Fasting motor activity occurs during a day of normal meals in healthy subjects

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SUMMARY Using a radiotelemetric technique of pressure recording which did not interfere with normal feeding, jejunal motor activity was recorded in seven healthy human subjects, who were given three hospital meals during the course of a day, and allowed *ad libitum* supplementary snacks. Fasting motor activity was detected during the day in five subjects, and, although its occurrence was very variable, tended to occur shortly before the next meal.

Periodic motor activity of the stomach and intestine, present during fasting and interrupted by feeding, was fully documented many years ago.¹ We have described² a minimally-invasive radiotelemetric technique for recording of patterns of human jejunal motor activity, which does not prevent normal feeding, and which is sufficiently comfortable for prolonged continuous observation. Using this technique, we have documented the incidence of cyclical jejunal motor activity in healthy human subjects during a 24 hour fast, and the interruption of this pattern by a single meal.

No data have been published to show the extent to which migrating complexes occur during a normal day in healthy adults. It seemed reasonable to suppose that, given the frequency of nutrient intake in everyday life, the occurrence of fasting motor activity in man must be confined to the night. Support for this belief derives from a study⁴ showing that the stomach does not usually empty completely between meals during the day, and also from our own data² which showed the median interval in healthy subjects between the start of a meal and the reappearance of recognisable jejunal fasting motor activity to be more than five hours. We now report the experimental testing of this supposition.

Methods

Seven healthy subjects (age 20-26 years) free of gastrointestinal symptoms, who had given informed consent, swallowed on the evening of

study a miniature (8 mm diameter, 22 mm length) radiotelemetric pressure transducer (Rigel Research Ltd) attached to a 100 cm thread. The lower end of the thread was enclosed in a radio-opaque flexible sleeve. The next morning, using an X-ray image intensifier and traction on the thread if necessary, its position was adjusted so that it lay just distal to the duodeno-jejunal flexure; the thread was then secured to the subject's face with adhesive tape. An aerial array was fastened around the subject's waist and connected to a receiver tuned to 450 KHz. Subjects were then given standard hospital meals (Table) during the study, and, in between meals, were allowed free access to coffee, tea, apples, and biscuits. After the evening meal, the subjects spent the night in the study unit (in one study the tape recorder failed during the night) until breakfast on the following day when recording was stopped and the 'radio-pill' was withdrawn. The recorded signal was replayed, and fasting activity was considered to have reappeared when bursts of regular contractions at 10-11/minute lasting not less than three minutes followed by quiescence³ were seen on the record (Fig. 1). Protocols for the study of gastrointestinal motor activity using ingested probes were approved by the Ethics Committee of the London Hospital Medical College in February 1975.

Results

Figure 2 shows the incidence of activity fronts in relation to meals and snacks in all seven studies. Two subjects noted sensations of hunger, neither of which coincided with complexes. In five subjects, complexes were seen between breakfast

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Table Composition of standard hospital meals

Constituents	Meal	Protein (g)	Fat (g)	Carbohydrate (g)	megaJ	(kcal)
Cornflakes with milk, boiled egg, bread, butter, marmalade	Breakfast	18.3	18.9	56.8	1.97	(471)
Chicken, peas, mashed potato, stewed fruit with custard	Lunch	30.2	23.9	61.5	2.43	(582)
Chicken, peas, mashed potato, ice cream, crackers, butter, cheddar cheese	Supper	23.9	35.5	41.9	2.86	(603)
Total		77.4	78.3	160.2	7.26	(1656)

Calorific value of snack supplements estimated as 0.1.55 megaJ (0.370 kcal).

and supper; out of the 10 complexes recorded during this time, six shortly preceded a meal and two preceded the consumption of a snack.

Discussion

The results of this study dismiss the notion that fasting motor complexes in man are only a nocturnal phenomenon. The variability between individuals which we have previously documented² is again demonstrated. The extent to which the variation relates to rates of gastric emptying cannot be assessed from our studies; the dependence of emptying rate on the composition of a meal is well recognised, but, even with similar meals, the data are confused. For example, it has been reported⁴ that emptying

of a homogenised meal is complete in 178 ± 14 minutes (mean $\pm$ SEM), compared with 220 ± 11 minutes for a solid-liquid meal, but earlier studies from the same laboratory³ had shown that, with a formula meal of similar nutrient and caloric value, subjects showed 100% emptying only after six hours.

This study is open to criticism on the grounds that a hospital diet is not 'normal'. The variation in nutrient intake in individuals from day to day makes it difficult to define a diet which is normal for an individual, and more so for a population sample. The diet in this study, while neither *gourmand* nor *gourmet*, is within the normal range of intake in the population.⁵

Because the technique employed was a single sensor, we cannot be certain that all the periods

Fig. 1 Recording of a human fasting migratory complex by four sensors spaced at 10 cm intervals in the proximal digestive tract. The upper three sensors were perfused tubes (PT) with attached transducers, and the distal sensor (RP) was a radio-pill. Inspection of the bottom line alone shows the easily-identifiable appearance of a migrating complex passing the radio-pill.

Fig. 2 Temporal relationship between food intake and the incidence of activity fronts in seven subjects. Horizontal lines indicate the duration of continuous recording.

of regular 11/min contractile activity represented phase III periods of a migrating complex, but we know of no reported evidence that periods of regular 11/min activity followed by quiescence have not been propagated, even if only over relatively short distances. Even conventional perfused tube systems, usually covering 50 cm segments,⁶ do not indicate whether complexes traverse the entire small bowel.

Similarly, we cannot be certain that all the complexes detected in our study were gastric as well as jejunal, but it seems likely that most of the complexes detected in the proximal jejunum are also present in the stomach.⁶ That the proximal jejunum is the optimal site for the detection of complexes is suggested by another study⁷ in which complexes appeared to fade out in their passage along the jejunum, but the precise incidence of complexes at all levels of the small bowel and the distance over which they migrate remains to be described. Clinically, the secretory component of the complex may be

equally, or more, significant than the motor component, as it is known that, in man, increased gastric acid secretion is normally associated with the active phase of periodic fasting motor activity.⁸⁻¹⁰ One inference that may be drawn from our data is that the traditional ulcer regime of frequent meals and antacids and anticholinergics may be helpful in the suppression of fasting secretory and motor activity during the day.

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