Imaging pancreatic carcinoma model with 11C-acetate: a comparison study with 18F-FDG using microPET

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Early detection of pancreatic carcinoma is still a clinical problem.

In early stage of pancreatic carcinoma, it is hard for ultrasound, CT, MR to obtain sufficient evidence of the tumor from mere anatomic evaluation.

The value of 18F-FDG PET imaging in the detection of pancreatic tumor is still controversial.

11C-acetate imaging has been used in hepatic tumor, prostate carcinoma and brain tumors. However, the data of its use in pancreatic carcinoma is few.
The objective of this study was to evaluate the significance of 11C-aceteate as a PET tracer for early detection of pancreatic carcinoma in comparing with 18F-FDG imaging.
Methods

Tumor model

- Animal: BALB/c-nu nude mice, 6-8 weeks old, 20-25g
- Cell line: BxPC-3 (human pancreatic carcinoma)
- Inoculation: subcutaneous injection of BxPC-3 cell on right shoulder. 2 weeks later, ready for microPET imaging

Radiopharmaceutical

CYPRISHM-12 Cyclotron (Sumitomo Heavy Ind., Japan)
  - 11C-acetate
  - 18F-fluorodeoxyglucose (FDG)
**Methods**

**Data Acquisition**
Micro-PET (Siemens Concord Rodent R4, USA)

- **11C-acetate PET imaging protocol**
  - Injection
  - 2 scans, 10min/scan
  - Time (min): 0, 10, 20, 30

- **18F-FDG PET imaging protocol**
  - Injection
  - 1 scan, 10min
  - Time (min): 0, 30, 60, 90

**Image Reconstruction**
OSEM algorithm
Data analysis

ROI determination

\[
\text{T/N ratio} = \frac{\text{maximum counts of tumor}}{\text{mean counts of background}}
\]

T/N ratio: tumor to non-tumor ratio

Immunohistochemistry

Grading of PCNA (proliferating cell nuclear antigen) expression:

- 1+: positive incidence 25%
- 2+: 25% positive incidence 50%
- 3+: 50% positive incidence 75%
- 4+: 75% positive incidence
Methods

Statistical analysis

Quantitative parameters
- ANOVA
- Linear correlation
  - T/N of 18F-FDG vs T/N of 11C-acetate

Non-quantitative parameters
- Spearman rank order correlation
  - PCNA grade vs tumor size
  - vs T/N of 18F-FDG
  - vs T/N of 11C-acetate
Results

Growth of Tumor

Tumor size = tumor length × tumor width
Results

Growth of tumor
visible from week 2, grow slowly

week 3, No. 2

week 5, No. 3

0.46X0.41 cm$^2$

0.61X0.45 cm$^2$
Results

Micro PET imaging

week 3

- 18F-FDG T/N=1
- 11C-acetate T/N=1.7

week 4

- 18F-FDG T/N=1.6
- 11C-acetate T/N=1.7
Results

Micro PET imaging

week 5

18F-FDG  T/N=1.6
11C–acetate  T/N=1.8

week 6

18F-FDG  T/N=1.6
11C–acetate  T/N=1.3
Results

PCNA expression

<table>
<thead>
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<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
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Optical microscope, 400 X
Results

T/N ratio in 11C-acetate and 18F-FDG micro PET imaging

N.S.: not significant
Results

Linear Correlation

T/N 11C-acetate vs T/N 18F-FDG

\[ r = -0.291, P = 0.485 \]

Spearman Rank Order Correlation

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<th>PCNA grade</th>
<th>n</th>
<th>r</th>
<th>P value</th>
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<tr>
<td>Tumor size</td>
<td>12</td>
<td>0.158</td>
<td>0.624</td>
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<tr>
<td>T/N 11C-acetate</td>
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<td>T/N 18F-FDG</td>
<td>9</td>
<td>-0.126</td>
<td>0.766</td>
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Conclusions

- 11C-acetate might be a valuable candidate for imaging pancreatic carcinoma model in early stage.

- Upon a certain phase of tumor growth, 18F-FDG showed comparable tumor detectability with 11C-acetate.