Abstract

Introduction

Prostate cancer is one of the most frequently diagnosed malignant neoplasms in men. Accurate assessment of disease stage is crucial for selecting an appropriate treatment strategy. Traditional imaging methods such as magnetic resonance imaging (MRI), computed tomography (CT), and bone scintigraphy have diagnostic limitations, particularly in the evaluation of lymph node involvement and distant metastases. Prostate-specific membrane antigen positron emission tomography (PSMA PET/CT) is a modern molecular imaging technique that may improve diagnostic accuracy and influence therapeutic decisions.

Aim of the Study

The aim of this study was to analyze the effectiveness of PSMA PET/CT in comparison with conventional imaging methods (MRI, CT, and bone scintigraphy) in the diagnostic evaluation of prostate cancer. Particular emphasis was placed on assessing the concordance between PSMA PET/CT findings and histopathological results in patients undergoing radical prostatectomy, as well as evaluating the impact of PSA levels on PSMA tracer uptake (SUVmax).

Materials and Methods

This prospective study included 128 patients with prostate cancer who underwent both PSMA PET/CT and conventional imaging. In a subgroup of 51 patients who underwent radical prostatectomy, imaging results were compared with histopathological findings.The effectiveness of PSMA PET/CT in the assessment of T, N, and M stages was evaluated, as well as the correlation between PSA levels and PSMA uptake. Statistical analysis included the Chi-square test, McNemar test, and Spearman rank correlation.

T Stage Assessment

MRI more frequently than PSMA PET/CT accurately reflected the local tumor advancement when compared with histopathological results (33% vs. 26%). PSMA PET/CT, on the other hand, tended to underestimate the T stage, leading to more frequent downstaging.

N Stage Assessment

PSMA PET/CT detected lymph node metastases in a greater number of patients compared to conventional imaging methods (MRI and CT), identifying 33 cases versus 29.

Histopathological confirmation in the operated subgroup supported the higher specificity of PSMA PET/CT over conventional methods.

M Stage Assessment

Distant metastases were detected by PSMA PET/CT in 23 patients, including 9 cases that were not visualized on bone scintigraphy. Bone scintigraphy yielded a greater number of indeterminate results, which were clarified by PSMA PET/CT, allowing for more confident exclusion or confirmation of metastatic spread.

Impact of PSA on PSMA Uptake

The Spearman rank correlation between PSA levels and SUVmax was $r = 0.38$ ($p < 0.00002$), indicating a moderate relationship. PSMA PET/CT showed higher diagnostic accuracy in patients with intermediate- and high-risk disease and in tumors of higher ISUP grade. However, no significant correlation was found between SUVmax and local tumor advancement (T stage).

Conclusions

PSMA PET/CT outperforms MRI and CT in the assessment of lymph node involvement and detection of distant metastases, which may result in changes to staging classification, including both upstaging and downstaging. While MRI remains the preferred imaging modality for evaluating local tumor extent (T stage), PSMA PET/CT demonstrates superior specificity. Furthermore, PSMA PET/CT avoids false-positive results often encountered in bone scintigraphy and is capable of detecting additional metastases that remain invisible in conventional imaging. Although there is only a moderate correlation between PSA levels and PSMA uptake (SUVmax), PSMA PET/CT appears effective even in patients with low PSA values. These findings suggest that PSMA PET/CT should be considered a standard diagnostic tool in the staging of prostate cancer, particularly for the detection of metastatic disease.

Keywords

Prostate cancer, PSMA PET/CT, MRI, staging, SUVmax, PSA, metastases, lymph nodes, T stage, N stage, M stage.