Gastrointestinal Motility In Health And Disease

Essay

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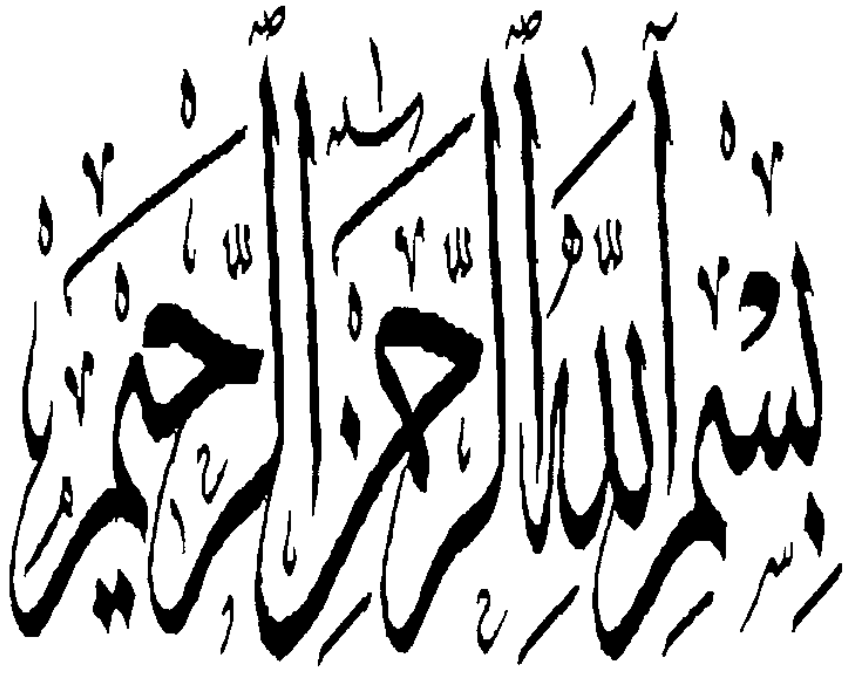

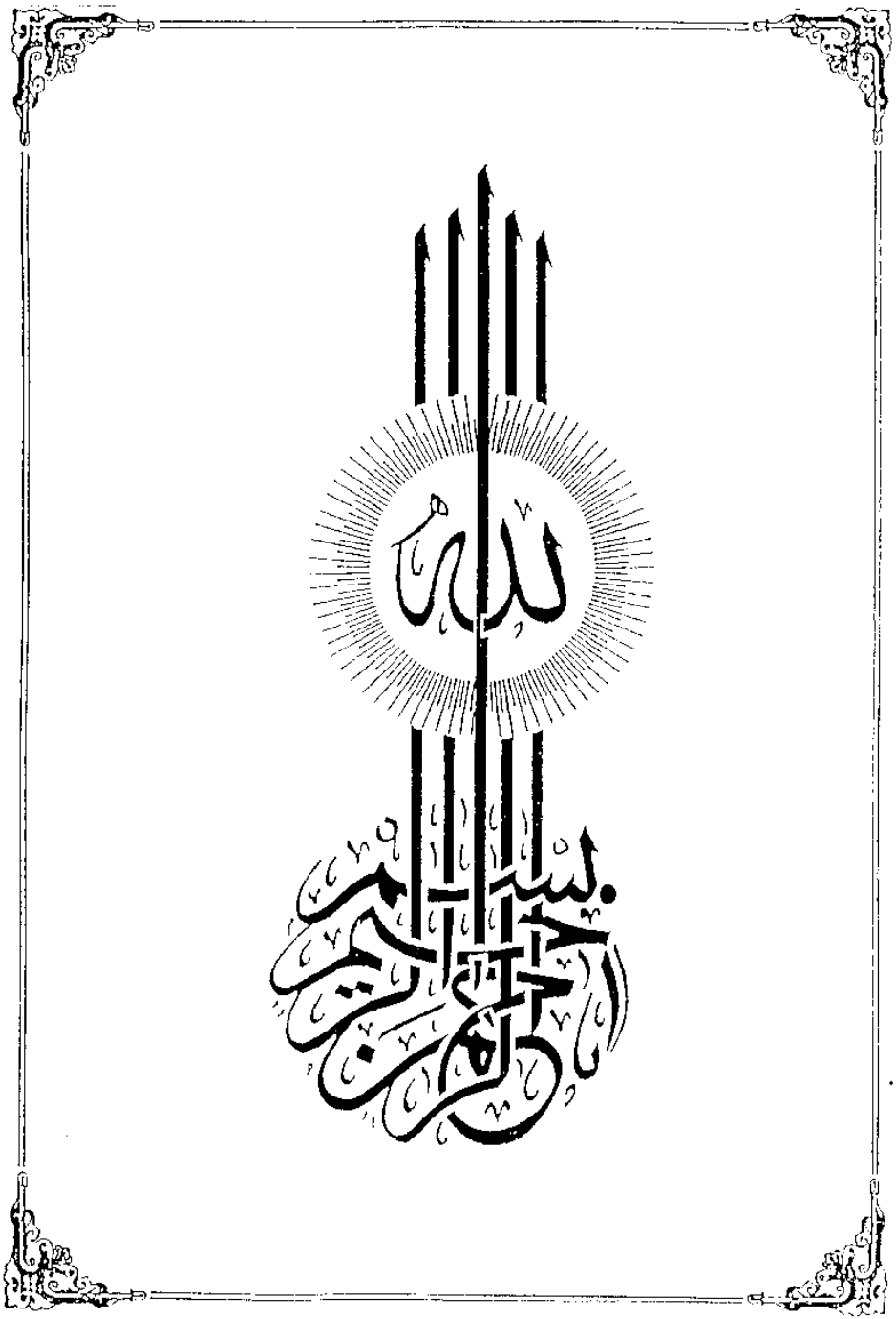

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Introduction

INTRODUCTION

The study of gastrointestinal motility is an area of great current interest. The large amount of informations presented in this study reflects how rapidly this field is advancing. A great portion of patients seeking medical advice will be proved, at the end, to have a motility disorders. Many complaints such as; heartburn, nausea, vomiting, abdominal pain, diarrhea, and constipation are often attributed to gastrointestinal motility disorders.

Also postoperative conditions such as; dumping syndrome, duodenogastric reflux, postvagotomy syndrome and postoperative ileus are often attributed to gastrointestinal motility disorder. In many of these conditions, the symptoms apparently due to functional disorders are not accompanied by any discernible organic lesion. In other conditions, organic lesions such as benign or malignant stenosis and diseases of gastrointestinal muscles or nerves, seem to be the cause of motilty disorders of gastrointestinal tract.

The widespread use of motility studies has clarified the nature of most of the disorders, which has a major impact upon therapy.

Aim of the work :

The aim of the presenting work is to review the gastrointestinal motility patterns during health and illness.

Esophagus

ESOPHAGUS

Normal Physiology of Esophageal Function :

The primary function of the esophagus is the transport of swallowed material from the pharynx to the stomach. Secondary functions are the prevention of regurgitation from the stomach into the lower esophagus, exclusion of air from the esophagus during the resting state and the contribution of small amounts of secretions to the esophageal lumen. (Guyton, 1992)

Normally the esophagus exhibits two types of peristaltic movement : Primary peristalsis and secondary peristalsis; Primary peristalsis is simply a continuation of the peristaltic wave that begins in the pharynx and spreads into the esophagus during the pharyngeal stage of swallowing. This wave passes all the way from the pharynx to the stomach in approximately 8 - 10 seconds. However, food swallowed by a person who is in an upright position is usually transmitted to the lower end of the esophagus even more rapidly than the peristaltic wave itself, in about 5 - 8 seconds because of the additional effect of the gravity pulling the food downwards.

If the primary peristaltic wave fails to move all the food that has entered the esophagus to the stomach, secondary peristaltic waves result from the distention of the esophagus by the retained food, and continue until all the food has emptied into the stomach. (Guyton, 1991)

Duranceau (1983) claimed the presence of tertiary contractions. They are usually spontaneous, but may be initiated by voluntary swallows. These

contractions are non-propulsive in nature, may be single or repetitive and may occur throughout the esophagus or in limited segments. Although often regarded as a sign of disturbed motility, tertiary waves are spontaneous in origin, are of low amplitude and are very
infrequently initiated by swallowing. (Duranceau, 1983)

Radiologically they produce a ring-like contraction in the circular, smooth layer that gives a serrated appearance. (Shackelford, 1978)

The esophagus is a region in which central and peripheral control mechanisms, voluntary and involuntary control mechanisms and the activity of the different types of muscles are intimately coordinated. Extrinsic control of esophageal motor function resides in the brain stem swallowing center. The striated muscle contraction is directed and coordinated by sequential excitation throughout vagal fibres programmed by central control mechanisms. (Diamant, 1989)

The musculature of the upper third of the esophagus is striated muscle, therefore the peristaltic waves in this region are controled only by skeletal nerve impulses in the glossopharyngeal and vagus nerves. In the lower two thirds of the esophagus the musculature is smooth and is strongly controled by the vagus nerve.

As the esophageal peristaltic wave passes towards the stomach, a wave of relaxation transmitted through myenteric inhibitory neurons, precedes the contraction. Furthermore the entire stomach, and, to a lesser extent, even the duodenum, becomes relaxed as this wave reaches the lower end of the esophagus, and thus is prepared ahead of time to receive the food propelled down the esophagus during the swallowing act. (Guyton, 1991)

Functionally the esophageal stage of swallowing has three parts ; the upper esophageal sphincter (UES), the body and the lower esophageal sphincter (LES).

The Upper Esophageal Sphincter (UES) :

The UES is a high pressure zone with resting pressure greater than either pharyngeal or esophageal resting pressure. It corresponds closely to the anatomical position of the cricopharyngeus muscle. (Stuart and Hennessy, 1989)

It is generally accepted that a portion of the inferior constrictor muscle, and possibly the upper esophageal circular, smooth muscle fibres, contribute to the sphincter. (Asoh and Goyal, 1978)

The cricopharyngeus is a muscle sling attached posteriorly to both laminae of the cricoid cartillage. It exerts its maximal pressure in an anteroposterior direction, forming a crescentic slit seen at rigid esophagoscopy as the upper limit of the esophagus. (Donner et al, 1985)

The major function of UES appears to be prevention of esophageal distension during respiration and protection against esophagopharyngeal reflux with subsequent aspiration. (Gerhardt et al. 1978)

At rest ; the cricopharyngeus, which is a striated muscle, receives its motor nerves from the vagal nuclei. This continual vagal dischage maintains the tonus of sphincter at rest. (christensen, 1976)

On swallowing, excitatory discharge to the upper esophageal sphincter ceases transiently in coordination with the rapid sequence of muscle activity in the buccopharyngeal phase of swallowing. (Roman et al. 1981)

This cessation of neural excitation to UES, plus elevation and forward movement of the cricoid cartillage, act together to decrease the UES resting pressure and open the sphincter on swallowing. (Goyal et al. 1981)

Esophageal Body :

Function of the esophageal body is dependent on the activity of the longitudinal and circular layers of muscle. These two muscle layers show a striated arrangement in the proximal esophagus and smooth muscle organization in the distal two thirds of the organ. (Sugarbaker et al, 1984)

Striated Muscle Esophagus :

Peristalsis in the striated muscle is directed by sequential excitation along the esophagus through vagal fibers programmed by the central control mechanism. (Diamant et al,1977) A swallow can adequately excite the entire control program regardless of the presence of an intraluminal bolus. However, afferent information from the esophagus has a significant effect on the control program to alter the force and velocity of the peristaltic contraction in the esophagus. Deglutative inhibition in the striated muscle esophagus results from cessation of excitatory discharges from the central program.

Smooth Muscle Esophagus:

There are at least four different potential mechanisms for the production of peristalsis in the smooth muscle esophagus:

1. The central neural program sends sequential excitatory discharges to this region. (Roman 1981)

2. There is an intramural neural mechanism that can be excited to provide peristalsis near the onset of vagal stimulation or intraluminal balloon distension "the on contraction".

3. There is an intramural neural mechanism that can be excited to produce peristalsis onsetting after the vagal or balloon stimulus is determinated "the on response" or "off response". (Gidda et al, 1981)

4. There is some type of mechanism for myogenic propagation of contraction. (Sarna et al, 1977)

Esophageal bolus transport is started by the contraction of the upper pharyngeal constrictor coinciding with the relaxation of the pharyngoesophageal sphincter allowing the bolus to pass through the sphincter. The three forces to propel the bolus are the buccopharyngeal pressure, pushing the bolus into the esophagus, gravity and the peristaltic wave.

As regards Liquids, they pass down the esophagus without help from the above-mentioned forces, the initial pharyngeal thrust and the gravity itself being all that is required when the subject is errect. If the fluids are

swallowed from a head-down position they are dealt with by peristalsis in the same manner as are solids.

Lower Esophageal Sphincter (LES)

At the lower end of the esophagus, extending from about 2 to 5 cm above its junction with the stomach, the circular muscle of esophagus is slightly thickened and functions as a lower esophageal sphincter or gastroesophageal sphincter.

Anatomically this sphincter is not different from the remainder of the esophagus. However, physiologically, it normally remains tonically constricted in contrast to the mid and upper portions of the esophagus which normally remain completely relaxed. Yet when a peristaltic swallowing wave passes down the esophagus "receptive relaxation" relaxes the LES ahead of the peristaltic wave and allows easy propulsion of the swallowed food into the stomach. (Guyton, 1991)

The tonic contraction of LES during rest is demonstrated in small strips of muscle cut from the region of the sphincter, whereas similar strips cut a short distance above or below this region do not demonstrate this tonus. (Christensen, 1978)

The LES serves two main functions; it prevents the reflux of gastric contents into the lower esophagus and it relaxes on swallowing to allow the passage of ingested material from the esophagus into the stomach. (Castell,1975 and Cohen et al,1972)

The sphincter rarely does not relaxe satisfactorily resulting in a condition called achalasia.

It is worth mentioning that in contrast to other parts of the gastrointestinal tract, the normal esophagus does not contract spontaneously in the resting state, ie.. when no deglutation or no distension has taken place, the musculature of the esophagus is relaxed and no muscular activity can be shown either mechanically or electromyographically.

Spontaneous activity is always clearly pathological. The normal esophagus empties a few seconds after food or drink has been swallowed, although small quantities of liquids or air can remain in the esophagus. Stasis of a considerable amount of material is always pathological. (Vantrappen et al, 1976)