



Prolonged effects of modified sham feeding on energy substrate mobilization¹⁻³

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ABSTRACT

Background: Vagal stimulation in response to nutrients is reported to elicit an array of digestive and endocrine responses, including an alteration in postprandial lipid metabolism.

Objective: The objective of this study was to assess whether neural stimulation could alter hormone and substrate metabolism during the late postprandial phase, with implications for body fat mobilization.

Design: Vagal stimulation was achieved by using the modified sham feeding (MSF) technique, in which nutrients are chewed and tasted but not swallowed. Ten healthy subjects were studied on 3 separate occasions, 4 wk apart. Five hours after a high-fat breakfast (56 g fat), the subjects were given 1 of 3 test meals allocated in random order: water, a lunch containing a modest amount of fat (38 g), or MSF (38 g fat). Blood was collected for 3 h poststimulus for hormone and metabolite analyses.

Results: Plasma insulin and pancreatic polypeptide concentrations peaked at 250% and 209% of baseline concentrations within 15 min of MSF. The plasma glucose concentration increased significantly ($P = 0.038$) in parallel with the changes observed in the plasma insulin concentration. The nonesterified fatty acid concentration was significantly suppressed ($P = 0.006$); maximum suppression occurred at a mean time of 11.4 min after MSF. This fall in nonesterified fatty acid was accompanied by a fall in the plasma glucagon concentration from 122 to 85 pmol/L ($P = 0.018$) at a mean time of 11.3 min after MSF.

Conclusions: Effects on substrate metabolism after MSF in the postprandial state differ from those usually reported in the postabsorptive state. The effects of MSF were prolonged beyond the period of the cephalic response and these may be relevant for longer-term metabolic regulation. *Am J Clin Nutr* 2001; 73:111-7.

KEY WORDS: Control group, modified sham feeding, nonesterified fatty acid, glucagon, insulin, pancreatic polypeptide, gastrin, glucose, postprandial period

INTRODUCTION

Gastrointestinal responses to nutrient intake can be subdivided into cephalic, enteric, and intestinal phase responses. Cephalic responses consist of vagal cholinergic activity initiated by the thought, sight, smell, and taste of food and are strategi-

cally placed to influence both the absorption and the utilization of incoming substrates.

Although vagal responses are transient, they may have longer-lasting metabolic effects. Vagal responses have been implicated in the improvement of postprandial glucose tolerance (1) and satiety (2). Elevations in postprandial lipemia over a period of several hours were reported when cephalic stimulation was combined with a gastric fat load compared with when the gastric load was given alone (3, 4), suggesting that there are also cephalic influences on the absorption and metabolic disposition of dietary fat.

Sham feeding, in which a gastric or esophageal fistula is fitted to an experimental animal and nutrients bypass the small intestine, may not be an appropriate model with which to study cephalic phase stimuli. Not only is it impossible to distinguish between oral taste receptors and pharyngeal and gastric mechano- or chemoreceptors stimulated before food exits through the fistula, but also the choice of food given to the animal is limited by the design of the fistula. Modified sham feeding (MSF), or the "chew-and-spit" technique, may provide a more selective test of vagal activity (5). One difficulty with studies of MSF is the incidental swallowing of nutrients. Although some authors weighed the expectorant as a crude index of swallowing (3), it may be preferable to use hormonal markers, eg, plasma cholecystokinin. Cholecystokinin is released via vagal mechanisms from cells of the duodenum by what is believed to be a fatty acid chain length-dependent mechanism (6); minimal evidence in the literature suggests release during MSF (7).

Most studies of MSF in humans were carried out in the postabsorptive (overnight fasted) state, when absorption of nutrients from the gastrointestinal tract has ceased and gastrointestinal effects therefore are not evident. In addition, metabolic patterns differ in the postabsorptive and postprandial states. Because humans in Western societies spend most of their day in

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²Supported by the Biotechnology and Biological Sciences Research Council, United Kingdom.

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Received October 27, 1999.

Accepted for publication June 26, 2000.

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Table of Contents Substrate Mobilization And Energy Provision In Man

1. Understanding the eBook Substrate Mobilization And Energy Provision In Man
 - The Rise of Digital Reading Substrate Mobilization And Energy Provision In Man
 - Advantages of eBooks Over Traditional Books
2. Identifying Substrate Mobilization And Energy Provision In Man
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Substrate Mobilization And Energy Provision In Man
 - User-Friendly Interface
4. Exploring eBook Recommendations from Substrate Mobilization And Energy Provision In Man
 - Personalized Recommendations
 - Substrate Mobilization And Energy Provision In Man User Reviews and Ratings
 - Substrate Mobilization And Energy Provision In Man and Bestseller Lists
5. Accessing Substrate Mobilization And Energy Provision In Man Free and Paid eBooks
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 - Substrate Mobilization And Energy Provision In Man Enhanced eBook Features
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 - Adjustable Fonts and Text Sizes of Substrate Mobilization And Energy Provision In Man
 - Highlighting and Note-Taking Substrate Mobilization And Energy Provision In Man
 - Interactive Elements Substrate Mobilization And Energy Provision In Man
- 8. Staying Engaged with Substrate Mobilization And Energy Provision In Man
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Substrate Mobilization And Energy Provision In Man
- 9. Balancing eBooks and Physical Books Substrate Mobilization And Energy Provision In Man
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Substrate Mobilization And Energy Provision In Man
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Substrate Mobilization And Energy Provision In Man
 - Setting Reading Goals Substrate Mobilization And Energy Provision In Man
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Substrate Mobilization And Energy Provision In Man
 - Fact-Checking eBook Content of Substrate Mobilization And Energy Provision In Man
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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