Characteristics of small bowel motility in patients with irritable bowel syndrome and normal humans: an Oriental study

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ABSTRACT

1. Small bowel dysmotility may be one of the clinical manifestations in Occidental patients with irritable bowel syndrome. Here we studied the characteristics of small bowel motility in Oriental patients with irritable bowel syndrome and identified the factors responsible for disturbed small bowel motility.

2. We enrolled 90 patients with irritable bowel syndrome and 45 healthy controls to the study. The patients with irritable bowel syndrome were further divided according to their predominant bowel habits. Of those, 45 were constipation-predominant and 45 were diarrhoea-predominant. Small bowel transit was measured by the non-invasive hydrogen breath test in the fasting state.

3. The transit times obtained in constipation-predominant and diarrhoea-predominant patients with irritable bowel syndrome and in controls were 108.4 ± 34.3, 67.4 ± 19.6 and 85.3 ± 37.3 min respectively (P < 0.05). Delayed transit characterized constipation-predominant patients with irritable bowel syndrome, whereas accelerated transit was observed in diarrhoea-predominant patients with irritable bowel syndrome. The ages of constipation-predominant and diarrhoea-predominant patients with irritable bowel syndrome and of controls displayed a significant positive correlation with their small bowel transit times (r = 0.34, 0.31 and 0.39 respectively; P < 0.05) and body mass indexes also demonstrated a positive correlation (r = 0.31, 0.41 and 0.30 respectively; P < 0.05). Other demographic characteristics did not influence the small bowel transit times.

4. Accelerated or delayed small intestinal transit is exhibited in Oriental patients with irritable bowel syndrome showing either diarrhoea-predominant or constipation-predominant symptoms. Age and body mass index must be taken into consideration to study patients with suspected small intestinal dysmotility.

INTRODUCTION

Irritable bowel syndrome (IBS) is often encountered in gastroenterology clinics as the occurrence rate is about 15% in population studies [1,2]. Although the definite pathophysiology of IBS remains obscure, it is believed that IBS is a motility disorder, particularly the well-known colorectal dysmotility in patients with IBS [3]. In addition, evidence suggests that there may be co-existing small bowel dysmotility in patients with IBS [4]. Likewise, constipation-predominant patients with IBS have delayed small bowel transit, whereas the transit time is

Key words: age, body mass index, gastrointestinal motility, gastrointestinal transit, irritable bowel syndrome.
Abbreviations: BMI, body mass index; IBS, irritable bowel syndrome.
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shortened in diarrhoea-predominant patients [5]. Moreover, patients with IBS also have altered small bowel motility during the episodes of their symptoms [6]. Most studies concerning the small bowel dysmotility in patients with IBS have been based on Occidental subjects. As we know, Oriental subjects have different backgrounds in terms of genetics, culture, dietary habits and living environments compared with Occidental subjects. Whether small bowel dysmotility is encountered in Oriental patients with IBS remains unknown. In addition, it is unknown what specific demographic characteristics are responsible for the disturbed small bowel motility in patients with IBS. The purpose of this study was to evaluate the characteristics of small bowel motility in the Oriental patients with IBS and to identify the probable impact of demographic characteristics on small bowel motility.

METHODS

Study subjects

Ninety patients with IBS from the gastroenterology clinic of Veterans General Hospital-Taipei were consecutively recruited into the study. The diagnosis of IBS was established according to the Rome criteria, and all patients with IBS were further divided into either a constipation- or diarrhoea-predominant group according to their bowel habits [7]. Those patients with IBS showing a bowel habit of alternating constipation and diarrhoea were excluded from study. Total duration of typical IBS symptoms must have existed for at least 6 months. The constipation-predominant group (n = 45) complained primarily of the passage of infrequent or hard stools, often with straining, while laxative was usually consumed. The diarrhoea-predominant group (n = 45) complained primarily of the passage of loose or frequent stools, often associated with urgency, while anti-diarrhoea medication was usually consumed. For comparison, 45 age- and sex-matched healthy subjects showing a once-daily bowel habit were enrolled as controls. All subjects, including patients with IBS and healthy controls, presenting with diabetes mellitus, heart disease, peptic ulcer disease, abdominal surgery, alcoholism, peripheral neuropathy, evidence of neurotic/psychotic disorders or milk intolerance or on medications known to alter gastrointestinal motility were excluded from the study.

Hydrogen breath test

Small bowel motility was measured using the hydrogen breath test which has been conventionally expressed as gastrointestinal/orocaecal transit time [8]. After cessation of all medications known to affect gastrointestinal motility including laxatives and anti-diarrhoea agents for at least 24 h, a low-fibre diet on the day before the test and an overnight fasting were instructed. Study subjects brushed their teeth immediately before the hydrogen breath measurement. The basal end-expiratory hydrogen concentration representing the content in alveolar gas was then measured using a clinical Microanalyzer™ (Model CM-2, Quintron, Menomonee Falls, WI, U.S.A.). Starting at 30 min after the ingestion of 10 g of lactulose (UDL Lab, Rockford, IL, U.S.A.), breath samples for hydrogen content determination were analysed every 10 min while the subject was still in the fasted state. A sustained increase in hydrogen content of at least 10 p.p.m. above the basal hydrogen level is considered as a sign of the arrival of lactulose bolus in the caecum and represents the end point of measured orocaecal transit time. The maximum measured time period was set at 180 min after the ingestion of test marker if there was no evidence of increased hydrogen level. Thus the orocaecal transit time for this particular individual was set at 180 min.

The demographic characteristics including age, sex, smoking status, body mass index (BMI) and weekly bowel habits were recorded and calculated for each subject. The frequency of weekly bowel habits in the absence of any medication to improve bowel movements was calculated by the subjects.

Statistical analysis

All values are expressed as means ± S.D. Numerical data were analysed using either a one-way analysis of variance with post test by Tukey’s method or Student’s t-test. Pearson’s correlation test was used to study the correlation between two variables. A P value less than 0.05 was considered to be significant.

RESULTS

The demographic characteristics of constipation-predominant and diarrhoea-predominant patients with IBS and of controls are illustrated in Table 1. There was no significant difference in the demographic data except an increased frequency of weekly bowel habits presenting in diarrhoea-predominant patients with IBS, while a decreased frequency was found in constipation-predominant patients with IBS. The measured transit times in constipation-predominant and diarrhoea-predominant patients with IBS and in controls were 108.4 ± 34.3, 67.4 ± 19.6 and 85.8 ± 37.3 min respectively. These differences were statistically significant (P < 0.05; Figure 1). Among the probable characteristics that might influence the measured orocaecal transit times in the constipation-predominant patients with IBS, the transit times obtained in 20 males and 25 females were 109.5 ± 24.3 and 106.7 ± 27.7 min respectively (P not significant),
Table 1  Demographic data in patients with IBS and in controls
Values are means ± S.D. NS, not significant.

<table>
<thead>
<tr>
<th></th>
<th>Constipation-IBS (n = 45)</th>
<th>Diarrhoea-IBS (n = 45)</th>
<th>Control group (n = 45)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>58.2 ± 13.9</td>
<td>54.3 ± 14.2</td>
<td>57.5 ± 16.5</td>
<td>NS</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>20/25</td>
<td>17/28</td>
<td>18/27</td>
<td>NS</td>
</tr>
<tr>
<td>Body height (m)</td>
<td>1.62 ± 0.08</td>
<td>1.62 ± 0.07</td>
<td>1.63 ± 0.07</td>
<td>NS</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>60.4 ± 8.8</td>
<td>62.1 ± 11.7</td>
<td>60.8 ± 9.4</td>
<td>NS</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>22.8 ± 2.4</td>
<td>23.7 ± 3.9</td>
<td>22.8 ± 3.0</td>
<td>NS</td>
</tr>
<tr>
<td>Smoking (-/+ )</td>
<td>34/11</td>
<td>32/13</td>
<td>35/10</td>
<td>NS</td>
</tr>
<tr>
<td>Frequency of weekly bowel habits</td>
<td>1.8 ± 0.8</td>
<td>19.8 ± 6.0</td>
<td>6.9 ± 0.3</td>
<td>P &lt; 0.0001</td>
</tr>
</tbody>
</table>

Figure 1  Distribution of gastrointestinal transit times in constipation-predominant and diarrhoea-predominant patients with IBS and in controls
The transit times were measured using a non-invasive hydrogen breath test. Delayed transit was found in constipation-predominant patients with IBS, whereas diarrhoea-predominant patients with IBS manifested an accelerated transit compared with controls. Mean values are expressed as horizontal bars.

while the transit times in 34 non-smokers and 11 smokers were 108.4 ± 33.7 and 107.6 ± 31.2 min (P not significant) respectively. There existed a significant positive correlation of transit times with age and BMI in constipation-predominant patients with IBS (r = 0.34 and 0.31 respectively, P < 0.05). Of the diarrhoea-predominant patients with IBS, the transit times obtained in 17 males and 28 females were 70.3 ± 34.3 and 66.5 ± 28.3 min (P not significant), while the transit times in 32 non-smokers and 13 smokers were 68.2 ± 32.1 and 67.1 ± 28.5 min (P not significant). The correlation coefficients of transit times against age and BMI in controls were 0.39 and 0.30 respectively, also showing a significant positive correlation (P < 0.05). The correlations between transit times and the frequencies of bowel habits in the three groups studied were not significant. When all 135 study subjects were taken into consideration, their transit times exhibited a significant negative correlation with the frequencies of weekly bowel habits (r = −0.28, P < 0.05).

DISCUSSION

Our study mainly indicated that delayed small bowel transit time was found in the constipation-predominant patients with IBS, whereas accelerated transit characterized diarrhoea-predominant patients with IBS. These observations are very compatible with the reports on Occidental subjects [8,9]. In addition, our study indicated that orocaecal transit times manifested a negative correlation with the frequencies of weekly bowel habits. Perhaps this observation suggests that small bowel dysmotility produces the predominant symptoms in patients with IBS.

Several pathophysiological mechanisms are reasonably linked to the small bowel dysmotility in patients with IBS. First, autonomic dysfunction may be an important factor. Aggarwal et al. [9] indicated that constipation-predominant patients with IBS were associated with dull cholinergic activity, whereas the diarrhoea-predominant patients with IBS usually manifested adrenergic abnormality. Recent reports indicate that a disordered autonomic nervous system can in turn alter small bowel transit to elicit clinical symptoms [10,11]. Second, the altered small intestinal motor activity may contribute to the IBS symptoms since the diurnal or nocturnal amplitude of phase III activity of migrating motor complex is weak in constipated patients with IBS [12]. Moreover,
the interval between two successive migrating motor complex cycles is short in diarrhoea patients with IBS [13]. It is obvious that altered migrating motor complex results in either accelerated or delayed transit time in patients with IBS. Third, psychological factors play an additional role on small intestinal motility. Psychiatric disorders are common in patients with IBS seeking medical care [14]. In fact, psychological stress does accelerate small bowel transit [15]. A canine study indicated that stress increases the frequency of slow waves and activity of action potential [16]. Fourth, some gut hormones also participate in the disordered small bowel transit in patients with IBS. Diarrhoea-predominant patients with IBS have increased fasting/postprandial serum levels of motilin and pancreatic polypeptide compared with controls [17]. Conversely, the constipation-predominant patients with IBS have reduced fasting/postprandial serum levels of motilin and pancreatic polypeptide [18]. Although not measured by us, it appears that altered gut hormone levels play a part in mediating the disordered small bowel transit in patients with IBS. Finally, small bowel mechanosensitive pathways are disturbed in patients with IBS [19]. Perhaps this disturbance may account for the disordered small bowel transit in patients with IBS.

Age has been an important factor to determine motility variables; for example, oesophageal contraction amplitude declines at around 60 years of age [20]. Therefore, age must be taken into consideration in evaluating patients with suspicious motor disorders. In the small bowel, age decreases rat myenteric nerve density and the number of nerve terminal varicosities [21]. There are conflicting results in the literature for the influence of age on gastrointestinal motility. Delayed whole-gut transit of radio-opaque pellets is seen in middle-aged subjects [22]. Reduced postprandial jejunal motility is found in elderly subjects [23]. On the other hand, measurement of orocecal transit time or manometry implies that human intestinal motility is maintained throughout the ageing process [24–26]. Our study indicates that age could display a significant correlation with small bowel transit times in all subjects studied, irrespective of their predominant bowel habits. It is of interest whether the gastrointestinal endorphin opioid system is involved in the delayed transit seen in elderly subjects. Some studies point out that opioid agonists slow gastrointestinal transit [27,28], and the density of opioid receptors changes significantly with ageing [29]. Furthermore, oral naloxone is effective in treating constipation in geriatric patients [30]. We believe that age is an important factor in mediating small bowel motility.

Our study also found that the bigger the BMI, the more prolonged the small bowel transit time. To the best of our knowledge, no study has addressed the relationship between small bowel transit times and body sizes using a hydrogen breath measurement. However, a study with small sample size did not find the correlation between BMI and small bowel transit times using scintigraphy [31]. In contrast, Backman and Hallberg [32] reported a correlation between body weight, surface area and small bowel length. Perhaps the subjects with bigger BMIs have a longer small bowel, and thus a prolonged small bowel transit would be expected. In conclusion, accelerated or delayed small bowel transit exists in Oriental patients with IBS showing either diarrhoea-predominant or constipation-predominant symptoms respectively. Age and BMI must be taken into consideration when studying patients with suspected small bowel dysmotility.

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