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Performance Characteristics and Influence of PSA Value/Kinetics on Carbon-11 Acetate PET/CT Imaging in Biochemical Relapse of Prostate Cancer

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An elevated serum prostate-specific antigen (PSA) level cannot distinguish between local-regional recurrences and distant metastases after treatment with curative intent. With the available salvage treatments such as cryotherapy, external-beam radiotherapy and brachytherapy, it has become important to localize the site of recurrence (local or distant). In this study, C11-Acetate positron emission tomography (PET/CT) was used to identify the site of recurrence in patients with rising PSA. To our knowledge, this represents the largest single institution experience of C11-Acetate PET/CT imaging for prostate cancer in North America.

Methods: A total of 618 patients with biochemical relapse were imaged with C11-Acetate PET/CT. 576 patients prospectively enrolled in this evaluation had a rising PSA for which doubling time and velocity could be calculated (mean PSA, 6.08; median, 2.69; range, 0.14 - 148). In 124 patients, the PSA was <= 1.0 ng/mL (mean, 0.62; median 0.61). Prior definitive treatment varied and included prostatectomy [PR] (155), external beam radiation or brachytherapy [RT] (215), RP + RT (180), ADT (14), Cryotherapy (6), HIFU (5). Chi-squares, 2-sample t tests, and logistic regression analysis were used to determine whether there was a relationship between PSA levels, PSA kinetics and the rate of detection of the site of relapse. Correlation to biopsy, subsequent imaging or PSA response to focal treatment with RT or Cryotherapy was also performed.

Results: 87% of the 576 C11-Acetate PET/CT scans were positive. There was a statistically significant difference in PSA values between the positive and negative scans (P<0.001 for mean difference). The percentage of positive scans and PSA value had a positive correlation. Logistic regression and ROC analysis demonstrated that a PSA of 0.98 ng/mL was an optimal cutoff point with a sensitivity of 87% (AUC 0.918). PSA velocity was not found to be a significant predictor of positivity. PSA doubling time was only found to be significantly correlated with a positive scan when the PSA was <1.0 ng/mL. A doubling time of <3.8 months appeared significant (P<0.05) as an optimal cutoff point with 88% sensitivity. Positive scan findings could be correlated (non-overlapping) by biopsy in 74 of 85 studies, subsequent imaging in 120 of 130, or significant PSA response to focal treatment with RT or Cryotherapy in 67 of 76, yielding a combined PPV of 90%. Disease was detected in the prostate or bed in 26%, regional nodes in 32%, and in distant sites in 42%.

Conclusion: C11-Acetate PET/CT appears to have a high overall detection rate for the site of recurrence/metastasis in biochemical relapsed prostate cancer (87% overall detection rate, PPV 90%). This study suggests a PSA threshold of >0.98 ng/mL or a PSA doubling time of <3.8 months when the PSA is below 1.0 as independent predictors of positive findings. These findings can be used to improve the selection of patients for C11-Acetate PET/CT scanning and increase the detection rates of the site of relapse.