III. 14 Studies on Myocardial Metabolism of Rats Using Positron-Emitting Radio-
pharmaceuticals

(3) Effects of Diet on Myocardial Glucose Metabolism

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INTRODUCTION

Ishemic heart disease (IHD) is considered to be affected by high calory intake
and/or high fat intake. Recently dietary fat is increasing gradually and propor-
tionally hypercholesterolemia and the other risks seem to be increasing in Japan.
Influence of diet on the onset of IHD is studied by epidemiological data, but few
reports are seen about the relation between diet and the myocardial metabolism.
In this work we investigate the influence of several diet on the myocardial glucose
metabolism using F-18-labeled-2-deoxy-glucose (F-18FDG) in the rats.

MATERIALS AND METHODS

1) Pre-treatment: The Donryu rats were divided into three groups according to the
diet.

I: The first group was fed by standard diet.

II: The second group was fed by high-protein diet.

III: The third group was fed by high-fat diet.

Each group had 7-8 rats weighing 170-180 g. The rats were fed by each diet for 7
days before the examination. The composition of each diet were showed in table 1.

2) F-18FDG was synthesized by the method developed by Ido et al. 1) Each rat was
injected 10uCi of F-18FDG intravenously. The rats were killed 30 minutes after
the injection. Blood, heart, brain and liver were removed and they were packed
into the tube and their radioactivity were counted by auto-gammacounter. Percent
injected dose/g of each organ was calculated.

RESULTS

The myocardial uptake of F-18FDG decreased in rats which fed high-fat diet(III)
than in control rat(I). Percent injected dose per gram of heart in control group
and high-fat diet group was 5.89 ± 1.24 and 3.24 ± 1.03, respectively. The uptake
by the heart in high-protein diet group(II) was in middle position between control
and high-fat diet group. Its percent dose per gram was 4.82 ± 1.26. Activity of
the blood, brain and the liver was increased in high-fat diet group than control.
group. It was opposite phenomenon which was seen in the heart.

DISCUSSIONS

The myocardial uptake of F-18FDG was lower in the rats fed high-fat diet than in control diet. Our examination was carried out by feeding the rats for 7 days. Phelps M. E.\textsuperscript{2) had shown same finding after meal in human subjects using ECAT. There are no difference in myocardial uptake between rat fed for 7 days and human subject immediately after meal. Under the condition of the high-fat diet, increaseasement of FFA oxidation and ketosis has been shown biochemically. And the heart seems to utilize FFA and/or ketone bodies as substrate for energy production. Under the condition of high-protein diet, glycolysis is considered to be suppressed and glyconeogenesis becomes active. Probably for this reason, the myocardial uptake of FDG was lower in rats fed high-protein than in control rats. Long time must be necessary for developing IND, so that long-term dietary experiments are required further more.

ACKNOWLEDGMENT

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References
Table 1. Composition of experimental diets.

<table>
<thead>
<tr>
<th>Diet</th>
<th>Composition</th>
<th>water</th>
<th>protein</th>
<th>fat</th>
<th>salt mix</th>
<th>fiber</th>
<th>carbohydrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Standard</td>
<td>8.5</td>
<td>21.2</td>
<td>6.0</td>
<td>6.3</td>
<td>9.5</td>
<td>48.5</td>
<td></td>
</tr>
<tr>
<td>II High-protein</td>
<td>7.1</td>
<td>60.0</td>
<td>6.5</td>
<td>9.6</td>
<td>7.6</td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>III High-fat</td>
<td>8.4</td>
<td>21.0</td>
<td>6.9</td>
<td>7.6</td>
<td>7.6</td>
<td>35.9</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Uptakes of F-18FDG in rats.

* P < 0.05 ** P < 0.01

<table>
<thead>
<tr>
<th>Diet</th>
<th>Organ</th>
<th>blood</th>
<th>heart</th>
<th>brain</th>
<th>liver</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Standard</td>
<td>0.19  ± 0.04</td>
<td>5.89 ± 1.24</td>
<td>1.45 ± 0.13</td>
<td>0.23 ± 0.05</td>
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<tr>
<td>II High-protein</td>
<td>0.22 ± 0.05</td>
<td>4.82 ± 1.26</td>
<td>1.70 ± 0.12**</td>
<td>0.23 ± 0.05</td>
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<tr>
<td>III High-fat</td>
<td>0.34 ± 0.12**</td>
<td>3.24 ± 1.03**</td>
<td>1.81 ± 0.29*</td>
<td>0.41 ± 0.15*</td>
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</tbody>
</table>

Table 3. Tumor-to-tissue ratios at 60 min. after administration of $^{18}$F-FuR or $^{18}$F-FUdR.

<table>
<thead>
<tr>
<th>Tumor/Brain</th>
<th>$^{18}$F-FuR</th>
<th>$^{18}$F-FUdR</th>
</tr>
</thead>
<tbody>
<tr>
<td>/Lung</td>
<td>10.1</td>
<td>21.7</td>
</tr>
<tr>
<td>/Liver</td>
<td>1.9</td>
<td>3.3</td>
</tr>
<tr>
<td>/Kidney</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>/Skeletal Muscle</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>/Blood</td>
<td>4.8</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>4.5</td>
</tr>
</tbody>
</table>
Fig. 1. Uptake of F-18FDG in rats.

- I: control rats
- II: high-protein diet fed rats
- III: high-fat diet fed rats