Report on Experiments and Clinical Cases

Resting Energy Expenditure in Pregnant Japanese Women

Hiromitsu Chihara, Yasuo Otsubo and Tsutomu Araki

Department of Obstetrics and Gynecology, Nippon Medical School

Abstract

The subjects were 160 pregnant women with no complications who were examined with indirect calorimetry by a single observer; 20 healthy age-matched non-pregnant women were used as controls. Assessment was performed 12 hours after oral intake of food. Each measurement of resting energy expenditure divided by the body surface area was analyzed and compared with that of the controls. In pregnant women, the mean resting energy expenditure divided by the body surface area did not significantly increase until 32 weeks’ gestation. Energy expenditure increased significantly by about 300–600 kJ/m² between before 31 weeks’ gestation and the end of pregnancy. Significant changes occurred in the 32–35 and 36–40 weeks’ gestational stages (3,790±370, 4,110±385 kJ/m²) (p < 0.05). Resting energy expenditure increases at conception, and does not increase until 32 week’s gestation, but increases gradually from 32 weeks’ gestation to term in normal pregnant women as assessed by indirect calorimetry. (J Nippon Med Sch 2002; 69: 373–375)

Key words: resting energy expenditure, indirect calorimetry, pregnancy

Introduction

Maternal malnutrition is associated with intrauterine growth retardation, premature labor1 and sometimes increased perinatal mortality and morbidity2. Intestinal obstruction or acute pancreatitis, which often occur in the gestational period, readily lead to severe maternal malnutrition3. Severe degrees of dehydration, hypokalemia, starvation ketosis or acidosis may occur and may be life threatening4. Most patients are able to eat after several days of therapeutic peripheral venous infusion; however, some patients must undergo prolonged starvation before refeeding. Therefore, it is important to determine the amount of energy needed to maintain the pregnancy5. To plan optimal therapy for malnourished patients the energy goal must be defined6.

Some studies have examined intravenous nutrition during pregnancy47. In these studies, the energy expenditure and adjustment of nutrient intake were estimated using predictive equations48.

The objective of this study was to investigate the relationship between the resting energy expenditure and gestational age during pregnancy in Japanese women.

Subjects and methods

Indirect calorimetry was measured in 160 pregnant women from 6 to 40 weeks’ gestation and 20 healthy women between January and May 1999. Patients with metabolic and endocrinological diseases such as diabetes mellitus, hyperthyroidism and with any gestational complications were excluded from this study. All patients were examined over 12

Correspondence to Hiromitsu Chihara, Department of Obstetrics and Gynecology, Nippon Medical School,
1–1–5 Sendagi, Bunkyo-ku, Tokyo 113–8602, Japan
E-mail: naru@nms.ac.jp
Journal Website (http://www.nms.ac.jp/jnms/)
Table: Characteristics of each group

<table>
<thead>
<tr>
<th>Subjects (weeks)</th>
<th>Age (years) (mean ± SD)</th>
<th>Weight (kg) (mean ± SD)</th>
<th>BSA * (mean ± SD)</th>
<th>REE † (mean ± SD)</th>
<th>REE/BSA (kJ/m²) (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>control</td>
<td>28.3 ± 3.86</td>
<td>51.4 ± 4.25</td>
<td>1.47 ± 0.07</td>
<td>4.710 ± 488</td>
<td>3.210 ± 304</td>
</tr>
<tr>
<td>5—11</td>
<td>28.3 ± 3.59</td>
<td>51.4 ± 3.85</td>
<td>1.47 ± 0.06</td>
<td>5.080 ± 565</td>
<td>3.470 ± 340</td>
</tr>
<tr>
<td>12—15</td>
<td>29.4 ± 3.32</td>
<td>50.9 ± 2.56</td>
<td>1.47 ± 0.05</td>
<td>4.860 ± 684</td>
<td>3.320 ± 462</td>
</tr>
<tr>
<td>16—19</td>
<td>27.6 ± 3.05</td>
<td>51.4 ± 4.25</td>
<td>1.51 ± 0.07</td>
<td>5.360 ± 553</td>
<td>3.560 ± 367</td>
</tr>
<tr>
<td>20—23</td>
<td>28.6 ± 3.00</td>
<td>55.5 ± 5.85</td>
<td>1.51 ± 0.09</td>
<td>5.490 ± 608</td>
<td>3.630 ± 342</td>
</tr>
<tr>
<td>24—27</td>
<td>29.3 ± 2.75</td>
<td>59.4 ± 6.08</td>
<td>1.57 ± 0.09</td>
<td>5.650 ± 867</td>
<td>3.600 ± 443</td>
</tr>
<tr>
<td>28—31</td>
<td>29.5 ± 3.90</td>
<td>57.1 ± 5.05</td>
<td>1.54 ± 0.08</td>
<td>5.730 ± 716</td>
<td>3.720 ± 340</td>
</tr>
<tr>
<td>32—35</td>
<td>27.9 ± 3.77</td>
<td>60.7 ± 6.49</td>
<td>1.58 ± 0.10</td>
<td>5.980 ± 629</td>
<td>3.790 ± 370</td>
</tr>
<tr>
<td>36—40</td>
<td>29.6 ± 3.29</td>
<td>60.6 ± 6.25</td>
<td>1.58 ± 0.08</td>
<td>6.480 ± 711</td>
<td>4.110 ± 385</td>
</tr>
</tbody>
</table>

* Body surface area (in m²).
† Resting energy expenditure (in kJ).
‡ Significant difference from the control: p < 0.05.
§ Significant difference from the group (5—11, 12—15, 16—19, 20—23, 24—27, 28—31): p < 0.05.

Results

The means of REE divided by BSA increased by about 200 kJ/m² at every gestational stage compared with non-pregnant women (3,210 ± 304 kJ/m²), and in pregnant women did not significantly increase until 32 weeks’ gestation. Significant changes of about 300–600 kJ/m² occurred in the 32–35 and 36–40 weeks’ gestational stages (3,790 ± 370, 4,110 ± 385 kJ/m²) (p < 0.05) (Table, Fig.).

Discussion

When malnutrition is accompanied by a prolonged period of inadequate energy intake, active intervention of nutritional support is necessary during pregnancy. With normal intestine function, enteral nutritional
therapy may be a safe and effective method of feeding. Total parenteral nutritional therapy may be an effective method of energy supplementation with or without normal bowel function. For all therapies, it is necessary to determine adequate energy demands to maintain pregnancy and normal fetal growth.

In general, the management of patients with malnutrition in pregnancy is the same as in non-pregnant patients. The energy expenditure and adjustment of nutrient intake for total parenteral nutrition was estimated using predictive equations. These equations of nutrient intake for pregnant woman were calculated according to the body height and weight with experimental adjustment of additional energy, but the actual nutritional demands during pregnancy have not been clearly established. The objective of this study was to clarify these demands.

Our findings clearly showed that the mean REE divided by BSA increased by about 200 kJ/m² at every gestational stage compared with non-pregnant female controls, and especially rose by about 600 kJ/m² in the third trimester. In addition, the nutritional demands did not markedly change from 6 to 32 weeks' gestation, but gradually increased after 32 weeks' gestation. These results indicate that the energy demands of pregnant women are different from those of non-pregnant women in all gestational stages, and that the management of pregnant patients with malnutrition should not be the same as for non-pregnant patients. To the best of our knowledge, this study is the first to examine energy expenditure during pregnancy in Japan as assessed by indirect calorimetry. However, our findings must be confirmed by larger studies.

In summary, our preliminary data suggest that the energy demand increases at conception, and does not change in the first or second trimester of pregnancy. These findings may be of therapeutic importance.

References


(Received, January 28, 2002)
(Accepted, March 29, 2002)