# The value of $^{68}$Ga-PSMA enhanced PET-CT and MR-PET in patients with recurrent prostate cancer

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## Introduction

In patients with prostate Cancer and those with recurrent disease after radical prostatectomy increased levels of PSMA can be measured. Recently a new tracer, $^{68}$Ga-PSMA, was developed as a specific marker for hybrid imaging (PET/CT, MR-PET).

## Purpose

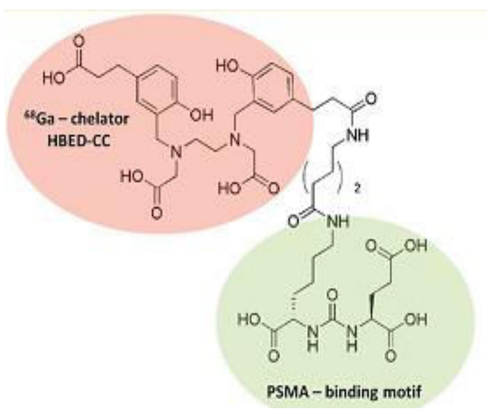
**The purpose of this study was to evaluate the accuracy of $^{68}$Ga-PSMA in patients with rising PSA after radical prostatectomy, so called „biochemical recurrent prostate cancer“ (BRPC).**

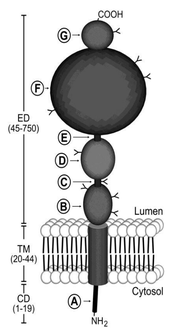
## Methods

PSMA: prostate-specific membrane antigen is a cell surface protein with overexpression in prostate cancer (approx. 10 kDa).

It is a promising target for prostate cancer specific imaging.

Recently various PSMA-ligands for PET and SPECT-imaging were developed.




Rajasekaran A et al. Am J Physiol Cell Physiol 2005

**Figure 1:**
PSMA: prostate-specific membrane antigen
Tracer development:$^{68}$Ga-PSMA: Glu-NH-CO-NH-Lys-(Ahx)-[$^{68}$Ga(HBED-CC)]

**Patients:**
A total of 322 patients with BRPC underwent a PET/CT or MR/PET examination (Siemens Biograph mMR) after injection of about 150 mBq $^{68}$Ga-PSMA.

**Computed Tomography (CT):**
contrast enhanced CT from head to pelvis.

**MR pulse sequences:**
head-pelvis: cor T1 TSE, ax T2 haste fat sat., ax T2 HR (pelvis Lnn.)

**Image analysis:**
Images were evaluated in consensus by one experienced nuclear medicine physician and one radiologist. Positive imaging results were judged as: a) suspicious, b) highly suspicious

These findings were stratified according to PSA-values.

Pelvine lymph node dissection was performed in some of the patients according to a predefined template with 8 fields. Lymph node involvement was evaluated according to a 5 point scale with a patient- and a field-based analysis.

## Results

Four patients were excluded from the study for different reasons. Sensitivity for detection of recurrence was 95.7 % for PSA-values ≥ 2ng/ml, 81.4 % for PSA-values of 1-2 ng/ml, 76% for PSA-values 0.5-1 ng/ml, and 51% for PSA values ≤ 0.5 ng/ml. In comparison to the MR-images alone MR-PET was of superior diagnostic value.

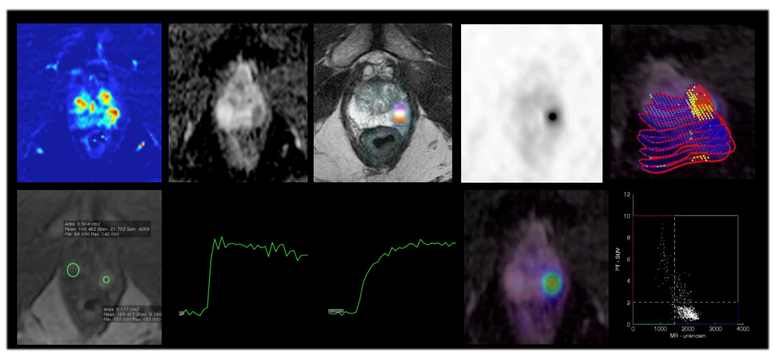


**Figure 2:**
Multiparametric MRI and PET-MR of prostate cancer: DCE-MRI (left and curves), DW-MRI, MR/PET with $^{68}$Ga-PSMA; Herterogeneity map (right b.)

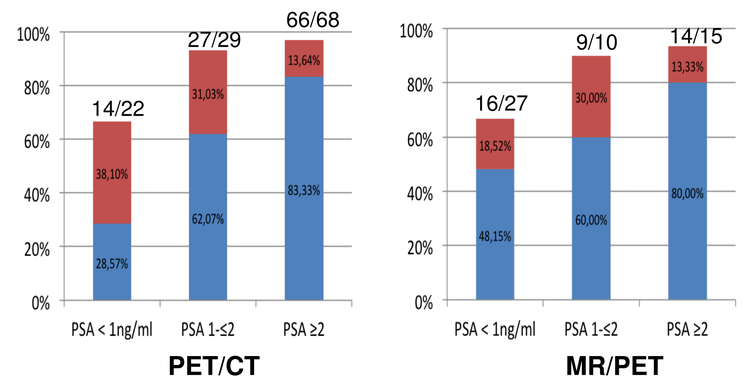



**Figure 3:**
Comparison of detection rate of PET/CT and PET/MR with $^{68}$Ga-PSMA according to PSA values in [%] and number of cases.
Red is suspicious and Blue highly suspicious.

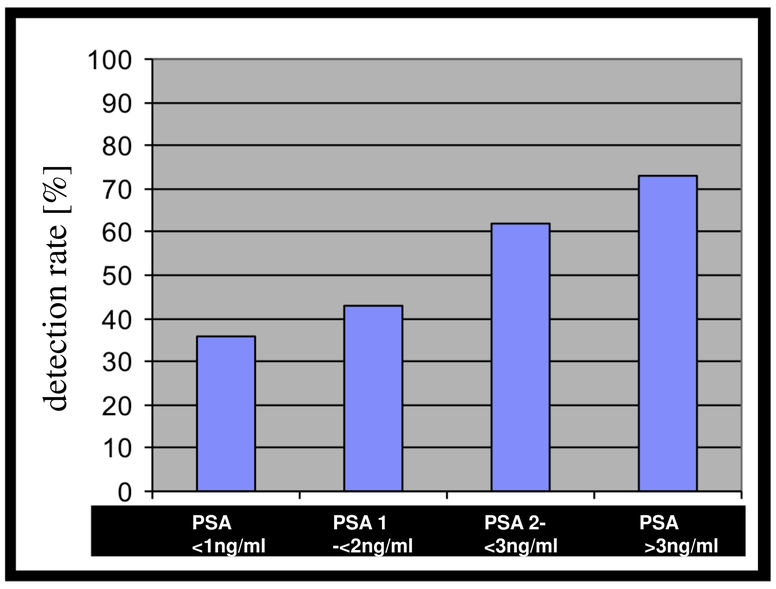



**Figure 4:**
Comparison of detection rate of PET/CT with $^{11}$ C-Choline according to PSA values in [%]

Lymph node metastases may be also the origin of a biochemical recurrence. Detection of these Metastases can also be improved by the use of $^{68}$Ga-PSMA

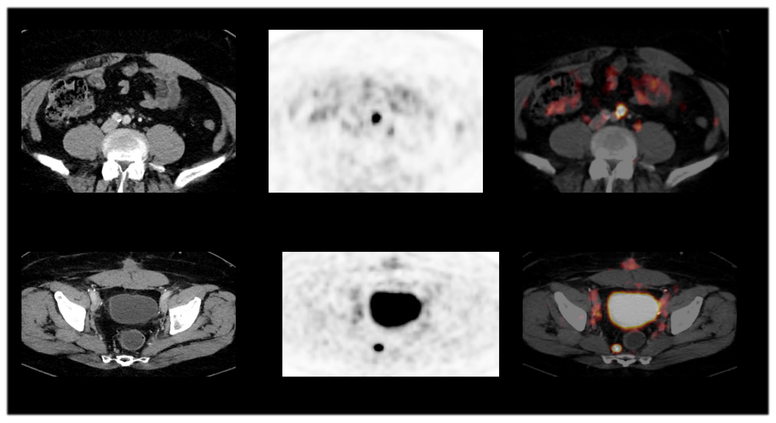


**Figure 5:**
CE-CT (left), $^{68}$Ga-PSMA PET (middle), and/$^{68}$Ga-PSMA PET/CT (right). Note the optimized detection and characterization malignant of lymph nodes with $^{68}$Ga-PSMA.

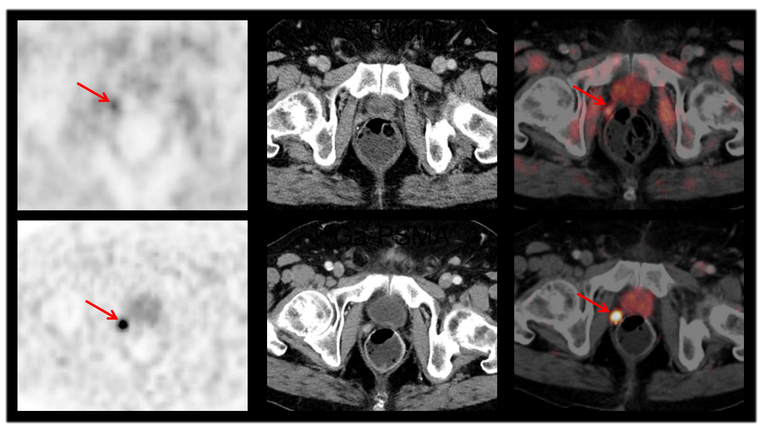


**Figure 6:**
Comparison of sensitivity of PET and PET/CT with $^{68}$Ga-PSMA. $^{11}$C-Choline PET/CT (upper row) and with$^{68}$Ga-PSMA (bottom row). Note the higher signal and better detection with $^{68}$Ga-PSMA

## Conclusion

**PET-CT and MR-PET using $^{68}$Ga-PSMA are sensitive techniques for detection and characterization of local recurrence of prostate cancer and of pathologic lymph nodes.**

**Thus these are highly accurate techniques for the diagnosis of biochemical recurrence (BRCP) of prostate cancer after radical prostatectomy. It yields high diagnostic performance at relatively low PSA-values.**

**Furthermore it may serve as a marker for radio-guided surgery and thus improve the outcome of a re-operation after radical prostatectomy.**

**References:** [1] Eiber M, Nekolla SG, Maurer T, et al.: (68)Ga-PSMA PET/MR with multimodality image analysis for primary prostate cancer. Abdom Imaging 2015 (Aug, 40(6): 1769-71

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