0.002 | 32 | 5.947/0.015 | 33 | 8.948/0.003 |
| | Yes | 15 | 2 | | 1 | | 8 | | 9 | |

2) Lee JM, Minasian L, Kohn EC. New strategies in ovarian cancer treatment. Cancer 2019; 125: 4623-4629.

3) Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global cancer statistics, 2012. CA Cancer J Clin 2015; 65: 87-108.

4) Tangjitgamol S, Anderson BO, See HT, Lertbutsayanukul C, Sirisabya N, Manchana T, Ilancheran A, Lee KM, Lim SE, Chia YN, Domingo E, Kim YT, Lai C, Mohd Dali AZH, Supakapongkul W, Wilailak S, Tay EH, Kavanagh J, Asian Oncology Summit. Management of endometrial cancer in Asia: consensus statement from theAsian Oncology Summit 2009. Lancet Oncol 2009; 10: 1119-1127.

5) Chan JK, Kapp DS. Role of complete lymphadenectomy in endometrioid uterine cancer. Lancet Oncol 2007; 8: 831-841.

6) Sari O, Kaya B, Kara PO, Gedik GK, Celik C, Ozbek O, Serdengecti M. The role of FDG-PET/CT in ovarian cancer patients with high tumor markers or suspicious lesion on contrast-enhanced CT in evaluation of recurrence and/or in determination of intraabdominal metastases. Rev Esp Med Nucl Imagen Mol 2012; 31: 3-8.

7) Kim JY, Lee SH, Kim S, Kang T, Bae YT. Tumour 18 F-FDG Uptake on preoperative PET/CT may predict axillary lymph node metastasis in ER-positive/HER2-negative and HER2-positive breast cancer subtypes. Eur Radiol 2015; 25: 1172-1181.

8) Rao L, Wang X, Zong Z, Chen Z, Shi X, Yi C, Zhang X, Yang Z. PET-CT for Evaluation of spleen and liver 18F-FDG diffuse uptake without lymph node enlargement in lymphoma. Medicine (Baltimore) 2016; 95: e3750.

9) Husby JA, Reitan BC, Biermann M, Trovik J, Bjørge L, Magnussen IJ, Salvesen ØO, Salvesen HB, Haldorsen IS. Metabolic tumor volume on 18F-FDG PET/CT improves preoperativeidentification of high-risk endometrial carcinoma patients. J Nucl Med 2015; 56: 1191-1198.

10) Pecorelli S. Revised FIGO staging for carcinoma of the vulva, cervix, and Endometrium. Int J Gynaecol Obstet 2009; 105: 103-104.

11) Lu Z, Chen J. Introduction of WHO classification of tumours of female reproductive organs, fourth edition.zhong Hua Bing Li Xue Za Zhi 2014; 43: 649-650.

12) Rossard L, Rua C, Duquesne M, Vildé A, Marret H, Body G, Ouldamer L. Reliability of Imaging Modalities for Preoperative Assessment of Patients With Endometrial Carcinoma. Gynecol Obstet Fertil 2013; 41: 641-647.

13) Muralidharan V, Kwok M, Lee ST, Lau L, Scott AM, Christophi C. Prognostic ability of 18F-FDG PET/CT in the assessment of colorectal liver metastases. J Nucl Med 2012; 53: 1345-1351.

14) Takagi H, Sasagawa T, Shibata T, Minato H, Takahashi T. Association between 18F-fluorodeoxyglucose-PET/CT and histological grade ofuterine endometrial carcinoma. Taiwan J Obstet Gynecol 2018; 57: 283-288.

15) Kakhki VRD, Shahriari S, Treglia G, Hasanzadeh M, Zakavi SR, Yousefi Z, Kadkhodayan S, Sadeghi R. Diagnostic performance of fluorine 18 fluorodeoxyglucose positron emission tomography imaging for detection of primary lesion and staging of endometrial cancer patients: systematic review and meta-analysis of the literature. Int J Gynecol Cancer 2013; 23: 1536-1543.

16) Sun J, Cui XW, Li YS, Wang SY, Yin Q, Wang XN, Gu L. The value of 18F-FDG PET/CT imaging combined with detection of CA125 and HE4 in the diagnosis of recurrence and metastasis of ovarian cancer. Eur Rev Med Pharmacol Sci 2020; 24: 7276-7283.

17) Kitajima K, Suenaga Y, Ueno Y, Maeda T, Ebina Y, Yamada H, Okunaga T, Kubo K, Sofue K, Kanda T, Tamaki Y, Sugimura K. Preoperative risk stratification using metabolic parameters of (18)F-FDG PET/CT in patients with endometrial cancer. Eur J Nucl Med Mol Imaging 2015; 42: 1268-1275.

18) Boonya-ussadorn T, Choi WH, Hyun J, Kim SH, Chung SK, Yoo IR. 18F-FDG PET/CT Findings in endometrial cancer patients: the correlation between SUVmax and clinicopathologic features. J Med Assoc Thai 2014; 97: S115-S122.

19) Kim HJ, Cho A, Yun M, Kim YT, Kang WJ. Comparison of FDG PET/CT and MRI in lymph node staging of endometrial cancer. Ann Nucl Med 2016; 30: 104-113.

20) Cancer Genome Atlas Research Network, Kandoth C, Schultz N, Cherniack AD, Akbani R, Liu Y, Shen H, Robertson AG, Pashtan I, Shen R, Benz CC, Yau C, Laird PW, Ding L, Zhang W, Mills GB, Kucherlapati R, Mardis ER, Levine DA. Integrated genomic characterization of endometrial carcinoma. Nature 2013; 497: 67-73.

21) Yu CG, Jiang XY, Li B, Gan L, Huang JF. Expression of ER, PR, C-erbB-2 and Ki-67 in endometrial carcinoma and their relationships with the clinicopathological features. Asian Pac J Cancer Prev 2015; 16: 6789-6794.

22) Bokhman JV. Two Pathogenetic types of endometrial carcinoma. Gynecol Oncol 1983; 15: 10-17.

23) Tomica D, Ramić S, Danolić D, Šušnjar L, Perić-Balja M, Puljiz M. Impact of oestrogen and progesterone receptor expression in the cancer cells and myometrium on survival of patients with endometrial cancer. J Obstet Gynaecol 2018; 38: 96-102.

24) Luo L, Xu L, Tang L. The Expression of ER, PR in endometrial cancer and analysis of their correlation with ERK signaling pathway. Cancer Biomark 2017; 21: 145-149.

25) Koskas M, Depreeuw J, Moens S, Annibali D, Cuppens T, Moerman P, Lambrechts D, Amant F. Genomic characterisation and response to tras-

tuzumab and paclitaxel in advanced or recurrent HER2-positive endometrial carcinoma. Anticancer Res 2016; 36: 5381-5384.

26) Yang B, Shan B, Xue X, Wang H, Shan W, Ning C, Zhou Q, Chen X, Luo X. Predicting Lymph node metastasis in endometrial cancer using serum CA125 combined with immunohistochemical markers PR and Ki67, and a comparison with other prediction models. PLoS One 2016; 11: e0155145.