The latter reflexively becomes relaxed as the food bolus occurs in its proximity. After the transition of the bolus, the tension of the distal sphincter is renewed. The oesophageal phase of deglutition takes 5–10 seconds. Under physiological conditions, the bolus's motion velocity is 2–6 cm/sec.

Each food bolus when forced into the oesophagus stimulates the receptors sensitive to distension. Consequently, the impulses of the deglutition centre increase, thus initiating the peristaltic movements of the oesophagus. The distal sphincter constitutes a barrier between the oesophagus and stomach. The tension of the distal oesophageal sphincter is affected by nervous and hormonal pathways. Progesteron, secretin and glucagon affect the distal oesophageal sphincter in sense of its relaxation. On the contrary, gastrin increases the tension of the lower sphincter. During deglutition, the sphincter's relaxation is procured by the vagus nerve.

7.3 Diseases of the oesophagus

7.3.1 Dysphagia

Impairments of oesophageal functions are manifestant by swallowed food being held up in its passage within the oesophagus. The patient is often able to assess the site where the bolus has stuck. Dysphagia can be caused by impaired oesophageal motility, oesophageal stricture, benign or malign processes. If dysphagia appears after meal, it is mostly due to the impairment of motility. The patient is unrestful, performs the so-called Valsalva maneuver, or repeatedly swallows until the bolus is forced further.

Pyrosis is a frequent oesophageal symptom which is percieved as a burning retrosternal discomfort. This sensation is caused by the reflux of the gastric contents into the oesophagus. It can be suppressed by antacids. More frequently it appears after occupying a recumbent position. Sometimes the burning retrosternal sensation is associated with a sensation of bitter or acid tastes. The reflux of the gastric contents into the oesophagus during sleep, can cause aspiration pneumonia.

Odynophagia is a pain which appears in coincidence with deglutition. It usually is associated with oesophageal obstruction, mucosal impairment, infection or reflux oesophagitis.

Abrupt retrosternal pain is most frequently a symptom of ischaemia of the heart muscle (angina pectoris), but it can represent a consequence of abnormal motoric oesophageal function, or diffuse oesophageal spasm.

7.3.2 Gastro–oesophageal reflux

The gastro-oesophageal reflux represents a reverse flow of the gastric or duodenal contents into the oesophagus. It appears owing to a wide spectrum of impairments. The oesophagus is normally protected against the prolonged effect of gastric acid, pepsin, bile acids and pancreatic enzymes. The protection is carried out by three mechanisms:

1. the antireflux barrier is formed by tonic contraction of the lower oesophageal sphincter
2. fast backward shifting of the regurgitated material
3. neutralisation of the acidic material in the oesophagus by swallowed saliva

The patients with gastro-oesophageal reflux usually develop one of the following detectable impairments:

a) decreased tension or sluggishness of the lower oesophageal sphincter,

b) impaired coordination of relaxation of the lower oesophageal sphincter

c) decreased neutralisation and oesophageal peristalsis

The gastro-oesophageal reflux can cause the development of oesophageal peptic ulcer or stricture.

7.3.3 Motor impairments of the oesophagus

Impairments of oesophageal motility can appear in consequence of changes in the smooth musculature (sclerodermia), or in the nervous system (achalasia). **Systemic sclerodermia** develops owing to atrophic changes in the smooth oesophageal musculature. Muscular contractions of the lower two thirds

of the oesophagus are therefore weakened and this condition is accompanied by incompetence of the lower oesophageal sphincter. **Achalasia** is a condition caused by ganglionic cellular degeneration of the Auerbach's plexus. Consequently, this degeneration decreases the tension and deteriorates the relaxation of the lower oesophageal sphincter. The peristalsis is frequently absent as well. The particular cause of the diffuse oesophageal spasms is not known. Application of immunosuppressive substances can bring about oesophageal infection by herpes virus or by Candida albicans. Radiation oesophagitis appears in coincidence with the therapy of mediastinal and pulmonary malign processes. It is more pronounced in combination with chemotherapy.

7.4 Stomach and duodenum

Owing to the gastro-oesophageal and pyloric sphincters, the stomach can retain the received food for the period which is necessary for the small intestine to become prepared to digestion. During this stage of gastric storage, the food is mixed with gastric juice. Thereafter it is released into the duodenum in small bulks.

The structure of gastric mucosa is highly specialized. The **blood supply** is performed via branches of the arteria coeliaca. The largest arteries are localised along the major and minor curvatures. The stomach possesses a rich collateral circulation. Assumedly, this fact aids to the origin of ischaemic changes in the gastric wall. The venous blood is drained away from its right half into the vena gastroepiploica dextra (vena mesenterica superior) and the blood from the left half of the stomach is drained into the vena gastroepiploica sinistra and venae gastricae breves (vena lienalis). The sympathetic and parasympathetic innervation systems are subordinated to local effects and are controlled by brain centres. The muscular layer of the gastric mucosa (muscularis mucosae) contains "plexus submucosus Meissneri" and the muscular layer of the stomach (tunica muscularis) contains a "plexus myentericus Auerbachi". The subserous tissue contains a "plexus subserosus".

An **empty stomach** contains approximately 50 ml of fluid. The tension of its walls is low. At the beginning, the intake of food causes relaxation of the gastric fundus. This relaxation is perfectly coordinated. This so-called receptive relaxation is positively affected by gastrin and cholecystokinin. Peristaltic movements proceed from the fundus to the antrum. Usually, three peristaltic waves are observed per minute. Gastrin and the vagus nerve enhance the contractions. Cholecystokinin hinders gastric motility and consequent evacuation of the stomach. The velocity of peristaltic waves is assessed by muscular cells which act as pacemakers.

The mixing of food and evacuation of the stomach takes several hours. When the bolus gets to the antrum, the contraction becomes stronger. If the pylorus does not open, the chyme returns to the gastric corpus. This activity is referred to as retropulsion and enhances proper mixing of food. Each peristaltic movement results in shifting a small bulk of prepared chyme via the pylorus into the duodenum. The pylorus, in its narrowest portion is 1.5 cm in length. This portion contains a permanent aperture, only 2 mm in diameter.

Evacuation of the stomach is a complex process which depends on the conditions within the stomach and duodenum, including the chemical conditions. The first products of fat digestion together with bile and pancreatic juices stimulate the secretion of cholecystokinin. The duodenum contains osmoreceptors which are sensitive to the changes in osmotic pressure in the duodenal contents. Both hyperosmotic and hypoosmotic gastric chymes delay the gastric evacuation in order to maintain the isoosmotic conditions within the duodenum. Secretions of the duodenal mucosa, pancreas and liver neutralise the acid gastric contents within the duodenum. Evacuation of the stomach is subordinated to these conditions.

The ingestion of food stimulates the **secretion of gastric juice**. The gastric mucosa produces various substances. Parietal cells of the gastric mucosa produce hydrochloric acid and the intrinsic factor. The chief or central cells form pepsinogen. The composition of gastric juice depends on the velocity of its production. Slow production results in low concentrations of hydrogen and chlorine ions, and the concentration of sodium ions is high. Fast production brings about reverse conditions. Potassium is always released into the gastric juice in an amount exceeding