Chapter 7

Pathophysiology of the gastrointestinal tract

7.1 Introduction

The essential role of the gastrointestinal tract is to prepare and process components of food in order to obtain products which may be easily resorbed. The second function of GIT resides in elimination of waste products.

The entire GIT is a continuous long tube of uneven width and shape with organs which participate in the processes of digestion. The luminal surface of the digestive tract is lined with mucosa which contains an enourmous amount of cells with an outstanding capability of transmembraneous absorption and secretion. The **absorption** is the basic acitivity of the digestive tract. The mucosa of the entire tract represents an ideal barrier against all potentially pathogenic substances emerging inside its lumen. This function can be procured solely by an intact luminal surface, namely by means of its protective cells. Intraepithelial lymphocytes suppress the response of organism to the presence of a large amount of potentially antigenic substances within the lumen. They inhibit the activation of inflammatory processes. Inversely, lamina propria and submucosa contain a large amount of leukocytes which are prepared to interfere in case of mucosal surface impairment. Consequently, the entire digestive tract is predisposed to inflammatory processes.

The mucosal surface has an outstanding potency to regenerate the epithelial cells. Assumedly, the superficial cellular layer of the gastroinstestinal tract turns over in its entirety every 24 to 72 hours. Owing to this fact, the entire tract is protected against various impairments. On the other hand, the capability of proliferation can be disadvantageous regarding the impact of carcinogens on DNA, and from the aspect of the origin of neoplasms which are very frequent in GIT.

Impairments within GIT can be brought about by **alteration in absorption and secretory functions** of the mucosal surface. Impairmets of mucosa can result in bleeding, excessive fluid loss, invasion of pathogens, as well as deterioration of absorption of nutrients. The disturbance of these processes may be of local character afflicting only certain areas of GIT. Absorption and excretory functions of GIT depend also on the muscular layer, the coordinated action of which propels the chyme via the tract. The intestinal motility depends on the nervous and humoral regulations. Impairments in intestinal motility are very frequent. Approximately 15 % of adults suffer from impaired motility of the large intestine. Abdominal pain and nausea may arise resulting from motility impairment, or from its combination with other discrete disturbances. Essentially they can arise directly due to motility impairment, or indirectly owing to the presence of inflammatory mediators, such as metabolites of arachidonic acid which have an impact on the activity of smooth muscles. However, the development of the defect per se depends on the particular section of GIT that is involved.

GIT impairments can appear in consequence of various changes in organism. They can develop from renal, endocrine and other diseases of more remote

organs and systems, as well as due to administration of a number of substances.

Digestion begins in the oral cavity during mastication of food and continues in the stomach where the chyme is triturated with hydrochloric acid, mucus, enzymes and other components of gastric juice. Partially processed chyme is propelled from the stomach into the small intestine where hepatic and pancreatic secretions are admixed. Their function is to split the nutrients and thus to enable absorption of proteins, carbohydrates and fat. Useful substances resulting from digestion are absorbed through the wall of the small intestine into the blood and lymphatic vessels; thereafter they are transported to the liver where they are stored or processed further. Chyme components which are either not useful or not utilised enter the colon. Water and some of the substances are absorbed in the colon being thereafter eliminated by urine. The remnant substances constitute the basis of stool.

All processes carried out in GIT, apart from mastication of food and defecation, are controlled by the autonomous nervous system and hormones. The autonomous nervous system, its sympathetic and parasympathetic parts, are controlled by higher centres in the brain as well as affected by local factors.

The **oral cavity** basically serves for the prepreparation and mixing of food with saliva. The oral cavity contains many nervous endings which trigger the process of digestion as soon as the food enters the oral cavity. The lingual surface contains thousands of chemoreceptors and taste buds which are able to distinguish taste components of food: salty, bitter, sweet, and sour. The entire process has its meaning in initiating the secretion of gastric juice.

The oral cavity is moistened by saliva originating from three pairs of salivary glands, namely submandibular, sublingual and parotid. The principal constituents of saliva are water, mucus, sodium, bicarbonates, chlorides and potassium. Salivary alpha-amylase, the further significant component of saliva (previously referred to as ptyalin) initiates the digestion of carbohydrates already in the oral cavity. Further digestion of carbohydrates continues later in the stomach.

Salivation is controlled by the parasympathetic and sympathetic nervous systems. Application of atropine inhibits salivation and evokes the feeling of dryness in the mouth. The composition of saliva depends of the velocity of secretion. Slow production intensifies reabsorption of sodium, chlorides and bicarbonates in the draining ducts of salivary glands.

7.2 Oesophagus

7.2.1 Deglutition

The oesophageal anatomical structure is relatively simple. Basically, it is a tube which connects oropharynx with the stomach. Deglutition is a process which forces the food bolus to proceed in aboral direction to the stomach. This action takes place owing to the contraction of circular and longitudinal muscles of the oesophagus. The upper third of the oesophagus is equipped with striated musculature innervated by motor nerves. The lower two thirds of the oesophagus are constituted of smooth muscles which are innervated by preganglionic cholinergic fibers of the vagus nerve. The oesophagus is an ideally enclosed tube. Upper oesophageal sphincter inhibits penetration of air into the oesophagus during inspiration. The lower oesophageal sphincter inhibits regurgitation of the stomach contents. This function of the lower sphincter is of great importance because the intraabdominal pressure is higher than the intrathoracic or atmospheric pressures.

The act of deglutition is a complex action which is regulated by the deglutition centre localised in the reticular formation. Basically, the deglutition takes place in two phases: oropharyngeal phase which is governed by voluntary control, and oesophageal phase. The task of the **oropharyngeal phase of deglutition** is to propel a part of food into the upper oesophagus. A sufficiently high pressure must be developed in order to overcome the resistance of the upper oesophageal sphincter. The basic fact in this phase is that the deglutition is simultaneously accompanied by stoppage of respiration, and the epiglottis inhibits the penetration of food into the trachea.

The **oesophageal phase of deglutition** begins as soon as the food bolus enters the oesophagus. Peristaltic movements of the oesophagus transport the bolus as far as to the lower oesophageal sphincter.