

# EXPERIMENTAL BIOLOGY

## Circadian Rhythm of Rectal Reactivity in Individuals with Regular and Irregular Bowel Evacuation Function

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Circadian dynamics of rectal reactivity was studied in humans with regular and irregular rhythms of bowel evacuation function by chronoenterography. In individuals with regular rhythm of this function (stool 7 days per week) the acrophase of circadian rhythm of rectal reactivity was observed in morning hours, while in the daytime and evening and this parameter decreased almost 7-fold. In subjects with bowel arrhythmia (3-6 days with stool per week) rectal reactivity was inverted: 2-fold decreased in the morning and 3-fold increased in the evening.

**Key Words:** *circadian rhythm; rectal reactivity; regularity; bowel evacuation function; bowel arrhythmia*

The problem of circadian regularity of bowel evacuation function (BEF) is a pressing problems of modern gastroenterology [1,3,5,6]. Chronobiological and chronomedical approaches to irregularity of this function now allow us to regard the cyclic pattern of this function as an endogenous circadian rhythm [2,9,10,14]. Chronoenterographic study of this function revealed the optimal and pessimal phases of defecation rhythms [10], but the phasic time structure of rectal reactivity (RR) in individuals with regular and irregular defecation remains unclear.

We investigated circadian rhythms of RR in individuals with regular and irregular BEF.

### MATERIALS AND METHODS

A total of 341 patients (males and females, aged 23-60 years) were examined by chronoenterography [9,10]. By the moment of examination all of them considered themselves healthy. The examinees recorded the time (morning 6.00-12.00, day 12.00-18.00, or evening

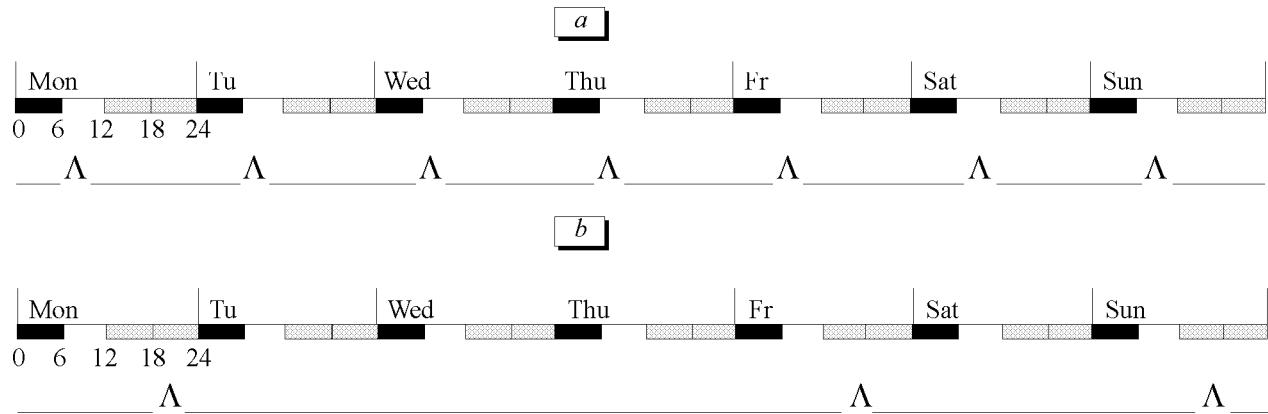
18.00-24.00) of BEF realization in autorhythmometry tables [10,13]. The number of days with and without stool per week was determined by chronoenterography. A wave directed above the isoline on enterograms corresponded to BEF realization, while the isoline corresponded to the absence of stool. Regular circadian BEF rhythm (7 days per week with stool) was regarded as bowel eurhythm, while irregularities of this rhythm (less than 7 days per week with stool) were regarded as bowel arrhythmia. Regular bowel rhythm was diagnosed in 202 subjects (group 1) and bowel arrhythmia in 139 subjects (group 2). Two de-

**TABLE 1.** Phasic Structure of Circadian RR Rhythm in Subjects with Regular and Irregular BEF Rhythms

Predominating phase of circadian RR rhythm	Patients with regular rhythm (n=202)	Patients with irregular rhythm (n=139)
Morning (6.00-12.00)	158 (78)	48 (35)
Day (12.00-18.00)	26 (13)	45 (32)
Evening (18.00-24.00)	18 (9)	46 (33)

**Note.** The percentage of subjects examined in this group is shown in parentheses.

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**Fig. 1.** Chronoenterograms in regular bowel rhythm (a) and bowel arrhythmia (b). Waves on the isoline: defecation acts.

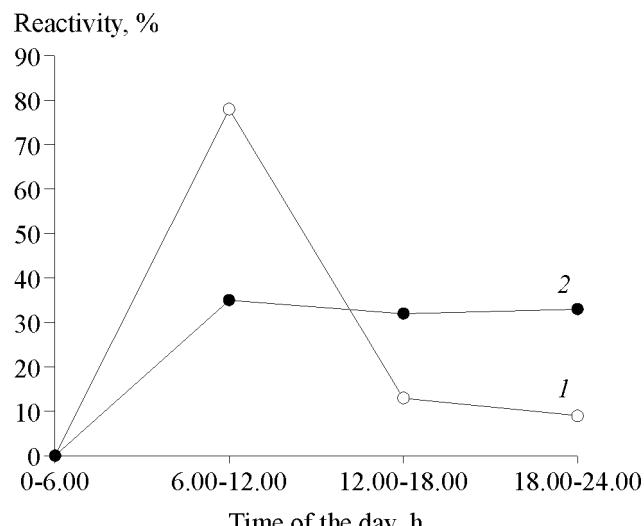
grees of bowel arrhythmia severity were distinguished in group 2: moderate (5-6 days with stool per week) and medium (stool 3-4 times a week) [9,10].

RR was evaluated by the number of rectal reactions to the orthostatic stimulus of the morning transfer from the horizontal into vertical position and to the realization of the postprandial gastrorectal reflex after breakfast [6]. The time course of RR was presented as the curve of circadian rhythm plotted on the basis of mean data for every 4 periods of day and night, 6 h each period: morning (6.00-12.00), day (12.00-18.00), evening (18.00-24.00), and night (0.00-6.00).

The significance of differences in the means was evaluated by the range of variations at 95% confidence level.

## RESULTS

Study of circadian time course of RR showed its differences in individuals with regular bowel rhythm and those with bowel arrhythmia (Fig. 1).



**Fig. 2.** Rectal reactivity in health individuals (1) and subjects with bowel arrhythmia (2).

In group 1 the morning phase of this rhythm predominated, while the day and evening phases occurred almost 7 times more rarely than the morning phase. Hence, the regularity of RR is associated with the morning acrophase of the rhythm. In group 2 the morning BEF phase occurred almost as often as the day and evening phase (Table 1).

Comparative analysis of phase structure of circadian rectal rhythm in subjects with regular and irregular BEF demonstrated essential differences in the time organization of this function (Fig. 2) and a notable decrease of the circadian range of rectal sensitivity in the majority of subjects with bowel arrhythmia. It seems that the sensitivity of rectal mechanoreceptors decreased in the morning hours in subjects with bowel arrhythmia.

24-Hour profiles of RR were distorted in subjects with bowel arrhythmia in comparison with the normal. RR in bowel arrhythmia was almost 2-fold lower in the morning hours (35 vs. 78%) and 3-fold higher in the daytime vs. the normal. It seems that this pathological afternoon increase of RR in subjects with bowel arrhythmia reflects hypersensitivity (irritability) of the colon in patients with "irritable colon syndrome" [1,3].

Hence, the time organization of RR circadian rhythm under normal physiological conditions differs significantly from that in patients with bowel arrhythmia; daily (circadian) regular bowel rhythm is physiological, while bowel arrhythmia is a sign of pathological process. Presumably, restoration of physiologically optimal morning phase of the circadian rectal rhythm can serve a regulatory factor aimed at correction of bowel arrhythmia.

In modern gastroenterology the frequency of 3-6 days with a stool per week is still regarded as a variant of the norm. According to the universally acknowledged "Roman Criteria" of bowel dysfunctions, one of the main criteria of these diseases is stool less than 3 times a week. However, our data indicate that bowel rhythm of 3-6 times weekly is associated with pro-

nounced RR disorders. It means that stool frequency of not only 1-2 times a week, but much earlier disorders of rectal rhythm should be considered as disease markers. It is obvious that even minor deviation of the frequency of BEF realization from normal (6 times a week) is a disorder of circadian regularity of the rectal rhythm. Chronophysiological approach will promote screening detection of the earliest shifts in the physiological regularity of BEF circadian rhythm. Recovery of physiological regularity of BEF is the very first (prenosological) preventive measure against colorectal cancer [4,6-8,11].

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